AMERICAN COLLEGE OF OCCUPATIONAL AND ENVIRONMENTAL MEDICINE

Hip and Groin Disorders

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Contributors

Editor-in-Chief:
Kurt T. Hegmann, MD, MPH, FACOEM, FACP

Evidence-based Practice Hip Panel Co-Chairs:
Carolos A. Guanche, MD
Atul F. Kamath, MD
Judith Green McKenzie, MD, MPH, FACOEM

Evidence-based Practice Hip Panel Members:
Joshua D. Harris, MD
Laura Rachel Kaufman, MD, PhD, FACOEM
Cameron W. MacDonald, PT, DPT, GCS, OCS, FAAOMPT
Jamie Stark, MS, PhD, MSN (cand)
Richard Strain, MD
Eric M. Wood, MD, MPH, FACOEM

These panel members represent expertise in occupational medicine, orthopedic surgery, physical therapy, sports medicine, family medicine, internal medicine, physiology, exercise kinesiology, and nursing. As required for quality guidelines – Institute of Medicine's (IOM's) Standards for Developing Trustworthy Clinical Practice Guidelines and Appraisal of Guidelines for Research and Evaluation (AGREE) – a detailed application process captured conflicts of interest. The above Panel has none to declare relevant to this guideline.

Methodology Committee Consultant:
Kurt T. Hegmann, MD, MPH, FACOEM, FACP

Research Conducted By:
Kurt T. Hegmann, MD, MPH, FACOEM, FACP
Kristine Hegmann, MSPH, CIC
Matthew S. Thiese, PhD, MSPH
Emilee Eden, MPH
Jenna L. Praggastis, BS
Harkomal Kaur, BS
Michael L. Northrup, BS
Skyler D. Walker, BS
Chapman B. Cox
Weijun Yu, BM, BA, MS
Vivian Nguyen
Matthew Houston, BS
Patrick Bittenbender

Jenny Dang
Melissa Gonzalez
Amrinder K. Thind
Helena Tremblay
Uchenna Ogbonnaya, MS

Specialty Society and Society Representative Listing:
ACOEM acknowledges the following organizations and their representatives who served as reviewers of the Hip and Groin Disorders Guideline. Their contributions are greatly appreciated. By listing the following individuals or organizations, it does not infer that these individuals or organizations support or endorse the hip and groin treatment guidelines developed by ACOEM.

American Association of Hip and Knee Surgeons

American Association of Occupational Health Nurses
Nicole Shaffer, DNP, CRNP-BC, COHN-S, FAAOHN
Carol I. Tobias, MBA, BSN, RN, COHN-S, FAAOHN
Stephanie Weinsier, DNP, ANP-BC, COHN-S, FAAOHN

American Occupational Therapy Association
Michelle L. Bradshaw, DC, OTR/L

American Society of Anesthesiologists

Other Reviewers:
James W. Butler, MD, MPH, FACOEM
Seth Gemme, MD
Richard D. Shih, MD, FACEP

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Introduction to Hip and Groin Disorders

Overview

This guideline provides recommendations from the ACOEM Evidence-based Practice Hip and Groin Disorders Panel for the diagnostic testing, assessment, and treatment of hip and groin disorders. Recommendations are based on critically appraised higher quality research evidence, and on expert consensus observing First Principles when higher quality evidence was unavailable or inconsistent. **To utilize this Guideline for clinical practice or medical management, the reader is cautioned to utilize the more detailed indications, specific appropriate diagnoses, temporal sequencing, prior testing, past treatment(s), and indications that are elaborated for each test or treatment.** These recommendations are not simple "yes/no" criteria, and the evidence supporting them is in nearly all circumstances developed from typical patients, not unusual situations or exceptions. (Studies were reviewed that included numerous disparate conditions beyond hip and groin pain; however, they are not included in this guideline in detail. The reader is referred to other guidelines, especially for a detailed review of many of those additional studies.)

All guidelines include analyses of numerous interventions, whether or not they are FDA-approved. For non-FDA-approved interventions, recommendations are based on the available evidence. This is not an endorsement of their use. Many of the medications recommended are utilized off-label.

Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient-Recommended (Consensus-based), "I" Level
- Insufficient-No Recommendation (Consensus-based), "I" Level
- Insufficient-Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

The hip and groin disorders described in this section are covered in this guideline. Other prominent disorders, including lumbar radiculopathy and lumbar spinal stenosis (which can present as posterior and lateral hip pain), are not reviewed here in detail but should often be considered in the differential diagnosis of hip pain and hip symptoms (see the ACOEM Low Back Disorders guideline for a discussion of these disorders) [1, 2]. Additional diagnostic considerations include inguinal hernias, femoral hernias, atherosclerotic abnormalities, aneurysms, avulsion fractures (especially sartorius, rectus femoris), femoral mononeuritis, coxa saltans, tumor, cancer, crystal arthropathies (e.g., gout, pseudogout, hydroxyapatite), and infections including septic arthritis.

Avascular Necrosis

See Osteonecrosis (Avascular Necrosis).

Epididymo-Orchitis

This is a condition of testicular and/or epididymal inflammation. Most cases of epididymitis or combined epididymito-orchitis have infectious origins [3-14]. More than 80% of patients with epididymito-orchitis who are younger than 45 years of age reportedly have *Chlamydia trachomitis* infections [4, 15]. Older patients tend to have gram-negative rod infections [3, 12], as do those who have had vasectomies and other urological procedures, a

history of prostatitis, or who have engaged in anal intercourse [4, 16, 17]. A few cases have been attributed to amiodarone [18, 19].
There is a small, but not insignificant, minority of patients who report a history of a heavy lift or strain that precipitated the symptoms [20-23], thus giving rise to the possibility that this entity may sometimes be an occupational disease or injury [24-28] outside of the obvious setting of direct work-related trauma [29]. Proposed mechanisms are reflux of urine in the course of the strain [23, 25, 30-32], elicitation of symptoms from a latent infection [20], or inguinal strain. In occupationally oriented medical clinics, patients whose jobs require heavy exertion appear to present more frequently with this diagnosis, whereas those with unequivocally non-occupational etiologies present less frequently [20, 25]. NSAIDs are typically provided for treatment.

Femoroacetabular Impingement

Femoroacetabular impingement (FAI), which occurs when there is abnormal abutment between the femoral neck and acetabulum, is thought to have many causes [33]. There are three categories of FAI: cam, pincer and mixed (which has elements of both). It has recently received increased attention as a structural entity reportedly associated with early arthrosis of the hip [34]. FAI is associated with predisposing factors, including altered femoral neck morphology (e.g., due to slipped capital femoral epiphysis), excessive anteversion of the femoral neck, femoral neck nonunion, developmental hip dysplasia, Legg-Calves-Perthes disease, osteonecrosis, a “pistol grip” femoral neck, altered motor control, and coxa vara. It is also associated with acetabular morphologic variants, such as retroverted acetabulum, and deep acetabular socket (coxa profunda and protrusion). Impingement can occur as a result of femoral-sided impingement (cam impingement), acetabular rim impingement (pincer impingement), or most commonly, a combination of both (Figure 1) [35].
Cam lesions on the femoral head-neck region develop and create shear forces of the nonspherical portion of the femoral head against the acetabulum, resulting in a characteristic pattern of anterosuperior cartilage loss over the femoral head and corresponding dome, as well as labral tears [36]. Labral tears associated with cam impingement are more commonly labral-chondral separation lesions affecting the transition zone cartilage and leaving the labral tissue in fairly good condition. The chondral damage tends to begin with softening, then debonding and delamination of the articular cartilage from the underlying acetabular bone. These chondral lesions are located in the anterosuperior region of the acetabulum and extend deeper into the acetabulum than chondral lesions due to pincer impingement.
The second category of femoroacetabular impingement is the pincer lesion, which is a result of repeated contact stresses of a normal femoral neck against an abnormal anterior acetabular rim as a result of “overcoverage.” This situation results in degeneration, ossification, and tears of the anterosuperior labrum, as well as the characteristic posteroinferior “contre-coup” pattern of cartilage loss over the femoral head and corresponding acetabulum [36]. In this setting, the acetabular labrum fails first, which leads to degeneration and eventual ossification. This worsens the overcoverage. Overall, the pincer lesion has chondral damage that is limited to near the rim, but it occurs more globally around the circumference of the acetabulum compared to the deep chondral injury associated with cam impingement.
Patients with femoroacetabular impingement commonly present with anterior groin pain, lateral hip pain, and pain with hip flexion and internal rotation. The typical patient is middle aged, younger than the usual patient with degenerative joint disease. The typical cam lesion patient is a young adult male in his 20s, whereas the average pincer patient is an active female in her 40s [36]. Pain and symptoms are normally activity related. On physical examination, patients commonly exhibit decreased internal rotation and adduction with the hip flexed to 90 degrees. Examination reveals a positive impingement test where there is pain with passive adduction and gradual internal rotation of the flexed hip. Common treatments include avoidance of aggravating exposures and positions, medications, exercise, manual interventions, and surgery [35]. As noted, femoroacetabular impingement is theorized to increase the risk for hip osteoarthrosis [34, 36-45]. Treatment has included the avoidance of postures that provoke symptoms, especially squatting [46, 47]. Surgery is often proposed as a treatment because it is thought to delay or prevent development of osteoarthrosis [48, 49]

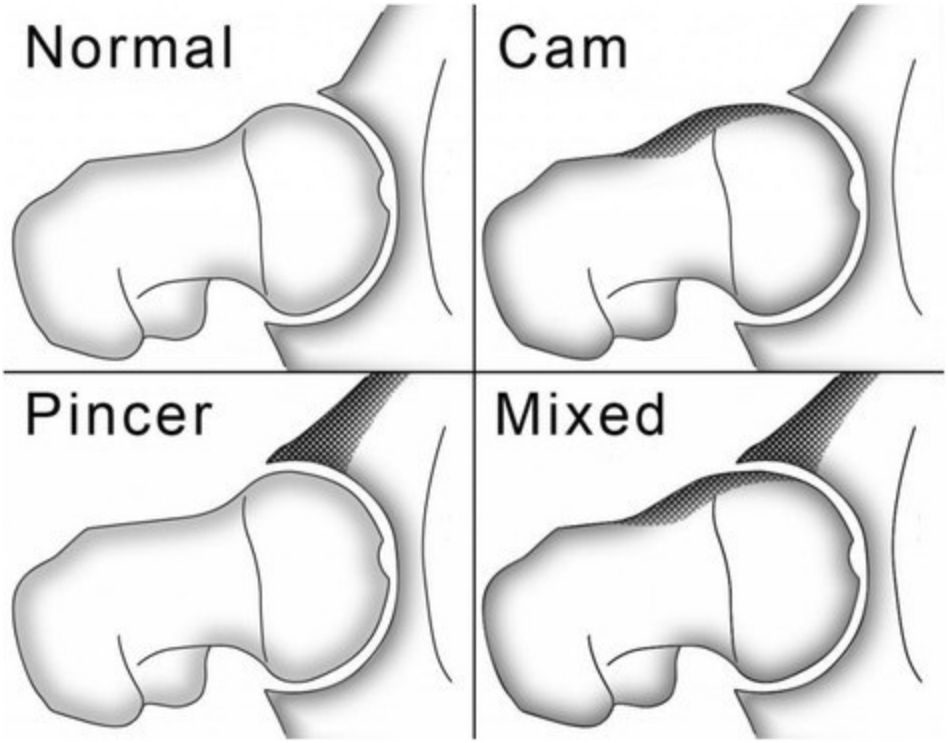


Figure 1: Subtypes of femoroacetabular impingement. Source: http://www.kevinneeld.com/2011/training-around-femoroacetabular-impingement

Trochanteric Bursitis, Greater Trochanteric Pain Syndrome, and Lateral Trochanteric Pain Syndrome

Bursae are sacks with small amounts of fluid that are usually located between structures that move. They help to reduce friction between the two moving body parts (e.g., between muscle and bone or between bone and overlying skin). Bursitis occurs when the bursae become inflamed and irritated.

Trochanteric bursitis is thought to be analogous to shoulder bursitis. It is a somewhat theoretical condition because there is little evidence that trochanteric bursitis occurs as an isolated entity [50]. Most cases are now believed to have gluteus medius tendinitis as the primary cause [51-53], with irritated bursa in the lateral hip less frequently [54]. Bursitis may theoretically occur due to direct trauma over the trochanter, such as falling on the lateral hip joint or repetitive and dysfunctional movement patterns. Unaccustomed use, such as putting pressure over the trochanter, is thought to be a risk factor. Greater trochanteric bursitis has most commonly been treated with NSAIDs, a glucocorticosteroid injection, and physical or occupational therapy [55, 56]. The term “greater trochanteric pain syndrome” is used to describe patients with pain in the lateral hip joint. Some practitioners use this diagnostic entity in preference to other terms because the precise diagnosis may be unclear at times or one label (e.g., greater trochanteric bursitis, gluteus medius tendinitis) may fail to completely describe a patient with other abnormalities.

Groin Strains (and “Epididymitis”)

A true strain consists of a disruption of a myotendinous junction, although the term is often used more broadly to describe muscular pain. A groin strain most classically involves the adductor muscles of the thigh. A complete muscular tear may occur. However, structures often included as part of the groin include the lower rectus abdominis musculature, inguinal region, symphysis pubis, upper portions of the adductor muscles of the thigh, and the genitalia. Sports hernias (aka, athletic pubalgia) are true strains which involve the lower abdominal musculature, such as the oblique muscles or rectus abdominus insertion on the symphysis pubis. Some cases of a lower abdominal muscle strain (usually in the inguinal area) include a clinical case of “epididymitis” in men, even without an apparent infectious component (see also Epididymo-Orchitis), although some cases have identifiable

infectious agents on testing [57-60] . Strains that do not promptly resolve are most commonly treated by removing the patient from high-force activities. For more severely affected cases, treatment includes NSAIDs, cold/cryotherapy, elevation and therapy.

Gluteus Medius Tendon Tears

The gluteus medius tendon is analogous to the supraspinatus in the shoulder. The most common location for gluteus medius tendon tears is regional to the middle facet. There may be extension of the tear toward fibers of the gluteus minimus insertion on the anterior facet of the greater trochanter. Often, these are high-grade partial thickness tears starting on the undersurface of the tendon. Therefore, a thorough evaluation is required to identify the site of the tear. Because the tendon is analogous to the supraspinatus [61], vascular causes may eventually be shown to be risk factors [62, 63] (see the ACOEM Shoulder Disorders guideline). Treatment includes NSAIDs, observation, physical or occupational therapy, and surgical repairs.

Lumbar Radiculopathy and Lumbar Stenosis

Lumbar radiculopathy and stenosis are two common disorders that may present as hip pain. They constitute prominent disorders in the differential diagnosis of hip pain (see the ACOEM Low Back Disorders guideline for a discussion of these disorders).

Osteoarthrosis, Including Degenerative Joint Disease ("Osteoarthritis" and "Degenerative Arthritis")

Hip degenerative joint disease (DJD) involves any type of hip joint degeneration and is most commonly caused by osteoarthrosis (OA). Although "osteoarthritis" is the more common name for this entity, osteoarthrosis is more technically precise because there is no classic inflammation. Other arthritic disorders that cause degenerative joint disease include inflammatory autoimmune disorders (e.g., rheumatoid arthritis, systemic lupus erythematosus, psoriasis) and crystal diseases (e.g., gout, pseudogout, apatite deposition). Because these latter disorders are non-occupational, they are not included in this discussion.

Other than intervertebral discs, joints in the body are typically synovial fluid-filled, synovium-lined, ligamentously encapsulated joints that allow for low friction movement between adjacent bones. OA, an age-related degenerative change in the joint particularly affecting the cartilage on the articular surface, leads to thinning of that cartilage, subchondral changes and osteophyte formation (Figure 2). Pain on movement and stiffness develop. OA may develop in only one joint after a significant traumatic injury (e.g., fracture), in which case it is often delayed by many years. If this injury was occupational, then the subsequent osteoarthrosis is also generally considered, at least in part, to be occupational.

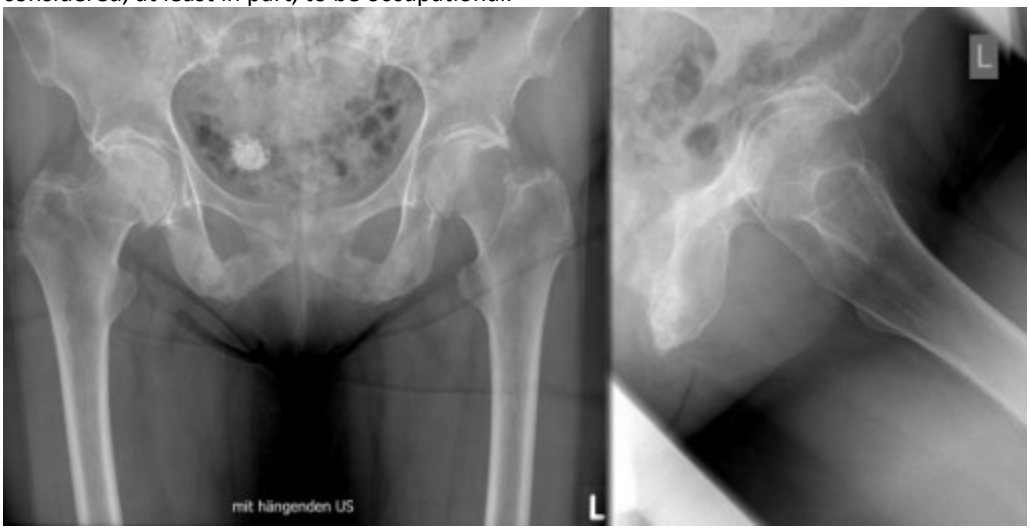


Figure 2: Preoperative antero-posterior pelvic (left) and true lateral (right) radiographs of the left hip showing bilateral osteoarthrosis of the hip and a calcified uterine myoma. Source: Konala P, Schaefer TK, Iranpour F, Friederich NF, Hirschmann MT. An unusual case of persistent groin pain after total hip arthroplasty: a case report. J Med Case Rep (2011); 5: 67.

The common pathway for hip OA includes such destruction of the joint that it may be indistinguishable on radiographs. Thus, a correct interpretation of a radiograph may include degenerative joint disease, but not osteoarthrosis. OA of the hips has been reported to occur as frequently in men as women. The reason for this difference compared with other joints where women are at a greater risk is unclear. Some studies have found that slipped capital femoral epiphyses are responsible for most cases of hip OA [64]. However, that finding has not been universal, although it would appear to explain the prevalence among men compared with OA in other joints. There is a predisposition for patients who already have OA in one or two joints to develop OA in other joint groups. Several genetic factors have been identified [65].

Most OA cases are symmetrical. As such, an occupational basis for such cases is much more difficult to identify. A few occupations have been consistently associated with one type of arthrosis (e.g., hip OA in farmers). However, there are relatively poor and/or inconsistent epidemiological studies in this area and the cause of symmetrical OA is controversial. The propensity for OA to develop in other joints once an individual has already developed symmetrical arthrosis in another body region signifies a probable genetic or other systemic predisposition (e.g., developing hand arthrosis after knee arthrosis or facet joint OA). Three or more body parts involved in OA is sometimes referred to as "systemic osteoarthrosis." Treatment of other types of OA is not covered in this guideline because there are substantive management differences by body part; thus, the reader is referred to other specific ACOEM Guidelines.

Most hip OA cases appear to arise without obvious exposures. The condition tends to slowly progress [66] and most cases are considered non-occupational. Cases that occur in only one joint are often post-traumatic, and it is that initial inciting event that determines whether the case is likely to be work-related. For example, if an individual fractures his or her femur at work and develops unilateral hip OA in that same hip 20 years later, the hip OA is thought to be occupational.

The sole occupation that has been consistently shown to be associated with hip OA is farming, although the duration of farming activities has not been found to further increase that risk (see Work Relatedness below). The exposure is unclear and has been hypothesized to involve forceful exposures in youth resulting in slipped capital femoral epiphyses, which later develop OA through altered biomechanics. However, regardless of the lack of clarity regarding the mechanism of development, the association is strong.

Many patients with hip OA are able to control their pain adequately by avoiding activities that significantly provoke symptoms and by using over-the-counter medications. Due to the deep nature of the hip joint, topical agents, heat, and ice may be relatively unhelpful. Because OA is generally characterized by morning stiffness or stiffness (and pain) after both long periods of inactivity or in association with unaccustomed increases in activity, patients may benefit from education, environmental and activity modification, and strategies for participation in meaningful occupations. Regular participation in programs stressing low-impact aerobics (e.g., walking programs, aquatic) or strengthening exercises may be beneficial, especially if they are individualized to the patient's diagnosis, prior and desired activity levels, and overall preferences. Weight loss is indicated for patients who are overweight or obese; improved prognosis has been shown for the knee, but it has not been clearly shown in the hip [67-79].

Nonsteroidal anti-inflammatory drugs (NSAIDs) are most commonly used for patients with OA. Chronic NSAID therapy may warrant ancillary use of proton pump inhibitors, H-2 histamine blocking agents, or misoprostol to provide prophylaxis against gastrointestinal adverse effects, especially among those who are elderly and have systemic diseases (e.g., rheumatoid arthritis). Selective Cox-2 inhibitors are also used due to lower risks of gastrointestinal effects. Tricyclic antidepressants, dual reuptake inhibiting antidepressants (i.e., SSNRIs), and acetaminophen may benefit certain patients. Highly select patients may also benefit from judicious use of low doses of opioids if they result in functional improvements, but are not otherwise indicated (see ACOEM Opioids Guideline).

Injections are not indicated for managing most OA patients unless the condition cannot be satisfactorily controlled with other noninvasive treatments. In such cases, intraarticular injections with glucocorticosteroids and viscosupplementation are sometimes used. In advanced cases, joint replacement is performed.

Osteonecrosis (Avascular Necrosis)

Osteonecrosis involves impairment of the blood supply to the head of the femur, which may evolve to subsequent degeneration and ultimately collapse of the femoral head. It is particularly likely to occur in areas of tenuous blood supply that lack collateral blood flow; thus, it most prominently affects the femoral head. There are numerous reported risk factors, including male sex [80], diabetes mellitus, glucocorticosteroid treatment or excess [80], sickle cell anemia, sickle cell trait, alcoholism, organ transplantation [81], and multiple myeloma [80]. The most prominent occupational risk factor for osteonecrosis is barotrauma ("the bends"), which may occur after diving or working in compressed air environments (e.g., tunneling projects through unstable sediments requiring compressed air to maintain the workspace). Significant, discrete trauma is thought to be a risk factor. However, nontraumatic job physical factors are controversial. Some workers' compensation jurisdictions have considered a pre-existing, previously nonoccupational case of advancing osteonecrosis after a discrete work injury, particularly including collapse, as having had an occupational contribution, although epidemiological support is tenuous. Treatment is primarily based on alleviating the exposure(s) thought to be responsible. A surgical "coring" procedure, vascularized and unvascularized bone grafting, and osteotomy are sometimes utilized. Severe cases may require arthroplasty.

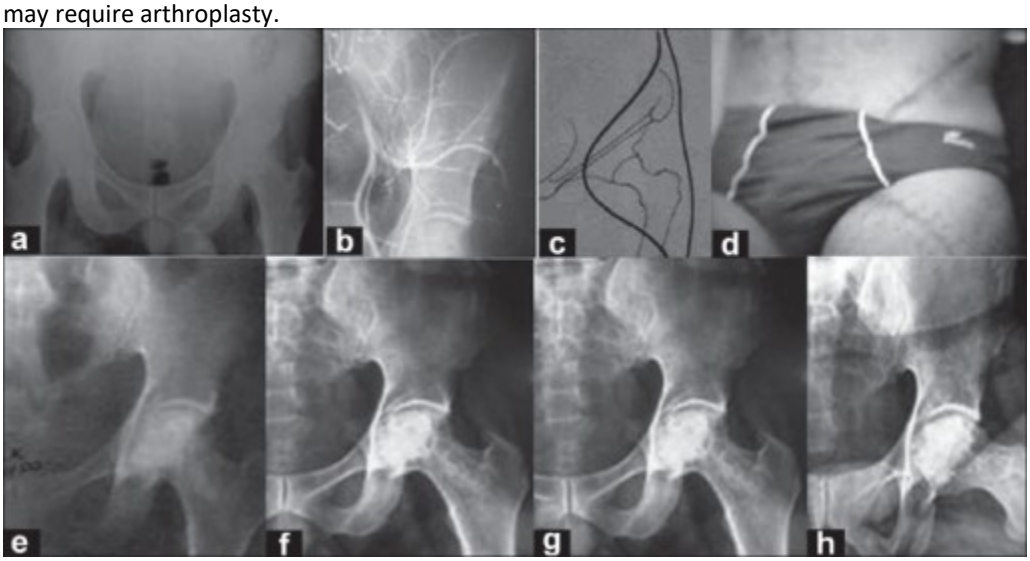


Figure 3: A 35-year-old man had bilateral osteonecrosis femoral head (steroid-induced osteonecrosis). (a) Preoperative anteroposterior X-ray of left hip shows stage III osteonecrosis. (b) Preoperative angiography showing the presence of deep circumflex iliac pedicle. (c) Line diagram shows proposed surgical incision for exploration of vascular pedicle graft and its implantation into the head and neck femur. (d) Clinical photograph showing operative scar. (e,f) Postoperative anteroposterior X-rays at three years showing good revascularization with preservation of joint space. (g,h) Postoperative anteroposterior X-rays at 5 and 10 years showing good revascularization, preserved joint space with no arthritic changes and no deformation. (Source: Babhulkar S. Osteonecrosis of femoral head: Treatment by core decompression and vascular pedicle grafting. Indian J Orthop. 2009 Jan;43(1):27-35.)

Hip Instability

The hip is subject to both traumatic and atraumatic instability. Traumatic hip instability is typically the result of a posteriorly directed, major force. The most common cause is motor vehicle collision; thus, some cases are occupational. The spectrum of injury ranges from subluxation to dislocation with or without concomitant injuries. In addition to standard radiographic workup, the evaluation may include an MRI, which may demonstrate the characteristic triad of findings of hemarthrosis, an iliofemoral ligament disruption, and a posterior acetabular lip fracture or posterior labral tear [82]. Anterior labral pathology is often present as well; it may represent a traumatic avulsion of the labrum or indicate the presence of some underlying bony impingement. The presence of a significant hemarthrosis may warrant aspiration under fluoroscopy to reduce intracapsular pressure. CT scanning may be helpful to define the bony anatomy of associated fractures of the acetabulum or femoral head. Atraumatic instability typically occurs among those with a developmentally abnormal hip joint. It includes a spectrum of hip anomalies to patients who manifest generalized ligamentous laxity. Preoperative diagnosis of

atraumatic instability of the hip is unclear and subjective. The labrum or iliofemoral ligament may be damaged from repeated force. These abnormal forces are theorized to cause increased tension in the joint capsule, which can lead to painful labral injury, capsular redundancy, and subsequent microinstability. The hip must rely more on the dynamic hip stabilizers for stability once the static stabilizers of the hip, such as the iliofemoral ligament or labrum, are injured. The spectrum of atraumatic instability also includes patients with hip pain secondary to more generalized ligamentous laxity or, in the extreme form, in patients with connective tissue disorders such as Ehlers-Danlos syndrome or Marfan syndrome. Physical findings include evaluation for ligamentous laxity and increased external rotation of the hip (in extension during the log roll or in flexion, such as the femoral abduction external rotation [FABER] maneuver). Treatment usually consists of rehabilitation therapy and appropriate exercises. Individualized exercise programs may be warranted because the direction of instability may vary among individuals and the loss of the natural stability of the hip is a challenging presentation requiring significant learned motor compensation.

Hip Dislocation

Most hip dislocations occur after violent or high-speed collisions (i.e., motor vehicle crash), a fall, or arthroplasty, or are due to a congenital joint malformation. (Some patients with inherited or congenital abnormalities, such as dysplasia, have a propensity for recurrence.) Among those with a developmentally normal hip joint, the mechanism of injury determines whether the condition is work-related. A hip dislocation requires radiographs and attempted relocation, often with procedural sedation. In cases with recurrent dislocation of the joint after replacement, a revision procedure may be performed to attempt to prevent dislocations. Preoperative CT scanning may be helpful to determine the rotational alignment (anteversion) of the femoral and acetabular components.

Hip Dysplasia

Hip dysplasia (developmental dysplasia of the hip) is a relatively common developmental problem that is heterogeneous in anatomic abnormalities and ranges in severity from mild to severe. It may be unilateral or bilateral and is multifactorial with certain risk factors reported (e.g., female gender, genetic factors, breech birth, firstborns, swaddling the legs of infants). The abnormalities involve a lack of appropriate fitting between the femoral head and acetabulum. In children, there is a propensity towards acetabular abnormalities that is usually accompanied by instability and dislocations. The Crowe classification system is sometimes used.
In adults, the condition is most often identified through an abnormal radiographic appearance of the acetabulum and/or proximal femur. It leads to an increased risk of labral tears, chrondral damage, ligamentum teres hypertrophy, and osteoarthrosis with some surgeries performed to attempt to reduce the risk of osteoarthrosis [83]. Patients may also present in youth or adulthood with hip pain that may be increased with physical activity. The pain is often in the inguinal region. There may be mechanical symptoms such as locking, painful clicking, or restricted range of motion (ROM). Pain is reproduced with the impingement sign as well as by hyperextending the hip or placing the hip in the FABER position. Radiographs and ultrasound are used for diagnostic purposes. There may be an increased ROM of both hips, although the affected hip has less motion, often limited by pain. The hip joint may be prone to dislocation and instability; if so, rehabilitation therapy and exercises are most commonly provided. When severe, osteotomies and joint replacement are often performed.

Hip Fracture

Hip fractures include both frank and stress fractures. Naturally, all fractures involve an application of force beyond the bone strength. Occupational fractures most commonly result from falls or motor vehicle crashes. These almost invariably require surgical fixation or sometimes arthroplasty. Stress fractures most typically involve repeated applications of unaccustomed force over a relatively short interval of hours to days. These are usually treated with elimination of the offending exposure and observation. Physical therapy to address movement system impairments, such as muscle performance and motor patterns, may assist in reducing forces on the affected site.

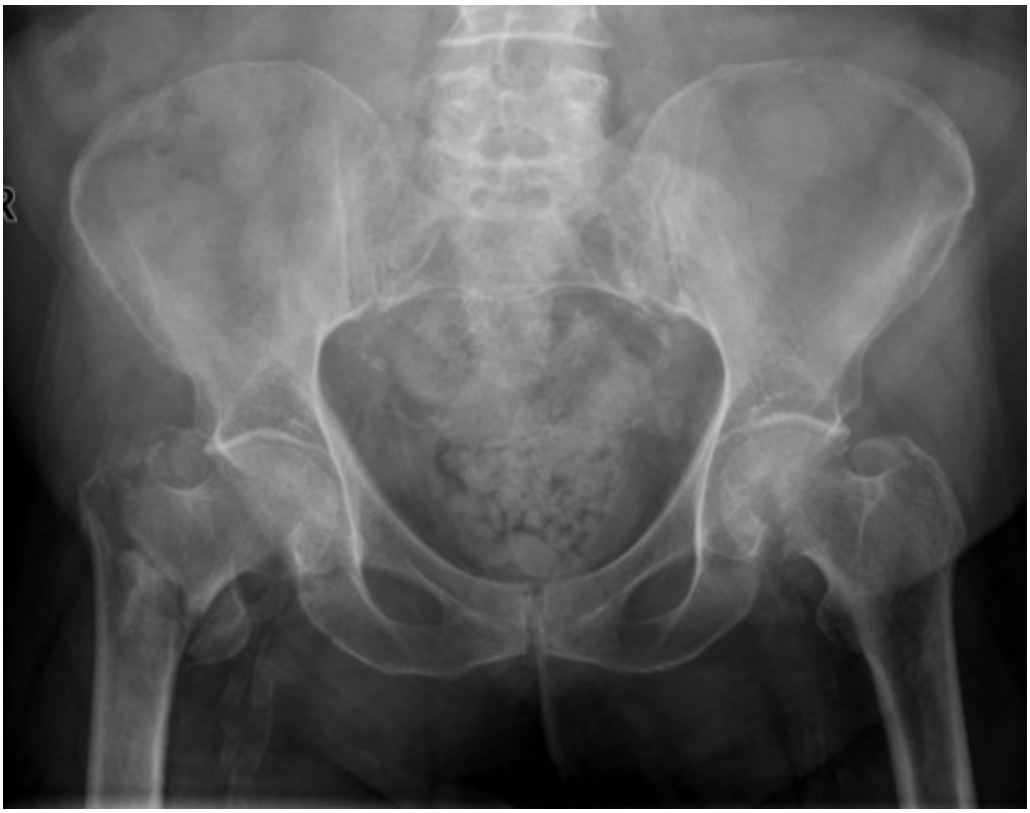


Figure 4: Anterior-posterior radiograph demonstrating a three-part intertrochanteric hip fracture on the right side. Discontinuity of the medial contex is seen with the less trochanter fracture fragment. (Source: Li X, Heffernan MJ, Kane C, Leclair W. Medial pelvic migration of the lag screw in a short gamma nail after hip fracture fixation: a case report and review of the literature. J Orthop Surg Res. 2010 Aug 27;5:62.)

Hip Impingement

See Femoroacetabular Impingement.

Labral Tears

The labrum is a triangular fibrocartilaginous structure attached at its base to the rim of articular cartilage surrounding the perimeter of the acetabulum. It is absent inferiorly where the transverse acetabular ligament completes the rim. The labrum provides some structural resistance to lateral and vertical motion of the femoral head within the acetabulum and has a sealing function that limits fluid expression from the joint space to protect the cartilage layers of the hip. The labrum may also provide some proprioceptive feedback. Labral tears may occur as an isolated problem, be degenerative, be associated with a traumatic injury such as hip dislocation or subluxation, or occur with bony abnormalities, such as hip dysplasia and femoroacetabular impingement [84] Labral tears less commonly may be the result of some other etiology, including capsular laxity, iliop/psoas impingement [85-88], or symptomatic internal coxa saltans.

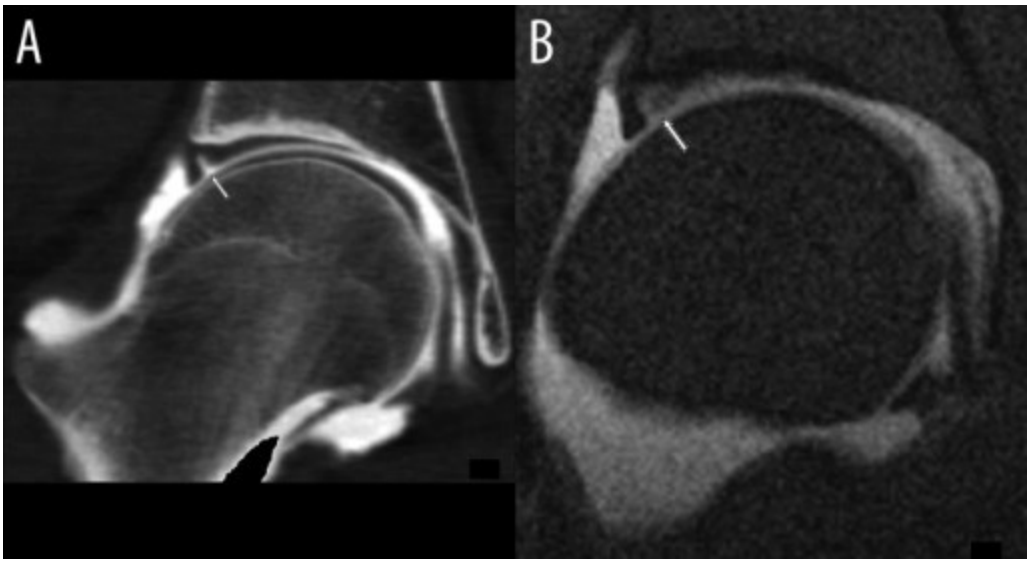


Figure 5: Cam-type femoroacetabular impingement and labral tear in a 36-year-old male with a 4-month history of pain in the right hip. Both coronal reconstruction (A) and corresponding T1-weighted fat-saturated MRA (B) show contrast extension into the anterosuperior labrum compatible with a tear (arrows). (Source: Sahin M, Calisir C, Omeroglu H, Inan U, Mutlu F, Kaya T. Evaluation of Labral Pathology and Hip Articular Cartilage in Patients with Femoroacetabular Impingement (FAI): Comparison of Multidetector CT Arthrography and MR Arthrography. Pol J Radiol. 2014 Oct 24;79:374-80.)

Labral tears have been classified in different ways [89-93]: radial flap (most common at 57%), radial fibrillated labrum (22%), longitudinal peripheral tears (16%), and abnormally mobile tears (5.4%). They are now described more functionally as intrasubstance tears and tears at the labral-chondral junction. The vascularity of the labrum comes from the capsule and bony acetabulum [94]. Many tears occur in the articular nonvascular zone, resulting in some labral repairs being slower or unlikely to heal. Labral tears are frequently seen in conjunction with acetabular chondral lesions. Tears more commonly occur anterosuperiorly due to the association between labral pathology and underlying bony abnormalities, such as impingement and dysplasia. Both femoroacetabular impingement and dysplasia lead to injury to the anterosuperior labrum, although they are thought to occur through different mechanisms. In the case of impingement, the anterosuperior labrum is compressed between the femoral head–neck region and the acetabular rim. In dysplasia, the anterosuperior labrum is overloaded due to loss of acetabular bony coverage and subsequent capsular and labral decompensation. In most dysplasia cases, the labral tissue is hyperplastic in an attempt to create a soft-tissue substitute for the loss of acetabular coverage and thus may be more vulnerable to degenerative tearing. The location of the labral pathology in hip instability may differ from the most common anterosuperior location seen in the setting of impingement and dysplasia. Traumatic hip instability, usually the result of a posteriorly directed force, may result in a posterior labral tear; however, an anterior labral injury may also be present, indicating a traumatic avulsion of the labrum. Hip subluxation may occur from the same mechanism as a dislocation or be the result of a cutting or pivoting maneuver.

The diagnosis of a symptomatic labral tear may be difficult. Not only do the history, symptoms, and physical examination vary among patients, but there is also a lack of familiarity with the diagnosis. Many patients present with mechanical symptoms such as buckling, clicking, catching, or painful restricted range of motion. Some can present with dull, activity-induced positional pain that does not improve with rest. Common presenting symptoms include insidious onset of inguinal/groin pain. Pain may be aggravated by pivoting and walking or other activities. The patient may also find the pain to be reproducible by bringing the hip into extension from flexion. Pain with hyperflexion, internal rotation, and adduction (impingement position) are present in most patients. The pain and/or clunk may also be reproduced with the labral stress test (patient supine, hip placed into full flexion, external rotation and abduction then moved to extension, internally rotated and adducted with reproduction of pain, clicking, or clunking) [95] and/or with resisted straight leg raise, although the diagnostic value of these tests may be limited.

The most common treatment is observation; however, exercise therapy may be helpful and surgical repair is thought to be indicated for tears that are either highly symptomatic and/or fail to improve with observation. Labral tears may lead to progressive osteoarthrosis; surgical treatment has been suggested to reduce that risk [96-98].

Ligamentum Teres Ruptures

The function of the ligamentum teres is not fully understood. It is a triangular-shaped structure with a broad-based attachment to the posteroinferior portion of the cotyloid fossa of the acetabulum. It provides blood supply during development through a small artery to the fovea of the femoral head. There is no known mechanical function, although it has been suggested that this ligament plays a biomechanical role that helps to stabilize the hip [99]. Analysis of the ligament's material properties has demonstrated similarities to other ligaments and confirms its ability to resist dislocation forces applied to the femoral head. It is tight in adduction, flexion, and external rotation. Disruption of the ligamentum can be associated with trauma and dislocation of the hip or it may occur without dislocation [99]. Disruption of the ligament may also occur with degenerative arthritis [99]. Patients suffering from ligament rupture as a result of trauma or dislocation will often have symptoms of instability and pain.

The prevalence of ligamentum teres ruptures seen at arthroscopy is more common than expected, with a reported 8% prevalence rate [100]. Acute disruptions of the ligament are thought to occur as a result of exaggerated movements of adduction and external rotation, although hip abduction is often the injury mechanism described with patient history. Diagnosis of these injuries may be difficult and a high index of suspicion with careful attention to the injury mechanism and the physical examination are critical to accurate evaluation. The high incidence of degenerative arthritis associated with complete ligamentum teres ruptures has been attributed to the original injury in many cases. However, recurrent instability and subluxation episodes may cause repeated injury to the femoral head and account for an increased incidence of osteoarthrosis.

Lower Abdominal Strains

Lower abdominal strains are frequent occurrences in sports and occupational groups, particularly those involved in heavy lifting [101]. The pathophysiological abnormality is unclear. Pain onset is usually acute, occurring in the context of a heavy lift or sports-related forceful exertion. Pain occurs most typically in the lower abdominal muscles, often along the inguinal canal; however, there is no hernia. Whether these types of abdominal strains are risks for, or a precursor to, an indirect inguinal hernia is unknown.

Among those with symptoms of epididymo-orchitis, some hypothesize that the disorder represents reflux of urine into the vas deferens during heavy lifting or strain (see Epididymo-Orchitis). Treatments typically involve reducing forceful use, NSAIDs, and therapy. Complete abdominal tears may be surgically repaired [102].

Meralgia Paresthetica

Meralgia paresthetica is a peripheral entrapment neuropathy of the lateral femoral cutaneous nerve, a sensory nerve supplying the upper lateral aspects of the thigh [103-105]. Although a nerve entrapment may occur at any point along the nerve, the condition is most commonly from localized pressure in the area of the inguinal ligament, generally in middle-aged adults in whom obesity [104] or tight-fitting clothing [106, 107] is presumed to produce direct pressure on the nerve. In an occupational setting, it has been attributed to pressure from tight, heavy tool belts or military armor [106]. Onset may be relatively acute (e.g., after one night's sleep) or insidious. Other causes include trauma, scarring from prior trauma or surgery, and insults from systemic rheumatological disorders. Symptoms involve tingling and numbness in the distribution of the nerve. Pain may be absent, mild, or (rarely) severe. There is no muscle weakness. Treatments typically include alleviating pressure on the nerve, and rarely involves surgery [108].

Impact

There are numerous disorders of the hip and groin, many of which will be covered in this Guideline. However, robust population-based prevalence, incidence, and cost estimates for hip disorders are largely unavailable, except for hip fractures and osteoarthrosis (OA). The incidence of femoral neck (hip) fractures rises through elderly years

[109, 110], occurring in an estimated 18% of females and 6% of males over their lifetimes [111], [112]. It has been estimated that the incidence of hip fracture will increase to anywhere between 6.26 million to 8.71 million people by 2050 [113-115]. Yet, recent data also indicate that incidence rates have actually been falling in many western regions and countries, including Finland [116], Sweden [117], Norway [118], [119], Australia [120], and the United States [121, 122]. By contrast, incidence rates are reportedly rising in Korea [123, 124] and China [125, 126], whereas data from Japan are conflicting [127, 128]. Improvements in fracture rates have been attributed, in part, to improved screening and preventive bone health [116, 122, 128].

Of those experiencing hip fracture, approximately 74% of U.S. cases occur in women [121, 129]. Treating hip fractures is also very expensive, with attendant hospital costs outstripping those for heart attack, stroke, and breast cancer [130]. A patient with a hip fracture spends on average around $40,000 in the first year following hip fracture for direct medical costs and almost $5000 in subsequent years [131 2012, Singer 15]. More than 95% of hip fractures are caused by falling from standing height level, although many can also occur from motor vehicle collisions [110]. After hip fracture injury, patients are two to three times more likely to die in the following year [110], with 1-month, 6-month, and 1-year fatality rates at 4.3%, 17%, and 18.8–22.8% respectively [132, 133]. Those that lived independently before hip fracture usually require assistance afterwards [129].

Hip osteoarthritis (OA) shows a greater prevalence in females compared to males in the workplace [134] and the incidence of hip OA is 88 per 100,000 person-years [135, 136]. In a systematic review by Harris 2015, impact of hip osteoarthritis at work was examined and included: physical limitations (60.5% of 1411 people with hip OA showed work limitations), hip pain (12/86 patients experienced hip pain), impact on work capacity (28% of employees required job modifications)[137], missed work or sick leave (18-19% of employees missed work for hip problem), early retirement (9% of a sample had to retire early due to surgery), job change (25.9-30% of multiple samples required job change) [134, 137], and job loss (6% of 52 patients lost job as result of hip problem) [134].

Definitions and Related Terms

Acetabulum: A somewhat spherical structure of the pelvis that articulates with and covers approximately 170 degrees of the femoral head.

Acute, Subacute, or Chronic Pain: For the purpose of identifying interventions at different stages of diseases, acute pain is defined as pain for up to 1 month; subacute pain lasts from 1 to 3 months; and chronic pain is of more than 3 months' duration (see ACOEM Chronic Pain and Low Back Disorders Guidelines for additional information) [138].

Active Therapy: The term "active therapy" generally involves the patient taking an active role in the treatment of their pain in rehabilitative treatment. Although there is no one specific treatment defined by this term, it most commonly includes aerobic activity, muscle reconditioning (light weightlifting or resistance training), and active physical therapy [139]. Active therapy may also include treatment with psychological, social, and educational components requiring active participation from the patient, generally in conjunction with therapeutic exercises [140].

Active Exercise Therapy: Active exercise therapy typically consists of cardiovascular training and muscle strengthening [141, 142]. It may also include progressive or occasionally even active stretching, especially in patients with substantially reduced ranges of motion. Active exercise therapy is used as a primary treatment for chronic pain, is frequently initiated in the course of treating subacute pain, and is a primary treatment after various surgeries. The goal of active exercise therapy is to improve function [141]. The word "active" is used to differentiate individualized exercise programs designed to address and rehabilitate specific functional, anatomic, or physiologic deficits from passive treatment modalities or from forms of "exercise" that require very little effort or investment on the part of the patient.

Allied Health Therapies: Allied health therapies are treatment approaches that require extensive training and development of specific skills, such as manipulation, mobilization, massage, and acupuncture.

Bursae: Bursae are fluid-filled sacs within the body that provide lubrication in areas, such as points where muscles move over bony projections.

Bursitis: Bursitis occurs when the bursae become inflamed and irritated. This may result in pain, most typically when the overlying muscle is used. It may occur from a number of exposures, including when there is direct pressure, in those with adjacent tissue that is degenerative (such as tendons), or with forceful and unaccustomed use.

Cerebral Palsy Hip Instability: Due to the spasticity and increased muscle tone observed in patients with cerebral palsy, patients with these problems may develop hip instability ranging from hip subluxation, pain, and degeneration.

Delayed Recovery: Delayed recovery is most commonly defined as an increase in the period of time prior to returning to work or to usual activities when compared with the length of time expected, based on reasonable expectations, disorder severity, age, and treatments provided.

Enthesopathy: Enthesopathy is a disorder of the muscular or tendinous attachment to bone.

Femoral Neck: The femoral neck lies between the femoral head and femoral shaft, demarcated by the greater and lesser trochanters. Because the blood supply to the femoral head primarily runs through the femoral neck, a femoral neck stress fracture may disrupt the blood supply to the femoral head, leading to osteonecrosis of the femoral head.

Femoral Neck Stress Fracture: Stress fractures of the femur occur mainly at the femoral neck and are classified as either tension fractures (at the superior aspect of the femoral neck) or compression fractures (at the inferior aspect of the femoral neck). Pain associated with femoral neck stress fractures may be poorly localized in the hip and may be referred to the thigh or back. Femoral neck stress fractures usually manifest insidiously; otherwise healthy persons report pain related to activity, which does not resolve with conservative therapy. These fractures may be mild, causing only minimal bone changes and eventually healing, or they might progress to a complete fracture that requires surgical fixation. Stress fractures of the femoral neck are usually seen in young, active individuals who substantially increase high force activity level(s) or who do strenuous activity to which they are unaccustomed.

Functional Capacity Evaluation (FCE): A functional capacity evaluation is a comprehensive battery of performance-based tests used to attempt to assess an individual's ability for work and activities of daily living [143]. An FCE may be done to identify an evaluee's ability to perform specific job tasks associated with a job (a job-specific FCE) or ability to perform physical activities associated with any job (a general FCE). The term "capacity" used in FCE may be misleading, because an FCE generally measures performance and effort rather than capacity. (See ACOEM Chronic Pain and Low Back Disorders Guidelines for additional information.)

Functional Improvement (especially Objective Evidence): Evaluation of the patient prior to the initiation of treatment should include documentation regarding objective physical findings and current functional abilities both at home and at work. This should include a clear statement regarding what objective or functional goals are to be achieved through the use of treatment if anything other than full functional recovery occurs. These measures should be tracked during treatment and evidence of progress towards meeting these functional goals should be sought. Examples of documentation supporting improved function would be increased physical capabilities including job-specific activities, return to work, return from off-duty-status to modified duty, performance of exercise goals, participation in progressive physical therapy, and other activities of daily living. Validated tool(s) (e.g., Harris Hip Score, Hip Outcome Score, WOMAC) may also help track progress, although they are subjective. Objectively measured improvements in strength or aerobic capacity may be physical examination correlates of improved function.

Functional Restoration: Functional restoration is a blend of various techniques and programs (both physical and psychosocial), rather than one specific set of active exercises, processes, or therapies. The basic principle for all of these individually tailored programs is to help patients cope with pain and return to the functional status required for their daily needs and work activities [144]. The term "functional restoration program" frequently refers to a full-day multidisciplinary, medically directed program typically lasting from 3 to 6 weeks, employing an interdisciplinary team often consisting of therapists, psychologists, case managers, and nurses [145].

Greater Trochanteric Pain Syndrome (Trochanteric Bursitis): Greater trochanteric pain syndrome occurs when the trochanteric bursa is inflamed (although in most cases, there are not classic symptoms and signs of inflammation).

There often is concomitant gluteus medius tendinitis. Classic inflammation may occur with arthropathies or infectious agents. Patients usually complain of lateral hip pain because pain may radiate down the lateral aspect of the thigh. The hip joint itself is not involved. The condition is thought to most commonly occur as a consequence of degenerative tendinitis (usually gluteus medius). It may also occur either as a result of acute trauma (such as contusions from falls), be idiopathic, or occur from stereotypical use where the bursa becomes irritated due to friction by the iliotibial band (ITB). Leg-length discrepancy, hip abductor weakness, and lateral hip surgery are thought to be predisposing factors.

Groin: The groin includes the lower rectus abdominis musculature, the inguinal region, symphysis pubis, upper portions of the thigh adductor muscles, and the genitalia and scrotum. It consists of the area where the abdomen meets the legs. A groin strain is technically considered to be a disruption of a myotendinous junction, although the term is often used more broadly to indicate muscular pain. A complete muscular tear may occur.

Groin Injury: Most groin injuries are related to unaccustomed or high forces on the hip joint and surrounding bony and muscular support structures of the pelvis. The most common *acute* groin injuries are contusions and hematomas. The most common *chronic* groin conditions are strains of the muscle-tendon unit resulting from high force.

Harris Hip Score: The Harris Hip Score is one of the more commonly used scoring systems for hip disorders (see http://www.orthopaedicscore.com/scorepages/harris_hip_score.html and WOMAC and Hip Outcomes Score below). Scoring is based largely on the degree to which pain limits activities combined with ranges of motion [146].

Hip Dislocation: Hip dislocations are relatively uncommon and usually result from a violent or high-speed collision or fall (up to 70% are due to motor vehicle crashes). Pain is usually severe, associated with an inability to bear weight and with shortening and rotation of one leg inward or outward. Hip dislocations are either anterior or posterior, with posterior hip dislocations comprising the majority of traumatic dislocations. Most other dislocations either occur due to a congenital malformation of the hip joint or occur after hip replacement.

Hip Dysplasia: Hip dysplasia (developmental dysplasia of the hip) is a relatively common problem where there is less acetabular bony coverage over the femoral head. Those with hip dysplasia are more prone towards both dislocation and osteoarthrosis.

Hip Joint: The hip joint is a synovial ball-and-socket type joint based on the articulation of the head of the femur and the acetabulum of the pelvis. Five ligaments hold the femur in the acetabulum: the iliofemoral ligament, pubofemoral, ischiofemoral, transverse acetabular, and femoral head ligaments. Dislocation of the hip joint is difficult to achieve due to the angulation of the proximal femur in relation to the acetabulum and the strength of these ligaments joined together.

Hip Outcome Score: The Hip Outcome Score [147] is a commonly used scoring system for hip disorders and prominently includes ratings of the degree of difficulty performing specific tasks. It also incorporates a sports rating system that is sometimes useful for more active patients.

Hip Pain: Pain originating from the hip is usually felt in the buttock or inguinal/groin area with radiation to the distal thigh and anterior medial aspect of the knee. Pain in the hip may also be due to referred pain from cardiovascular or metastatic processes, lumbar disc herniation with neurological impingement, retroperitoneal or pelvic tumor, or from aortoiliac insufficiency.

Hockey Groin Syndrome: Hockey groin syndrome is more prominent in athletes. The constant stress on the groin area is thought to result in a small tear in the external oblique aponeurosis, which allows branches of ilioinguinal nerve to be irritated.

Inflammatory Arthritis: Inflammatory arthritis is an aggregate term for various autoimmune diseases (e.g., rheumatoid arthritis). Inflammation of the bone occurs when several growth factors and cytokines are increased, inducing osteoclast differentiation and activation. Inflammation can become chronic and initiate systematic bone loss.

Iatrogenic Femoral Fracture: Iatrogenic fractures most commonly occur in the course of medical treatment. Femoral procedures that may result in iatrogenic fractures include intramedullary nailing, cortical notching, and repeated or forceful closed reduction of an irreducible femoral head.

Labrum: The labrum consists of cartilaginous tissue surrounding the hip acetabulum. The hip labrum is analogous to the shoulder labrum in both structure and function. The labrum effectively enlarges the size of the hip joint and is necessary for hip stability by maintaining contact between the head of the femur and the acetabulum of the pelvis.

Metabolic Bone Diseases: The bones in the body go through an ongoing process of remodeling in order to maintain their bone mass and preserve bone strength. In metabolic bone diseases, there is an increase in the rate

of bone turnover. Paget's disease of the bone (PDB), early-onset Paget's disease of the bone, familial expansile osteolysis (FEO), expansile skeletal hyperphosphatasia (ESH), and juvenile Paget's disease (JPD) are all forms of accelerated metabolic bone disease.

Neoplasm: A neoplasm (tumor) can be categorized as benign (cancerless) or malignant (cancerous). The classification of neoplasms includes the site of its origin (topography) and how it behaves (morphology). A complete morphology code includes histology, behavior, and grade, differentiation, or phenotype.

Osteoid Osteoma: An osteoid osteoma is a benign osteoblastic tumor that commonly occurs in the subcortical shaft and metaphyses of long bones.

Osteonecrosis (Avascular Necrosis) of the Femoral Head: Osteonecrosis occurs when the tenuous blood supply to the femoral head is interrupted. Osteonecrosis of the femoral head can be a result of traumatic or non-traumatic factors. The condition is generally painless early; however, as it advances, patients frequently present with pain and limitation of motion. Pain most commonly localizes in the inguinal/groin area, but also manifests in the ipsilateral buttock, knee, or greater trochanteric region. Pain is usually exacerbated by weight bearing and is relieved with rest.

Pain Behavior: Pain behavior includes verbal and non-verbal actions (e.g., grimacing, groaning, limping, using pain relieving or support devices, requesting pain medications), which communicate the concept of pain.

Paget Disease: Paget disease of the bone (PDB, or osteitis deforams) is a metabolic disorder with focal abnormalities of increased bone remodeling, which leads to conditions such as bone deformity, pain, pathological fractures, and deafness.

Passive Modality: Passive modalities are various types of treatment that usually involve the administration of some form of applied stimulus rather than active therapy (see Active Therapy above). Forms of passive modalities include massage, hydrotherapy (e.g., whirlpools, hot tubs, spas), ultrasound, and hot/cold compresses.

Physical or Occupational Therapy (PT/OT): The term "physical therapy" is used in the ACOEM Guidelines generically to mean physical medicine, therapeutic and rehabilitative evaluations, and procedures. Much research uses this term generically. This rehabilitative therapy may be performed by or under the direction of trained and licensed individuals such as physical therapists, occupational therapists, exercise physiologists, chiropractors, athletic trainers, and physicians. Jurisdictions may differ on the qualifications for licensure to perform these interventions. The recommendations in the ACOEM Guidelines are not meant to restrict physical therapy to being performed only by physical therapists.

Primary Prevention: Primary prevention involves preventing a condition or risk factor from developing (e.g., physical activity programs to prevent obesity, which results in osteoarthrosis).

Rehabilitation: The term "rehabilitation" is used in the ACOEM Guidelines to mean physical medicine, therapeutic and rehabilitative evaluations, and procedures. Rehabilitation services are delivered under the direction of trained and licensed individuals such as physicians, occupational therapists, or physical therapists. Jurisdictions may differ on qualifications for licensure to perform rehabilitative evaluations and interventions.

Rheumatoid Arthritis (RA): Rheumatoid arthritis is an autoimmune disease that leads to joint destruction due to increases in some autoantibodies and proteolytic enzymes.

Secondary Prevention: Secondary prevention involves a reduction in an exposure or risk factor after the risk factor has already developed but before the disease has occurred (e.g., use of fall protection equipment to prevent hip fractures).

Sports Hernia: Sports hernias (aka, athletic pubalgia) are true myotendinous strains which involve the lower abdominal musculature, such as the oblique muscles or rectus abdominus insertion on the symphysis pubis.

Sprain: A sprain is the disruption of a joint's ligaments. Because the hip's ligaments closely bind the hip joint together, a dislocation of a pre-morbidly normal hip joint invariably also involves a hip sprain.

Strain: A strain is the disruption of a myotendinous junction, usually from a high-force, unaccustomed exertion. It may also occur during an accident. This term is occasionally used to describe non-specific muscle pain in the absence of knowledge of an anatomic pathophysiological correlate.

Synovitis: Synovitis is inflammation of a synovial membrane, although in most cases there are no classic symptoms or signs of inflammation. Classic inflammation occurs with crystalline arthropathies or infectious agents. Synovitis is usually painful, especially with motion. Fluctuating swelling may occur due to effusion within the synovial sac, although the hip joint is too deeply covered to appreciate synovial joint swelling other than indirectly (e.g., through reduced ranges of motion).

Synovial Membrane: The synovial membrane incorporates the entire femoral head, the anterior neck, and the proximal half of the posterior neck of the femur to generate the synovial fluid that lubricates the hip joint.
Tenosynovitis: Tenosynovitis is inflammation of a tendon sheath, although in most cases there are no classic symptoms or signs of inflammation. Classic inflammation may occur with arthropathies or infectious agents.
Tertiary Prevention: Tertiary prevention has most typically been defined as amelioration of the condition after it has already developed. For example, after a patient has been diagnosed with osteonecrosis, tertiary prevention may preclude him or her from diving or other decompression activities.
Trochanteric Bursa: The trochanteric bursa lies between the femoral trochanteric process and the gluteus medius/iliotibial tract, just superficial to the greater trochanter of the femur.
Visual Analog Scale (VAS): The Visual Analog Scale attempts to measure a patient's level of subjective pain on a 0 to 100 scale. In research and some clinical settings, this is commonly obtained with a 10-cm-long horizontal line with verbal scale anchors of "no pain" to "worst pain" that a patient marks and can then be measured in millimeters to give a VAS (e.g., 45 mm = 4.5). Most commonly, a 0 to 10 verbal rating scale is used clinically as a surrogate without implementation of a true VAS.
Western Ontario and McMaster Universities Osteoarthritis (WOMAC) Index: The WOMAC index is the most common outcome measure other than standard and VAS pain ratings. It combines subjective ratings of pain with activities, stiffness, physical function, social function and emotional function measures [148].

Risk and Causation

Risk Factors and Associated Factors

Femoroacetabular Impingement (FAI)

The development of FAI is not well defined, with competing theories regarding the relative importance of congenital and developmental factors [149]. Evidence now suggests an absence of cam morphology in young pediatric patients, but cam morphology subsequently is present after epiphyseal closure [150, 151]. FAI is widely prevalent in the general population and more common among men [152] There is evidence that FAI abnormalities develop in the course of high-impact sports use in youth [150, 151], including FAI and slipped capital femoral epiphyses, with an estimated 10-fold increased risk of an abnormal alpha angle attributable to sports [153, 154]. Overall prevalence has been estimated at 10–20%; for example, an estimated 14% of asymptomatic men have cam-type FAI [155] and 19.6% of men have a pistol-grip deformity [152]. Regardless of the developmental process, once FAI is present, it has been shown to be a strong risk factor in longitudinal studies for development of hip arthritis (see the section on Work-Relatedness) [156-158]. A 19-year prospective cohort study estimated a 5% increased risk of hip OA for every degree increase in the initial alpha angle [159]. Altered motor control of pelvic movements relative to the femur, with or without ligamentous laxity, has been associated with hip impingement [160].

Gluteus Medius Tendinopathy and Tears

Gluteus medius tendinopathy and tears are believed to be the same pathophysiological condition as greater trochanteric pain syndrome (see below).

Greater Trochanteric Pain Syndrome (Trochanteric Bursitis, Lateral Trochanteric Pain Syndrome)

Limited research has been conducted on the risk factors for greater trochanteric pain syndrome (GTPS). A population-based analysis of electronic medical records estimated a prevalence rate of 4.2/1000 for greater trochanteric pain syndrome [161]. A crude incidence rate of 2.03 per 1000 was reported in a military population, with age as a risk factor; the risk was more than double among women [162]. There was a trend towards greater risk of gluteus medius injury with a rapidly increased running distance [163]. Reported associated risks include obesity [164], female sex [165], knee osteoarthrosis [165], iliotibial band syndrome [165], and a reduced neck shaft angle [164]. There is growing evidence of an association between the analogous tendon in the shoulder, rotator

cuff tendinosis, and cardiovascular disease (CVD) risk factors, including obesity [166-170], smoking [171-178], hypercholesterolemia [179], diabetes mellitus [180-183], and combinations of CVD risks. Other than obesity, these risks have not been reported as evaluated in the hip.

Groin Strain

Groin strains have been primarily reported among athletes requiring high-force lower extremity use, such as American football [184], Australian football [185], soccer [186, 187], and hockey [188], [189]. Scant evidence suggests flexibility and/or muscle recruitment may be risks [190]. There are no quality studies of the incidence of groin strains. There are no prospective cohort studies and no retrospective studies. Thus, risk factors and associated factors are ill-defined.

Hip Dislocation

Hip dislocations in normal hip joints occur due to very high-force accidents, especially motor vehicle crashes [191, 192], extreme sports [193], and falls from considerable heights. FAI reportedly increases the risk of posterior dislocation [194]. Among those without high-force accidents, hip dislocations are usually the result of developmentally abnormal hips, such as dysplasia [195, 196]. The risk of hip dislocation is also increased after hip arthroplasty [197].

Hip Fracture

Risk factors for hip fracture that are common in the general population include increasing age [198], female sex [199-201], multiparous status [202], later age at menarche [202], smoking [203, 204], regular alcohol intake [205-207], low body mass index [208, 209], high body mass index [210, 211], low bone density [209, 212], low muscle mass and/or poor strength [213-216], low physical activity [217-221], prior fractures [222-224], recurrent falls and/or instability [205], chronic illness, including arthritis and Parkinson's disease [225-227], cardiovascular disease [228] [229], chronic obstructive pulmonary disease [229], diabetes mellitus and/or poor glycemic control [230, 231], renal disease [229], osteoporosis [232], dementia [229], and general debility, such as sustained immobilization and use of walking aids [213, 233]. Other studies identified several drugs that are risk factors for hip fractures, including long-acting benzodiazepines [234], anticonvulsant drugs, high caffeine intake, and gonadotropin-releasing hormone agonists (GnRH) [222, 235, 236]. Most occupational hip fractures occur in high-impact traumatic events, including falls and automobile crashes [237]. Most non-occupational hip fractures occur in the context of debility and/or elderly age with declining bone strength. Some occupational hip fractures include both trauma and debility. Occupational physical demands have not been found to increase or reduce the risk of hip fracture [238]. Another study found no association with bone mineral density at retirement [239, 240].

Hip Osteoarthrosis

Osteoarthrosis (osteoarthritis) is the most common form of arthritis [76]. It has been estimated that 22.7% of the US adult population (52.5 million people) have been diagnosed with arthritis and 9.8% (22.7 million people) have associated activity limitations [241]. There appear to be significant differences in risk between the sexes. A large population-based study found that most men have a hip deformity underlying their OA compared with women (71.0% vs. 36.6) [152].

There are numerous risk factors and associated factors for this disease:

a) **Age:** Age is a very strong risk factor for hip arthritis [242-247].
b) **Sex:** Overall risk for hip arthritis by sex is less disparate than that for knee arthritis, which has a preponderance of females. Data are suggestive that hip anomalies, including slipped capital femoral epiphyses, may explain some of these differences (see Femoroacetabular Impingement below). Low levels of estrogen have been suggested to be a risk factor for hip OA, with some indirect evidence that women receiving postmenopausal estrogen replacement therapy had a lower prevalence of OA [248, 249].
c) **Nutritional:** Studies on nutrition conflict, with one reporting an association between low levels of 25-vitamin D and Hip OA characterized by joint space narrowing [249, 250]. However, another prospective cohort study found an elevated risk of hip arthroplasty in males but not females, associated with higher vitamin D levels [251, 252]. Yet another study found no relationship [253].

d) **Injury:** Injury is a risk factor for hip OA, although there are more data for knee OA than for hip OA [254].
e) **Developmental disorders:** Anatomical abnormalities of the hip may predispose an individual to osteoarthrosis, including Perthes' disease [255-257], dysplasia [258, 259], the development of cam morphology, and/or slipped capital femoral epiphysis [260] [261].
f) **Femoroacetabular impingement:** Multiple prospective cohort and population-based studies have shown that FAI is a strong risk factor, especially a cam morphology and an elevated alpha angle [34, 149, 159, 262-265]. Evidence is less strong for pincer FAI abnormalities [149]. Risks of hip OA associated with FAI have been reported to be as high as 25-fold [263]. Another found a trend toward cartilaginous thinning among those with FAI [266].
g) **Body mass index (BMI):** Body mass index has been shown to be an independent risk factor in many studies [78, 267], [268-272], although its effect is less strong on the hip than knee joint [248, 249, 268, 272-274].
h) **Genetics:** Genetic factors are reported risks for hip OA [244], [260], [275], [276], with some noting genetics are an essential component for this disease based on a near absence in non-European patients [277].
i) **Inflammatory mediators:** Many different inflammatory mediators are detectable in joints or systemically in affected individuals, including collagenase, tissue inhibitor of metalloproteinases, proteoglycan fragments, aggrecan, stromelysin-1, decorin, biglycan, lumican, keratocan [278-290], and hyaluronic acid, which may predict earlier progression of OA. Weight loss has been shown to reduce those same inflammatory markers among knee osteoarthrosis patients [291, 292].
j) **Systemic arthrosis:** Systemic arthrosis, traditionally defined as three or more joints, is another significant risk for hip osteoarthrosis [65, 243, 293-296]. There appear to be different patterns of joint involvement, such as Heberden's nodes, knee osteoarthrosis, or spine osteoarthrosis [243-245, 294, 296]. This may be due to genetic factors and/or systemic impacts, such as from obesity.
k) **Sports:** Considerable evidence is accumulating that heavy sports participation in adolescence causes the development of cam morphology [153, 154], which then sharply increases the risk for hip OA. Most studies of adults suggest that high levels of sporting activities are associated with a higher risk of hip OA [249, 260, 273, 297, 298], although at least one study was negative [299]. A retrospective study suggested a stronger risk from recalled sports activities as a youth compared with adulthood [250]. For the knee, cohort data suggest that running does not increase the risk of hip arthritis [297, 300-307]. Whether there is an independent risk of hip OA from sports in adulthood beyond the development of FAI and cam morphology as a youth is not known.
l) **Occupation:** See the section on Work-Relatedness.

Labral Tears

No quality epidemiological studies have identified risk factors for labral tears. One case series suggested male sex, increasing age, and increasing alpha angle are risk factors for labral tears [308]. An association with hip arthritis has been reported [309-311], whereas others reported an association with dysplasia and FAI [312]. The presence of cam-type FAI has been associated with a 2.8-fold increased risk of a labral tear in a population-based study of asymptomatic young males [266]. Case studies suggest that labral tears may occur in pediatric dancers [313], athletes [314], football players [315], and adult runners [316]. For both FAI and labral tears, consideration should be given to identifying a syndrome related to pain in the presence of a labral tear or FAI rather than to asymptomatic findings.

Meralgia Paresthetica

The incidence rate of meralgia paresthetica (MP) has been variously estimated at 4.3 per 10,000 per year [317] and 32.6 per 100,000 patient-years [318]. It is also a reported post-surgical complication [319], [320]. Age is a reported risk factor [318], and the incidence rate among diabetics is also statistically higher [318]. There are a few reported associated factors, with the most commonly identified being obesity; all quality studies evaluating obesity found it

to be an associated risk [317]; [321]; [322]; [318] [320]. MP has also reportedly been 7-fold associated with CTS and 12-fold associated with pregnancy [317], although measurement and adjustment for obesity is somewhat unclear. It has also been shown that those with MP are also more likely to be diagnosed subsequently with diabetes mellitus [318].

Osteomyelitis

Osteomyelitis, or infected bone, is nearly always due to either an open fracture and/or penetrating wound to the bone. It is also a post-surgical complication [323-325]. Thus, whether the condition is considered occupational is based on whether the mechanism of the original event or disorder is considered work-related. There may be some increased risk associated with diabetes and other potential devascularized states [326].

Osteonecrosis

The strongest risks for osteonecrosis are generally considered to be alcohol [327-333] [334] and glucocorticosteroid treatment or excess glucocorticoid hormones (e.g., tumor) [80, 335-338] [334, 339, 340]. However, there are many other nonoccupational factors associated with osteonecrosis, including male sex [80], [334], genetic factors [341], [342], [343], [344], diabetes mellitus [345, 346], [339], total and LDL cholesterol [334], triglycerides [334], gout [329, 336], sickle cell anemia [331, 336], sickle cell trait [331], organ transplantation [81, 347], multiple myeloma [80], smoking [328, 332, 333], and obesity [328] [334]. The primary occupational associated factor is barotrauma ("the bends") [348, 349] [350, 351] [352] [353] [354] [355] [356] [357].

Sports hernias

Sports hernias, which are also known as athletic pubalgia, are true strains and involve the lower abdominal musculature (most typically the oblique muscles or rectus abdominus). These strains involve maximal force use of these muscles, most typically in football, hockey, soccer, and wrestling; occupational cases have been reported. The cause of sports hernias is generally not controversial as the event is highly forceful and the pain is generally immediate.

Causation

A method for the determination of work-relatedness is discussed in detail in the ACOEM Work-Relatedness Guideline. For some of the hip conditions, acute, discrete traumatic events cause the condition (e.g., hip fracture). For those discrete, traumatic events, the location of the trauma determines causation; these are generally noncontroversial determinations of (non)work-relatedness.
For chronic disease states, the causal assessment is more complex and involves many steps, including determining the diagnosis, ascertaining workplace tasks, and epidemiological review of identified occupational risk factors.

Prevalence/Incidence

Hip osteoarthrosis is one of the most common and disabling musculoskeletal conditions, affecting millions of people worldwide [358]. The estimates of prevalence are higher when the definition relies on radiographs [359]. The reported prevalence of hip OA is 0.9 and 1.6 per 1000 per year in men and women, respectively [360]. The hospitalization rate for hip OA more than doubled from 1997 to 2009 [361]. The burden of hip OA has been growing over the past two decades and is projected to grow 174% by 2030 [358]. Studies have reported that the overall prevalence of hip OA is about 10.9% throughout the world, but ranges from 1% in Japan and China to 45% in Tasmania [362-364]. The prevalence of hip OA increases with age; some studies have also reported a 2- to 10-fold increase in the incidence and prevalence of hip OA between ages 30 and 65 years [358] [365]. Approximately 1.6 million hip fractures occur each year. The Incidence rate of meralgia paresthetica has been variously estimated at 4.3 per 10,000 per year [317] and 32.6 per 100,000 patient-years [318].

Work Relatedness

Acute hip injuries are sometimes related to a specific acute traumatic event. The location of the event determines work-relatedness and is usually noncontroversial. Most jurisdictions also request a physician opinion as to whether a

disease or disorder should be considered work related for the purpose of workers' compensation. These determinations are governed by regulations and case law precedents in a particular jurisdiction (workers' compensation system/state) and frequently differ between jurisdictions. For a reproducible method to determine work-relatedness, see the ACOEM Work-Relatedness Guideline. There are few quality epidemiological studies addressing work-relatedness of hip disorders. Thus, aside from these specific circumstances (e.g., occupational fractures and other acute trauma; osteonecrosis from barotrauma without other risk factors; hip osteoarthrosis in farmers), most opinions are speculative. In circumstances in which no specific trauma is present, it may be reasonable to consider a change in work tasks or altered work conditions.

Epididymo-orchitis

There are no prospective cohort studies or retrospective cohort studies of occupational physical factors for epididymo-orchitis. Thus, there are no quality studies on which to base the work-relatedness of noninfectious epididymo-orchitis. Acute sudden cases occurring with a heavy lift would generally not be controversial; otherwise, work-relatedness is speculative. Although most cases are due to either Gram-negative enteric bacteria or sexually transmitted diseases, select infectious etiologies may be due to occupational exposures, such as mumps in unvaccinated healthcare workers. One occupational infectious exposure with epididymo-orchitis as a potential presentation is brucellosis, although it usually presents with other systemic infectious problems (e.g., joint pain, fever) and may have many other systemic features [366, 367]. Occupations at increased risk of brucellosis include slaughterhouse workers, meat processing, farmers, veterinarians, and animal laboratory workers.

Femoroacetabular Impingement

There are no prospective occupational cohort studies of the development of femoroacetabular impingement (FAI) and no retrospective cohort studies of occupational factors. Thus, there are no quality studies on which to base work-relatedness of this condition. If FAI is a developmental abnormality based on teenage sports use [150, 151] (see Risk Factors above), then few cases may potentially be considered work-related. Theoretically, potential work-related cases would involve teenagers with prolonged, heavy forceful use before epiphyseal closure. In considering FAI as a syndrome and not a singular etiology, altered motor control and occupational exposure to new and challenging environments may need to be considered.

Greater Trochanteric Pain Syndrome (Trochanteric Bursitis)

There are no prospective cohort studies or retrospective cohort studies of occupational factors for greater trochanteric pain syndrome. Thus, there are no quality studies on which to base work-relatedness of greater trochanteric pain syndrome.

Gluteus Medius Tendinitis and Tears

No prospective cohort studies or retrospective cohort studies are available on the occupational factors for gluteus medius tendinitis and tears. Thus, there are no quality studies on which to base the work-relatedness of these conditions. Regardless of an absence of evidence, discrete accidents seem likely to be able to cause or materially aggravate these tears. It is theorized that forceful use may contribute to the condition; thus, this condition may be considered administratively occupational in some circumstances.

Groin Strains

True groin strains involve myotendinous strains in the groin. Similarly, sports hernias are also true strains, but instead involve the lower abdominal musculature. Symptoms are acute and occur with high force or intense exertion. These injuries are considered more analogous to acute injuries than diseases. The location of the high-force event determines whether the injury is considered work-related, and they are generally not controversial. Whether repeated, unaccustomed use may precipitate the event is unclear, but it is another purported mechanism. Thus, the nature of the forceful unaccustomed use also determines whether the condition is generally considered work-related.

Hip Dislocations, Fractures, and Sprains

Hip dislocations [191-193], fractures [237], and sprains are usually consequences of significant trauma. The mechanism(s) of trauma determines whether the condition is work-related. With nontraumatic dislocations, there is usually an inherited or congenital abnormality with a propensity towards recurrences. This also may occur as a complication of hip arthroplasty [368] [197, 369-373]. In situations where there is inherited dysplasia or prior hip arthroplasty, for example, dislocation may occur in the context of a work event. However, work-relatedness will be determined largely based on a specific jurisdiction's definition of work-relatedness in the setting of pre-existing, nonoccupational conditions.

Hip Dysplasia

Hip dysplasia is a nonoccupational condition. It may precipitate excessive intraarticular and extraarticular wear and disuse and may be associated with FAI and intraarticular impairments.

Hip Instability

Traumatic instability is not controversial because the location of trauma determines work-relatedness. Atraumatic instability is unlikely to be occupational. No quality studies have demonstrated an increased risk for instability from occupational tasks. Although a theory could be constructed for work-relatedness due to stereotypical use, factors are currently unclear.

Hip Osteoarthrosis

There are numerous non-occupational risk factors for hip OA, as reviewed previously. Unilateral hip osteoarthrosis as a consequence of a discrete occupational traumatic event (e.g., femur fracture) is considered occupational and is not substantially controversial [248, 249, 273, 374] [254].

No prospective cohort occupational studies have measured occupational factors and adjusted for all of the strongest nonoccupational factors. There are some retrospective studies, but none have measured occupational factors. Other retrospective studies generally focused on either job titles or self-reported job exposures of occupational factors. Thus, there are no quality studies on which to base work-relatedness of non-traumatic hip arthritis.

Farmers have been reported to have an elevated risk for hip osteoarthrosis [77, 273, 375-377], although one study was negative [363]. The reason that farming poses an increased risk has been unclear. There are no other occupations with consistent findings of work-relatedness. Studies about construction work conflict, with some reporting no association with hip OA [273] and others reporting an association [77]. Jobs requiring heavy lifting conflict somewhat, with most studies suggesting increased risk [77, 269, 273, 363, 378-380], others not suggesting increased risk [77], and others with conflicting data. Data also are mostly statistically negative for female workers. Jobs that require stair climbing conflict with studies suggesting increased risk of hip OA [77, 380], negative studies [363, 378] and one study with mixed results [273]. A study of runners found no greater prevalence of hip osteophytes and trended towards *greater* articular cartilage thickness on radiographs in runners compared with non-runners [381]. A population-based study from Denmark found a lack of increased risk for hip osteoarthrosis requiring arthroplasty with increased exposures by expert ratings incorporating standing/walking, sitting, whole body vibration, and heavy lifting ranging from low (e.g., office workers) and medium (e.g., nurses) to high risk (e.g, construction workers) [382].

Some studies suggest that hip OA is strongly related to abnormalities in hip morphology, especially cam and increased alpha angles [153, 154] [34, 261, 383, 384] [385] [149, 159, 262-265]. The magnitude of these risks is commonly reportedly to be 10- to 25-fold; thus, these are extremely strong risk factors [263]. There appear to be significant differences in risk between the sexes. A large population-based study found that more men than women have a hip deformity underlying their OA (71.0% vs. 36.6, respectively) [152]. Sex differences are also apparent in occupational studies, with greater and/or more consistent reports of risks of hip OA in men than women. Importantly, there is evidence that these changes develop in association with—if not directly as a consequence of—high-impact sports in youth [34, 151, 250, 261, 383, 384] [153, 154], sharply increasing the risk for hip OA. This would also provide a plausible mechanism for the finding in farmers (i.e., high-force use as a teen to accomplish farming tasks).

Job selection is not a random event. Individuals selecting careers that require high force (e.g., construction, firefighting, maintenance) naturally also tend to have larger muscle mass to be able to perform that work. Although quality evidence is lacking, these individuals would seem likely to have differentially participated in strenuous sports. Children may also seek and/or inherit the occupation of their parents, especially in farming [377].

No prospective cohort studies have measured sports activities prior to epiphyseal closure, hip morphology, or subsequent job factors to determine whether any occupational risks are true risk factors for hip OA. Confounding is highly likely without adjustment for these factors. The criticality is that adult job tasks would not be true risk factors, merely associated factors. Thus, job (re)design would have no effect on the incidence of hip OA.

The body of evidence currently suggests support for the theory that forceful use in youth with resultant development of abnormal cam morphology, alpha angles, and/or slipped capital femoral epiphyses may explain most cases of hip arthrosis [64, 386-388] [34, 149, 159, 261-265, 383, 384]. An occupation that would tend to track childhood activities, sports, and parents' jobs may then be an association but not a risk factor. Thus, whether there are true occupational risk factors for hip OA and/or whether occupational factors are effect modifiers is unknown.

Hip Osteomyelitis

Osteomyelitis in the hip is usually due to either an open fracture, a penetrating wound to the bone, or a postsurgical complication. The original event determines whether the osteomyelitis is considered work-related.

Hip Osteonecrosis (Avascular Necrosis)

The most widely known occupational factor for osteonecrosis is barotrauma ("the bends", caisson disease) [348-357]. Barotrauma may occur from excessively fast decompression while diving. Barotrauma also occurs from decompression after working in compressed air environments (e.g., tunneling projects through unstable sediments requiring compressed air to maintain the workspace). Significant, discrete trauma is a reported risk factor (e.g., unilateral fracture and unilateral osteonecrosis) [389, 390]. Other occupational physical factors are controversial [332]. It has been theorized that high-force or repeated activities are risk factors, but no quality epidemiological studies support the work-relatedness of osteonecrosis under those circumstances; thus, these risk factors are speculative. There is one case report of osteonecrosis from chronic aluminum exposure, but no quality studies to support this as a risk factor [391].

Labral Tears

No prospective cohort studies have evaluated occupational factors, nor have retrospective studies measured job factors. Like other cartilaginous tears in the body, most labral tears are likely degenerative, associated with hip OA [309-311], and thus unlikely to be work-related. Case studies suggest that labral tears may occur in those with high-force use, such as pediatric dancers [313], athletes [314], football players [315], and adult runners [316]. Thus, there may be theoretical support for some labral tears to be considered work-related. For tears that occur with an acute symptomatic onset due to a significant discrete event, work-relatedness is largely noncontroversial. When there is a symptomatic degenerative tear in the absence of trauma, work-relatedness is speculative.

Ligamentum Teres Ruptures

No prospective cohort studies have evaluated occupational factors, nor have retrospective studies measured job factors. A ligamentum teres rupture in the setting of a discrete traumatic occupational event may not be controversial. Other cases of possible work-relatedness are speculative.

Meralgia Paresthetica

No prospective cohort studies have evaluated occupational factors, nor have retrospective studies measured job factors. One case-control study included occupational factors as a variable, but it did not focus on them; it also provided unclear assessments and limited data on the occupational factors. The authors suggested that occupational exposure of seatbelt use, tight clothing, and/or standing for long periods of time (all apparently aggregated) were associated factors [322]. The rationale for standing being a risk was not provided, and standing is theoretically protective compared with sitting. Thus, there is scant information that there is an occupational basis

for meralgia paresthetica. Tight clothing and tool belts that apply significant pressure directly to the nerve are presumed to be risks, but epidemiological support is poor.

Trochanteric Bursitis

See Greater Trochanteric Pain Syndrome above.

Signs and Symptoms

Most hip and groin disorders share similar symptoms: pain in the hip, muscle stiffness, and pain in the leg. Signs of hip disorders include limping, reduced movement in the hip joint, and referred pain. Signs and symptoms for some hip and groin conditions may vary, as described in the following sections.

Epididymo-Orchitis

Epididymo-orchitis symptoms are focused on testicular tenderness in association with tenderness of the epididymis, possibly accompanied by inguinal pain. If the condition is non-infectious, there are generally no other symptoms or signs.

Groin Strain

Groin strain and sports hernia symptoms are characterized by focal, non-radiating pain in the area involved (inguinal or adductors). Signs are typically consistent with tenderness. With increasingly severe strains, additional findings include swelling, bruising, hematomas, and palpable muscle abnormalities and defects.

Femoroacetabular impingement (FAI)

Femoroacetabular impingement symptoms include anterior groin pain exacerbated by hip flexion, pain with prolonged sitting or squatting [392], and lateral hip pain (often described as a “C” sign) [35].

Greater Trochanteric Pain Syndrome (Trochanteric Bursitis)

Symptoms for greater trochanteric pain syndrome include pain and tenderness on the affected side, radiating pain, paresthesia, and pain when standing for more than 15 minutes [165] [393].

Hip Dislocation

Hip dislocation signs include posterior dislocation with leg flexed, adducted, and internally rotated. Anterior dislocations are exhibited with the leg in external rotation, abduction, and either extended or flexed [394]. Symptoms of hip dislocation include pain at the hip, pain with passive movement at the hip joint, inability to move the leg, and the inability to feel in the ankle area [129].

Hip Fracture

Signs of hip fractures may include bruising, swelling in and around the hip area, a shortened leg on the side of the injured hip, and external rotation (turning outward) of the lower extremity on the side of the injured hip. Additional symptoms include severe pain in the hip or groin, pain with passive movement at the hip joint, outer thigh pain or outer groin pain, and the inability to bear weight or move immediately after a fall [129] [395].

Hip Joint Infection

Signs of hip infection associated with orthopedic implants are persistent local pain, edema, erythema, wound healing disturbance, and hematoma. Systemic symptoms may be present, including fever, general muscle weakness, chills, and swelling [396] [397].

Hip Osteoarthrosis

Signs of hip osteoarthrosis may include tenderness of the hip joint, crepitus sound of rubbing joint, reduced range of motion, and the inability to move the hip for routine activities. Symptoms include joint stiffness after sitting or getting out of bed and pain with flexion or internal rotation of the hip [398].

Hip Osteomyelitis

Symptoms of hip osteomyelitis include nonspecific pain, fever, chills, swelling, erythema, bone pain, and drainage around the wound area. Signs of osteomyelitis include elevated leukocyte count, erythrocyte sedimentation rate, and C-reactive protein [399].

Osteonecrosis (Avascular Necrosis)

Symptoms of hip osteonecrosis may include pain in the hip or thigh during standing or walking [400]. Radiograph may show collapse of the femoral head, a band of sclerosis within the head, a subchondral crescent sign, narrowing of the joint space, and cyst-like translucency and sclerosis within the head.

Labral Tears

Symptomatic labral tears may present with anterior and medial inguinal pain, clicking that is reproductive of the primary pain complaint, and pain with resisted hip flexion.

Red Flags

Medical history and physical examination findings can alert the physician to other pathology that presents with pain or other constitutional symptoms. Certain findings ("red flags") may raise suspicion of serious underlying medical conditions (see Table 1. "Red Flags" for Other Potentially Serious Conditions Associated with Hip and Groin Pain*). Potentially serious disorders include infections, tumors, or systemic rheumatological disorders.

Table 1. "Red Flags" for Other Potentially Serious Conditions Associated with Hip and Groin Pain*

Disorder	Medical History	Physical Examination
Tumor/ Neoplasia (including metastases to the hip)	• Severe localized pain (often deep-seated, unrelenting bony pain) • History of cancer (at any point in the lifetime) • Age >50 years • Symptoms consistent with disease in a specific organ system (e.g., cough, change in bowel habit, epigastric pain, early satiety) • Constitutional symptoms, such as recent unexplained weight loss, fatigue • Pain that continues at night or at rest	• Pallor, reduced blood pressure, diffuse weakness • Tenderness over bony landmarks and percussion tenderness (other than greater trochanteric pain syndrome or groin strain) • New mass or tenderness • Abnormal pulmonary examination (crackles, wheezes, rhonchi, decreased breath sounds) • New findings at a distant site to the original complaints (e.g., distant painful bones)
Infection	• Constitutional symptoms, such as recent fever, chills, or unexplained weight loss • Recent bacterial infection (e.g., urinary tract infection), intravenous drug use, diabetes mellitus, or immunosuppression (due to corticosteroids, transplant, or HIV) • History of recurring infections treated with antibiotics (e.g., repeated urinary tract infections) • Foreign travel with exposure potential • Insect bites	• Fever, tachycardia, tachypnea, hypotension • Elevated white blood cell count (may be decreased in elderly or immunocompromised) • Shift in the white blood cell differential towards immature cells ("left shift") • Abnormal urinalysis [401] • Abnormal body part examination (e.g., pulmonary)[401] • Tenderness over bony landmarks
Progressive Neurologic Deficit	• Severe spine or extremity pain • Progressive numbness or weakness • Complaints of new clumsiness of gait	• Significant and progressive dermatomal and/or myotomal (motor) involvement • Evidence of cauda equina (urinary retention or bowel incontinence) • Hyperreflexia or other evidence of myelopathy

Disorder	Medical History	Physical Examination
Rheumatologic Disease	• Diffuse arthralgias • Prior arthropathy • Skin changes, lesions, or ulcers • Fatigue, malaise • Subtle mental status changes	• Polyarticular joint effusions (usually with warmth) • Radiographic abnormalities consistent with erosive or degenerative pathology • Elevated sedimentation rate (ESR) or C-reactive protein (CRP) • Hematuria, proteinuria • Other specific abnormalities as appropriate (e.g., ANA, RF, anti-DNA, C3, anti-Ro, anti-La, oral ulcers, pulmonary abnormalities, ophthalmological involvement, dermal abnormalities)
Testicular Torsion	• Acute onset testicular and groin pain	• Tenderness • Loss of blood flow on ultrasound
Ectopic Pregnancy	• Acute onset lower abdominal or groin pain	• Pregnancy test • Vaginal ultrasound

*This list is not meant to be comprehensive; rather, it is a review of the more common suggestive historical and examination findings.

Absence of Red Flags

In the absence of red flags, the evaluation of a patient with hip or groin disorders may progress as noted in the Diagnosis section.

The absence of red flags largely rules out the need for special studies, referral, or inpatient care during the first 4 to 6 weeks for most patients, by which point spontaneous recovery is expected.

Diagnosis

Initial Assessment

The history, physical examination, and radiographs will effectively diagnose most hip disorders. If the diagnosis of a hip and groin disorder remains unclear, magnetic resonance imaging (MRI; with or without gadolinium) is generally the imaging method used to diagnose most other intraarticular and extraarticular pathologies [402, 403]. Other imaging techniques include ultrasound [404], computed tomography (CT) imaging, postoperative radiography [405], and magnetic resonance and CT arthrography [406].

The physician performing an initial evaluation of a patient with hip or groin pain should seek a discrete explanatory diagnosis. A careful, thorough history is required. A review of systems that also involve the knee, spine, abdomen, and genitourinary tract is necessary. The examination of a patient with hip or groin pain generally needs to focus on the hip joint and include relevant neighboring structures similar to the review of systems. Medical history and physical examination findings can alert the physician to other pathology that presents with pain or other constitutional symptoms. Certain findings ("red flags") raise suspicion of serious underlying medical conditions (see Table 1. "Red Flags" for Other Potentially Serious Conditions Associated with Hip and Groin Pain*). Potentially serious disorders include infections, tumors, or systemic rheumatological disorders.

Diagnostic Criteria

The criteria presented in Table 2. Diagnostic Criteria for Non-"Red Flag" Conditions follow the clinical thought process from the mechanism of illness or injury to unique symptoms and signs of a particular disorder and finally to test results (if tests are needed to guide treatment at this stage).

Table 2. Diagnostic Criteria for Non-"Red Flag" Conditions

Probable Diagnosis or Injury	Symptoms	Signs	Tests and Results
Hip Osteoarthrosis	Nonradiating hip pain. Morning stiffness or stiffness on standing after sitting <1 hour. Sleep disturbance sometimes present; mood disturbance usually not present. Often other affected joints.	Range of motion (ROM) generally reduced, especially hip internal rotation. May be normal when mild.	Radiographs usually ordered to help secure diagnosis. Other diagnostic tests only if targeting the specific body part and there is a potential for meaningful intervention.
Hip Dislocation	Inability to bear weight. Acute onset associated with forceful event or accident. Recurrent problem if congenital.	Unable to bear weight. Lower extremity shortened and externally rotated.	Hip radiographs usually ordered. Other testing usually not necessary.
Hip Fracture	Fall or motor vehicle collision. Severe pain. Unable to bear weight.	Unable to bear weight. Lower extremity shortened and externally rotated.	Radiographs required. Other testing usually not necessary in acute treatment setting.
Labral Tears	Nonradiating groin pain with ROM. Typically provoked with specific, predictable activities, such as specific position(s). May have buckling, clicking, catching. Pain may be worse with pivoting and walking.	Variable findings; pain reproducible on ROM. Extent of ROM often restricted. Pain reproduced with hip into extension from flexion. Pain with hyperflexion, internal rotation, and adduction (impingement position) is present in most cases. Pain and/or click may also be reproduced with the labral stress test and/or with resisted straight leg raise.	Radiographs are often ordered. MRI is sometimes ordered, and MR arthrography is often helpful.
Hip Osteonecrosis	Nonradiating hip pain. History of systemic factors (e.g., diabetes mellitus, alcohol).	Reduced ROM and pain with passive ROM usually present. May have pain with weight bearing. May be unable to bear weight if osseous collapse has occurred.	Radiographs required. MRI and CT may be ordered for further evaluation of the femoral head. Bone scans are sometimes ordered, particularly for evaluation of other joints.
Femoroacetabular Impingement	Nonradiating groin pain. Pain is often positional and worse with activity. Pain with hip flexion and internal rotation.	Decreased internal rotation and adduction with hip flexed to 90 degrees. Positive impingement test (pain with passive adduction and gradually internally rotating the flexed hip).	Radiographs usually ordered. MRI and MR arthrography helpful.

Probable Diagnosis or Injury	Symptoms	Signs	Tests and Results
Gluteus Medius Tears	Nonradiating hip pain. May have weakness, especially with more acute tears.	Abnormal gait with inability to stabilize pelvis. Tender over greater trochanter. ROM usually reduced. Qualitative muscle strength weakness.	Radiographs usually ordered. MR helpful.
Greater Trochanteric Pain Syndrome	Nonradiating hip pain. Pain increased when lying on the affected side or stair climbing. Pain worse with activity.	Tender to palpation over the greater trochanter. Pain with hip ROM. Extent of ROM usually normal. Antalgic gait sometimes present and increased pain with stair climbing.	Radiographs sometimes ordered. Other testing usually not required for short-term and mild cases. MRI sometimes helpful.
Groin Strains and Sports Hernias	Focal pain in the muscle-tendon junction affected. May have epidydimal pain if inguinal area is involved. Pain in the adductor if an adductor strain, and lower abdominal musculature for sports hernias. Generally history of very forceful use for adductor strain.	Patients avoid use or movement. Focal tenderness at affected myotendinous junction. Muscular defect if complete rupture, usually with hematoma at rupture site. Reduced qualitative strength. Those with epididymo-orchitis may have epididymal tenderness	No testing usually ordered. Sometimes, x-ray and MRI are needed. See also epididymo-orchitis below re. sexually transmitted disease workup for that mechanism.
Epididymo-orchitis	Testicular pain, often accompanied by inguinal pain. History of onset with heavy lifting if "groin strain" type mechanism. History of urethral discharge and sexually transmitted disease risk factors if infectious etiology.	Unilateral tender testicle and epididymis. May have tenderness in ipsilateral inguinal canal and over the entrance to the inguinal canal. For infectious mechanism, urethral discharge may be visible.	No testing is usually ordered for an inguinal strain type of mechanism. Sexually transmitted disease workup should be ordered for patients with that mechanism.
Hip Dysplasia	May be asymptomatic other than with dislocation or instability. Pain is in groin and may have symptoms with specific positions.	Pain reproduced with impingement sign. Pain reproduced with hip hyperextension or placing hip in the FABER position. Increased ROM of both hips may be present, but affected hip has altered motion, often limited by pain.	Radiographs are usually ordered and often sufficient for diagnostic purposes.

Probable Diagnosis or Injury	Symptoms	Signs	Tests and Results
Hip Instability	Dislocation may have occurred. May have subjective weakness.	ROM may be increased and findings present for ligamentous laxity. Increased hip external rotation (in extension during log roll or in flexion such as the FABER maneuver).	Radiographs are usually ordered. MRI may be helpful.
Ligamentum Teres Ruptures	May be asymptomatic or have experienced pain if there was a ligament tear with a discrete traumatic event. Event usually involved exaggerated adduction and external rotation or abduction.	Exam is usually normal in the absence of other findings. May accompany osteoarthrosis; thus, those exam findings may be present.	Radiographs are usually ordered. MRI may be helpful.

Adapted from Rondinelli RD (Ed.). *Guides to the Evaluation of Permanent Impairment, Sixth Edition*. Chicago, Ill: AMA Press; 2008; and Sanders SH, Harden RN, Vicente PJ. Evidence-based clinical practice guidelines for interdisciplinary rehabilitation of chronic nonmalignant pain syndrome patients. *Pain Prac*. 2005;5(4):303-15.

Classification

Hip disorders may be classified into one of three somewhat arbitrary categories:

- **Potentially serious conditions:** Potentially serious conditions include fractures, hip dislocation, infection, or neurological or circulatory conditions, as well as referred sacral, thoracic, cardiac, or intraabdominal pain. Hip dislocations are considered serious until they are confirmed to not involve a concomitant fracture or nerve damage.
- **Specific hip disorders:** Specific hip disorders include labral tears, femoroacetabular impingement (FAI), avascular necrosis, gluteus medius tendinosis or tears, hip dysplasia, hockey groin syndrome, piriformis syndrome, deep vein thrombosis, irritable hip syndrome, greater trochanteric pain syndrome, ligamentum teres ruptures, hamstring tendon rupture, osteochondral lesions, hip instability, and hip destruction lesions.
- **Other hip disorders:** Other hip disorders suggest neither internal derangement nor referred pain, including trigger points/myofascial pain (including muscle tension syndrome), complex regional pain syndrome (see the ACOEM Chronic Pain Guideline), hip degenerative joint disease (including osteoarthrosis), and nonspecific pain.

Formal classification has been established for the following hip and groin disorders.

Hip Pain

Hip pain is classified into three categories: acute, subacute, and chronic. Acute pain persists for less than 1 month, subacute pain persists for 1–3 months, and chronic pain persists for >3 months. Other common hip pain functional classification systems include the Harris Hip Score [146], Hip Outcome Score [147], and WOMAC [148].

Femoroacetabular Impingement Syndrome

Femoroacetabular impingement syndrome is classified into two types: cam impingement and pincer impingement, which may be distinguished by the type of osseous and chondral impairment present. Jamming of the femoral head causes cam impingement, whereas linear contact of femoral head and acetabular rim cause pincer impingement [407] [408] [156] [157] [35].

Hip Dislocation

Hip dislocations may be classified by the cause of dislocation. Type I is a positional dislocation, type II is soft tissue imbalance, and type III is component malposition [409]. Dislocation may also be classified by the direction of the dislocation [410].

Hip Fracture

Hip fractures are classified by radiographs into either an intracapsular or an extracapsular fracture. Hip fractures can be further categorized depending on the level of fracture, displacement, and comminution [411, 412].

Hip Infection

Hip infections are generally classified by joint involvement. Extraarticular infections are usually considerably less serious. Further classification is not widely used clinically, but intrarticular infections may be further classified into four stages. Stage I has opacity of fluid, red synovial membrane, and possible petechial bleeding. Stage II has severe inflammation, fibrinous deposition, and pus. Stage III shows thickening of the synovial membrane and compartment formation. Stage IV shows aggressive pannus with infiltration of cartilage, undermining of the cartilage, radiographic signs of subchondral osteolysis, and possible osseous erosions and cysts [413].

Hip Osteoarthrosis

Hip osteoarthrosis is classified by grading severity using radiographs and pain level. Radiographic findings may not be accompanied by significant pain. The condition may also be classified by including functional components. The most commonly used scoring system may be the WOMAC [148].

History

The initial evaluation of patients with hip or groin pain should include a thorough medical history (see Medical History Questionnaire); the vast majority of data to successfully evaluate and treat these patients is historical. A complete occupational history is necessary to help establish work-relatedness, as well as to assist with successful accommodation and rehabilitation. Hip joint pathologies have varying clinical presentations, with pain experienced in various joints and body regions documented by fluoroscopically guided intraarticular bupivacaine injection (see Table 3. Frequency of Pain Referral to the Buttock, Thigh, Groin, Leg, Knee, and Foot) [414]. Other data from patients awaiting hip arthroplasty have suggested pain referral patterns to the groin, anterior thigh, and knee [415-421]. Pain referral patterns are highly variable; thus, physicians must have a clinical suspicion for hip joint pathology to properly evaluate and diagnose hip disorders.

Table 3. Frequency of Pain Referral to the Buttock, Thigh, Groin, Leg, Knee, and Foot

Anatomic Region	Patients with Pain (%)
Buttock	71
Thigh	57
Anterior	27
Lateral	27
Posterior	24
Medial	16
Groin	55
Leg	16
Lateral	8
Posterior	8
Anterior	4
Medial	2
Foot	6
Knee	2

From Lesher JM, Dreyfuss P, Hager N, Kaplan M, Furman M. Hip joint pain referral patterns: a descriptive study. *Pain Med*. 2008;9(1):22-5.

Medical History Questionnaire

The initial evaluation of patients with hip or groin pain should include a thorough medical history, as the vast majority of data to successfully evaluate and treat these patients is found in the history. A complete occupational

history is necessary to assist the patient with successful accommodation and rehabilitation, as well as determine work-relatedness.

1. *What may I do for you today?*
2. *What are your symptoms?*
   - Where are your symptoms?
   - Do they radiate or travel?
   - Do you have symptoms somewhere else?
   - When did your symptoms begin?
   - What activities make you worse or better?
   - Do you have pain or stiffness?
   - Do you have clicking or popping in your hip?
   - Do you have numbness or tingling?
   - Have you lost control of your bowel or bladder?
   - Do you have fever, night sweats, or weight loss?
   - Are your symptoms constant or intermittent? What makes the problem worse or better?
   - Is there a pattern to your pain? For example, is it better getting out of bed in the morning, during the morning, mid-day, evening, or asleep? When is it worst? Do you have a problem sleeping? What position is most comfortable?
   - Since these symptoms began, have your symptoms changed? How?
   - How does having this pain affect your life?
3. *How did the condition develop?*
   - Have you had similar episodes or problems previously?
   - Have you had previous testing or treatment? What treatment? What were the results? With whom? How long did it take to get back to work? To modified or light duty? (Was recovery similarly delayed?)
   - Did you receive a disability or impairment rating?
   - Was recovery complete? (Did you get a disability award?)
4. *Discuss symptom limitations.*
   - How do these symptoms limit you?
   - If these symptoms limit you, how long have your activities been limited?
   - How long can you sit, stand, walk, and bend?
   - Can you lift? How much weight can you lift (use gallons of milk, groceries, etc., as examples)?
   - How much can you push or pull?
5. *Cause*
   - What do you think caused the problem?
   - How do you think it is related to work?
   - Were you doing anything at that time when your symptoms began? (It is important to obtain all information necessary to document the circumstances and biomechanical factors of injury to assist the patient in obtaining compensation, where appropriate.)
   - Did your symptoms begin gradually or suddenly? Did you notice the pain the day after the event?
   - Did you slip, trip, fall, twist, jerk, or strike an object?
   - For traumatic injuries: Was the area deformed? Did you lose any blood or have an open wound?
6. *Job Characteristics*
   - What are your specific job duties?
   - What are your work hours and breaks?
   - Do you rotate jobs?
   - How long do you spend performing each duty on a daily basis?

- Do you have assistance of other people or lifting devices?
- What do you do for work/modified duty?
- What is the hardest part of the job for you to do with your injury? Why?
- How much do you lift at work as a maximum? Usual lift?
- How much do you sit during the day?
- How much do you squat during the day?
- How many minutes/hours do you commute each day?
- What was your previous job? What were those occupational factors?

7. *Nonoccupational Activities*
   - What other activities (hobbies, workouts, sports) do you engage in? At home or elsewhere? (For suspicion of hip osteoarthrosis: What prior activities did you engage in? What prior jobs?)
   - Describe your current daily activities by explaining your activities from awakening to bedtime?
   - Any heavy lifting? How? How often?
   - Can you perform activities of daily living (e.g., dressing, bathing, grooming, etc.) or instrumental activities of daily living (e.g., shopping, food preparation, housekeeping, etc.)?
   - Could these have contributed to the development of pain?
8. *Assess treatments and how the responses may or may not have differed from expected outcomes.*
   - What treatments have you had?
   - Did anything help decrease your symptoms? What and for how long?
   - Are you doing any exercises at home? Which ones? How often?
   - Are you taking any non-prescription medications and supplements?
9. *Are there other medical problems? For example:*
   - Osteoarthrosis (including elsewhere, e.g., hands), rheumatoid arthritis, or other arthritides
   - Fractures, lower extremity surgeries
   - Cardiovascular disease
   - Pulmonary disease
   - Gastrointestinal problems
   - Diabetes mellitus
   - Neurological disorders (including radiculopathies, headaches)
   - Psychophysiologic disorders (e.g., irritable bowel syndrome, chronic fatigue syndrome, sick building syndrome, fibromyalgia, and multiple chemical sensitivity)
10. *Is there any psychological, psychiatric, mental health, substance use, alcohol, or tobacco disorder history?*
    - Have you ever had a substance use problem? DUI? Detoxification?
    - Have you ever had an alcohol problem? (CAGE or MAST screening especially required for possible osteonecrosis)
    - Is there tobacco use? Prior use? (Assess number of packs per day/number of years)
    - Is there use of other drugs? (Current and prior use)
11. *What is the occupational psychosocial context?*
    - Do you like your job?
    - What is your relationship with your co-workers and supervisor and how do they treat you?
12. *Assess whether there are problems at home/social life. Does the patient feel in control of most situations? Is there support?*
    - How do your family members get along with each other?
    - How do they help and support you, including assistance with chores?
    - Does your family treat you differently now that you are in pain? Have your roles at home changed because of your injury?

- How do your friends treat you differently?
- Do you get increased symptoms when you are dealing with problems with your family and friends? How often? When? Why?

13. *Are there advocagenic (litigious) influences?*
    - Do you have a workers' compensation claim for this injury?
    - Do you have a lawsuit or other legal action involving this pain problem?

Physical Examination

The objective of the physical examination of the hip is to help define any physical abnormalities and narrow the diagnostic considerations to ultimately help focus the treatment plan. Physical examination data, including vital signs, should be reviewed for potential inferences regarding infectious or neoplastic origins.

The physical examination should begin the moment the physician sees the patient. Observing how the patient sits, walks, and moves is of major importance—often, of more importance than any other aspect of the examination. It also helps to have the patient demonstrate what positions seem to provoke or cause the symptoms, as the demonstration is invariably of greater help than verbal descriptions.

Guided by the medical history, the physical examination includes the following:

- General observation of the patient, including changes in positions, stance, and gait
- Regional examination of the hip and inguinal/groin areas
- Examination of organ systems related to appropriate differential diagnoses
- Neurologic screening
- Testing for various specific hip and groin disorders
- Monitoring for pain behavior during range of motion or changing postures as clues to the origin of the problem

Most of the hip examination is not purely objective. There is generally an element of cooperation for the determination of strength or active range of motion, and most maneuvers require a subjective statement of pain to be considered positive. However, atrophy, fasciculations, and extremity length discrepancies are all wholly objective measures.

It is frequently helpful to obtain measurements of the patient's capabilities in the clinic to follow in subsequent clinic visits. These may include the following:

- Walking distance (observe in the hallway or outdoors and subsequently simultaneously interview the patient about their progress if a longer walking ability is demonstrated)
- Ability to climb stairs (walking to the nearest stairwell with the patient and observing capabilities)
- Repeated toe raises (number able to perform)
- Distance of heel walking
- Squats (number)
- Sensory examination findings (e.g., monofilaments)
- Movement inconsistent while in exam room with pain/injury problem

This also moves the examiner from the role of a more passive observer to a more active team leader, resulting in more informed decision making on exercise and other physical activity benchmarks. Active involvement of the provider is believed to be helpful to facilitate the patient's recovery [422]. The use of validated functional assessment tools to follow patient progress is recommended.

Physical examination findings vary largely with the severity and acuity of the disorder. Generally (but not always), conditions that arise acutely present with more pronounced physical examination findings. Patients with long-standing conditions have less prominent physical examination findings.

Epididymo-orchitis

Physical examination findings of epididymoorchitis consist of unilateral epididymal tenderness with or without testicular tenderness. Dysuria, discharge, or abnormalities are not found on urinalysis if the condition is noninfectious.

Femoroacetabular Impingement (FAI)

FAI patients have variable physical examination findings that include decreased internal rotation and adduction with the hip flexed to 90 degrees. Patients usually have a positive impingement test (pain with passive adduction and gradual internal rotation of the flexed hip) [35].

Gluteus Medius Tears

Patients with a relatively acute onset tear of the gluteus medius have an abnormal gait because they are unable to horizontally stabilize their pelvis. Tenderness over the greater trochanter may be present and range of motion is usually reduced. Qualitative muscle strength weakness is present in eccentric hip external rotation at end range and while stepping down off a box; this tends to be worse with larger tears. On a chronic basis, the compensatory mechanisms of the surrounding muscles help to minimize the abnormalities found on physical examination.

Greater Trochanteric Pain Syndrome

Tenderness is invariably present over the greater trochanter. Pain is also usually present with hip range of motion. The total extent of the hip range of motion is usually normal.

Groin Strains and Sports hernias

Patients with groin strains and sports hernias avoid use or movement of the affected myotendinous junction, which is also focally tender on examination. If there is a complete rupture, there is a muscular defect and findings of a hematoma usually form acutely. Patients tend to have reduced qualitative muscle strength.

Hip Dislocations, Fractures, or Sprains

Patients with acute dislocations or fractures are unable to bear weight. Both of these conditions tend to have a shortened lower extremity that is usually externally rotated. Patients with sprains are able to bear weight and use the joint, although pain is present.

Hip Dysplasia

In hip dysplasia, pain is often reproduced with the impingement sign. Pain is reproduced with hip hyperextension or by placing the hip in the FABER position. Increased range of motion of both hips may be present; however, the affected hip has less motion, often limited by pain.

Hip Instability

In cases of hip instability, range of motion may be increased and findings may be present for ligamentous laxity. Patients tend to have increased hip external rotation (in extension during the log roll or in flexion, such as the FABER maneuver).

Hip Osteoarthrosis

The physical examination for rheumatological issues should include an evaluation of all relevant joints as well as a comprehensive musculoskeletal examination. Common joints for abnormalities must be examined (DIP, PIP, MCP, wrist, shoulder, spine, hip, knees, great toe MTP), with a low threshold for an examination of other joints not listed. This examination should include observation, inspection, function, gait, palpation, active and passive range of motion, and strength and stretch reflexes. The evaluation should attempt to detect whether signs of degenerative joint disease are present despite the absence of complaints (e.g., Heberden's nodes, crepitus on range of motion of the knee in a patient with hand and hip complaints). These signs may provide evidence for a systemic arthropathy (whether osteoarthrosis or not). For example, the presence of warmth and mild tenderness over the MCP joints may indicate rheumatoid arthritis. These diagnostic clues have substantial long-term implications for successful secondary prevention. The threshold for a comprehensive rheumatological examination should generally be low, especially if arthritic issues are present in multiple joints. Range of motion is generally reduced (especially hip internal rotation and flexion), although it can be normal when mild.

Hip Osteonecrosis (Avascular Necrosis)

The physical examination findings of patients with osteonecrosis usually include reduced range of motion and pain with passive range of motion. There may be pain with weight bearing. Patients may be unable to bear weight if the avascular bone has collapsed.

Labral Tears

Labral tears present with variable findings. Pain may be reproducible on range of motion. The extent of the range of motion is often restricted. Pain may be reproduced by placing the hip into extension from flexion, especially if with rotation. Pain is present in the majority of cases with hyperflexion, internal rotation, and adduction (impingement position). The pain and/or click may also be reproduced with the labral stress test and/or with a resisted straight-leg raise.

Ligamentum Teres Ruptures
The physical examination is usually normal in the absence of other findings. Because this condition may accompany osteoarthrosis, those examination findings may be present.
Lower Abdominal Strains
The physical examination findings consist of focal tenderness in the affected muscle. Generally, there are no other findings on examination, although on occasion these strains may accompany epididymo-orchitis.
Meralgia Paresthetica
Patients with meralgia paresthetica have reduced sensation in the distribution of the lateral cutaneous nerve to the thigh.
Trochanteric Bursitis
See Greater Trochanteric Pain Syndrome and Gluteus Medius Tears.

Follow-up Visits

Groin Strain presenting as Epididymo-Orchitis
Patients with groin strains presenting as non-infectious epididymo-orchitis generally require follow-up for approximately 2 weeks. A few severe cases require further follow-up beyond that time, especially if complicated.
Femoroacetabular Impingement
Some physicians recommend early surgery for patients with FAI, particularly to prevent the development of arthritis [423]. Thus, time is thought to be important [424]. If surgery is not planned, then follow-up visits will often occur over approximately 1 year to ascertain stability and resolution of pain and/or impairments, along with therapeutic interventions to establish exercise and management strategies. See the section below on Hip Surgery for more information on follow-up visits.
Gluteus Medius Tears
Gluteus medius tears are generally followed over a period of months, with specific motor retraining in therapy. Depending on the clinical severity, therapy may be implemented and the patient may be followed for several months. In some cases, surgery is performed (see the section below on Hip Surgery for analogous information).
Groin Strains and Sports Hernias
Groin strains and sports hernias are followed over a period of a few weeks to months. Mild strains generally resolve within a few weeks and require no further care. Moderate strains may require more care, including therapy. Surgery is generally performed for severe groin strains with completely torn muscles (see the section below on Hip Surgery for analogous information).
Hip Bursitis
Recovery times from hip bursitis depend on the severity of the injury [425]. Follow-up is recommended if the bursitis is severe in nature.
Hip Dislocations
Hip dislocation occurs when the femoral head is pushed forwards or backwards out of a socket. It typically takes 2 to 3 months for the hip to heal after a dislocation. Rehabilitation time is affected by associated complications such as nerve injury, osteonecrosis, and arthritis. Reductions in hip-related use may be recommended for several weeks to attempt to protect the hip from another dislocation [426]. Children with developmental hip dislocation (dysplasia) should be followed-up for radiographs until the child's growth is complete [427, 428]. Follow-up has also been recommended 3 months after hip dislocation to screen for osteonecrosis [394].
Hip Dysfunction
Different forms of hip dysfunction such as hip muscle weakness (atrophy), hip functional limitation, and gait abnormalities tend to occur after hip surgery [429]. Patients with hip osteoarthrosis may also have these types of dysfunction [430]; refer to the Hip Surgery, Hip Osteoarthrosis, Hip Fractures, and Hip Dislocations sections for more information on follow-up visits. Gait and balance disorders are more common in older adults and are a major cause of falls in this population. It is often helpful to ask older patients (especially those who are frail or vulnerable) at least annually about falls; furthermore, ask about or examine for difficulties with gait and balance at least once [431].

Hip Fractures

In most cases, a patient with a hip fracture will undergo surgery [432]. Most patients will regain a majority of their mobility and independence months after surgery and physical therapy [129]. For patients with excellent results, follow-up beyond 1 year is generally not necessary. Please see the section below on Hip Surgery for further details.

Hip Infections

Hip joint infections may occasionally occur due to joint seeding without preceding trauma or surgery. More commonly, hip joint infections occur after arthroplasty. Because the number of total joint arthroplasties performed is rising sharply [433], there is also a rise in infectious complications [425, 434-436]. Hip infection can develop around artificial implants or in open wounds. It can also develop during hospital stays, after returning home postsurgery, and even several years after surgery. Incision care is important after surgery to prevent some of these infections.

Hip Osteoarthrosis

Due to the chronic nature of osteoarthrosis, patients diagnosed with hip OA should generally visit a physician regularly [437, 438] for monitoring and addressing of modifiable factors (e.g., weight loss), which may alter the course of the disease. Initial treatments include self-management programs, specific physical therapy interventions, and medications [439]. Monitoring will also help track treatment progress and help a physician determine when a new or more invasive treatment is necessary. Follow-up time is dependent on the treatment type.

Hip Osteonecrosis

Timely follow-up is important when assessing osteonecrosis to attempt to prevent the need for surgical procedures [424]. Frequent follow-up is recommended to evaluate and modify potential risk factors to attempt to prevent collapse. A coring procedure may be attempted to avoid arthroplasty. Patients with osteonecrosis can recover with core depression procedures within 3 months.

Hip Pain

Patients experiencing hip pain may not require long-term follow-up if symptoms are mild or moderate and the condition is relatively benign. If symptoms become severe, physicians may conduct various diagnostic tests to determine a more specific reason for the pain, such as a fracture or tear.

Hip Replacement

Short-term postoperative follow-up visits are important to evaluate and address functional progress. Most individuals will remain in the hospital for 1–3 days postsurgery [440, 441], although younger, healthy patients are increasingly released the day of surgery. Patients should see their surgeon within 4–6 weeks to be cleared for participation in light or normal daily activities [440, 441]. Ongoing follow-up for at least the first year is generally recommended. Most patients have excellent outcomes; thus, follow-up beyond 1 year in such patients is of unclear benefit. Hip replacements are designed to last between 10 and 20 years [440] [442], although registry data suggest most last over 20 years [443-446]. Nevertheless, some physicians prefer ongoing annual follow-up for unanticipated conditions (e.g., mechanically-assisted crevice corrosion (aka, trunnionosis) and failure of devices (some dual-modular neck designs) that may be symptomatically silent for an extended period of time but lead to osteolysis, soft-tissue destruction and systemic effects that would not otherwise be detected but through routine clinical and radiographic surveillance.

Hip Strains

The recovery time from a hip strain depends on the severity of the injury. Follow-up is recommended if the hip strain is severe in nature.

Hip Surgery

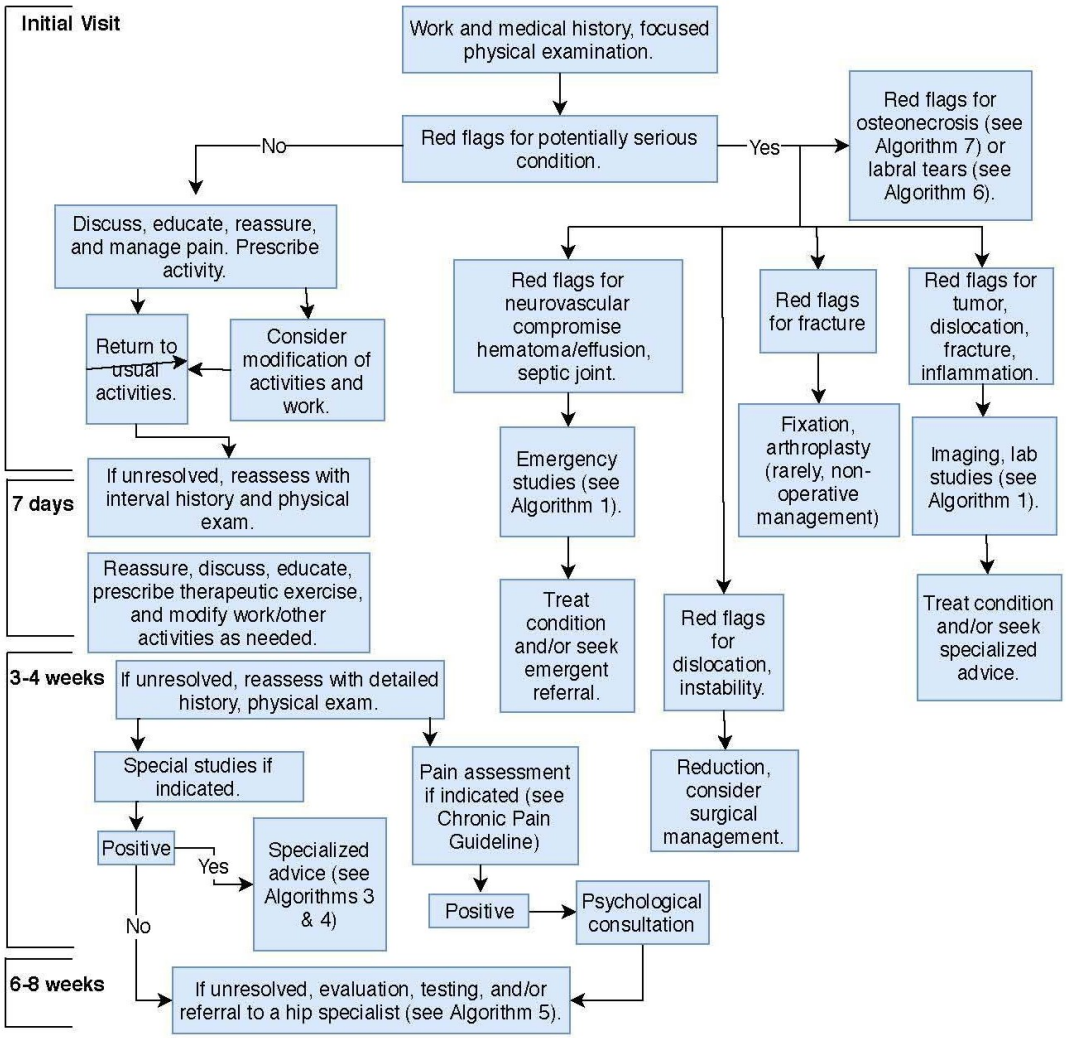
Postsurgical follow-up generally ranges between 6 and 12 weeks to examine the healing process [447]. After this period, patients should routinely see their orthopedic surgeon for examinations and radiographs [448] until there is stabilization or a healing plateau. Significant functional loss in joint and muscle function is often present after hip surgery; thus, specific rehabilitative interventions are often necessary to restore function.

Labral Tears

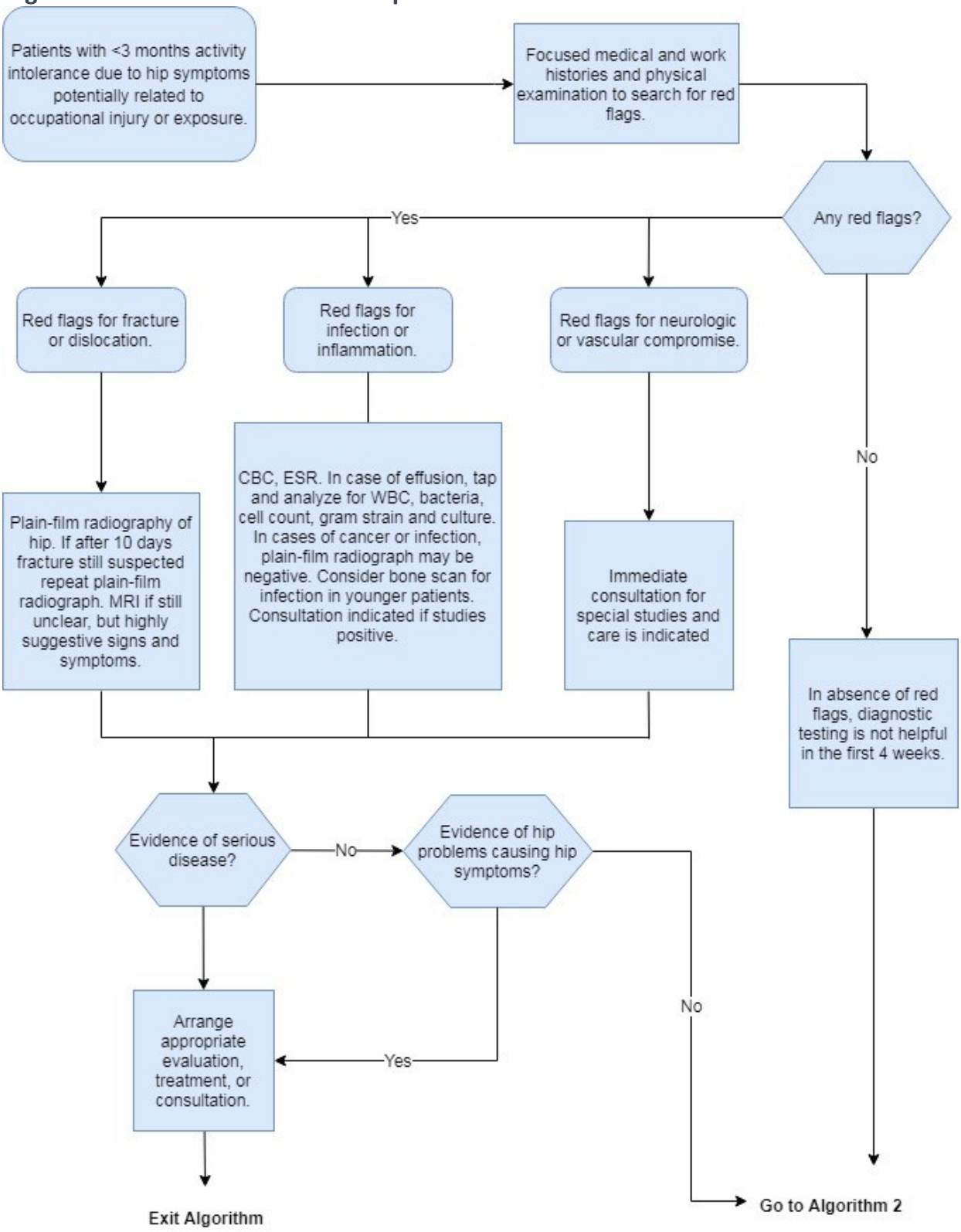
Labral tears are generally initially followed over a period of several weeks to ascertain whether they will resolve without surgical intervention. A failure to respond to nonoperative care indicates a higher likelihood of requiring surgical repair (see also Hip Surgery above).

Algorithms

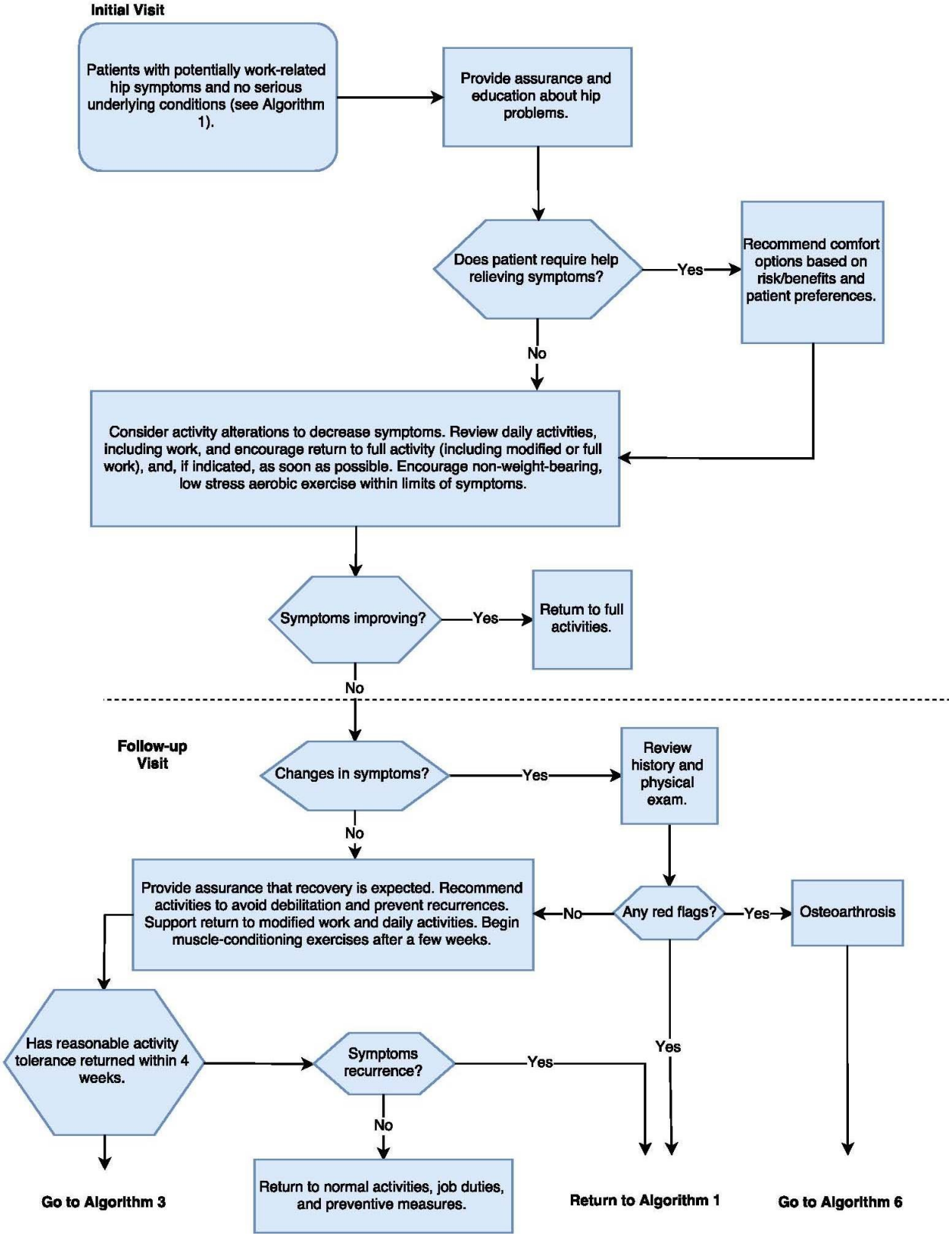
Master Algorithm. ACOEM Guidelines for Care of Acute and Subacute Hip Disorders



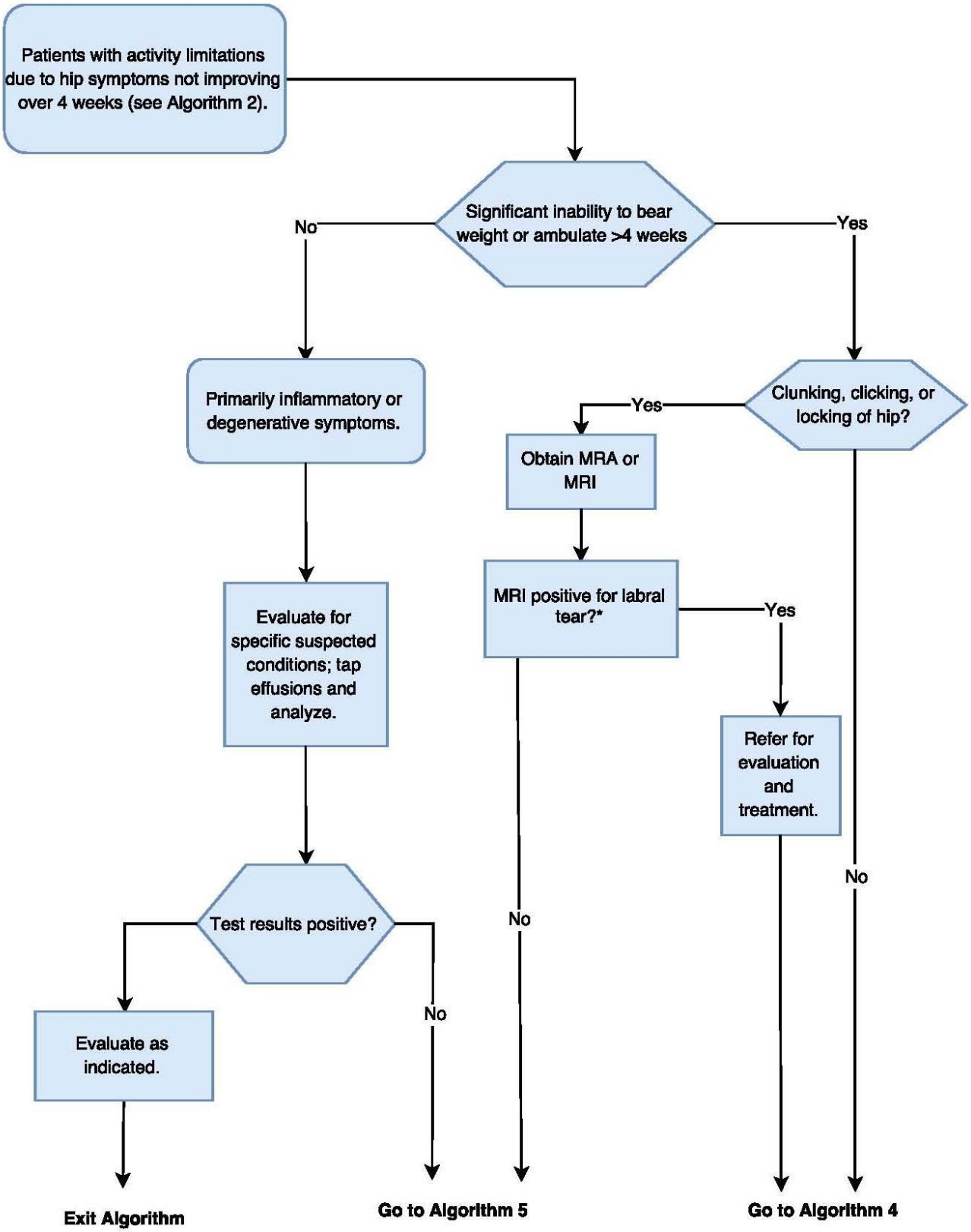
Algorithm 1. Initial Evaluation of Hip and Groin Disorders



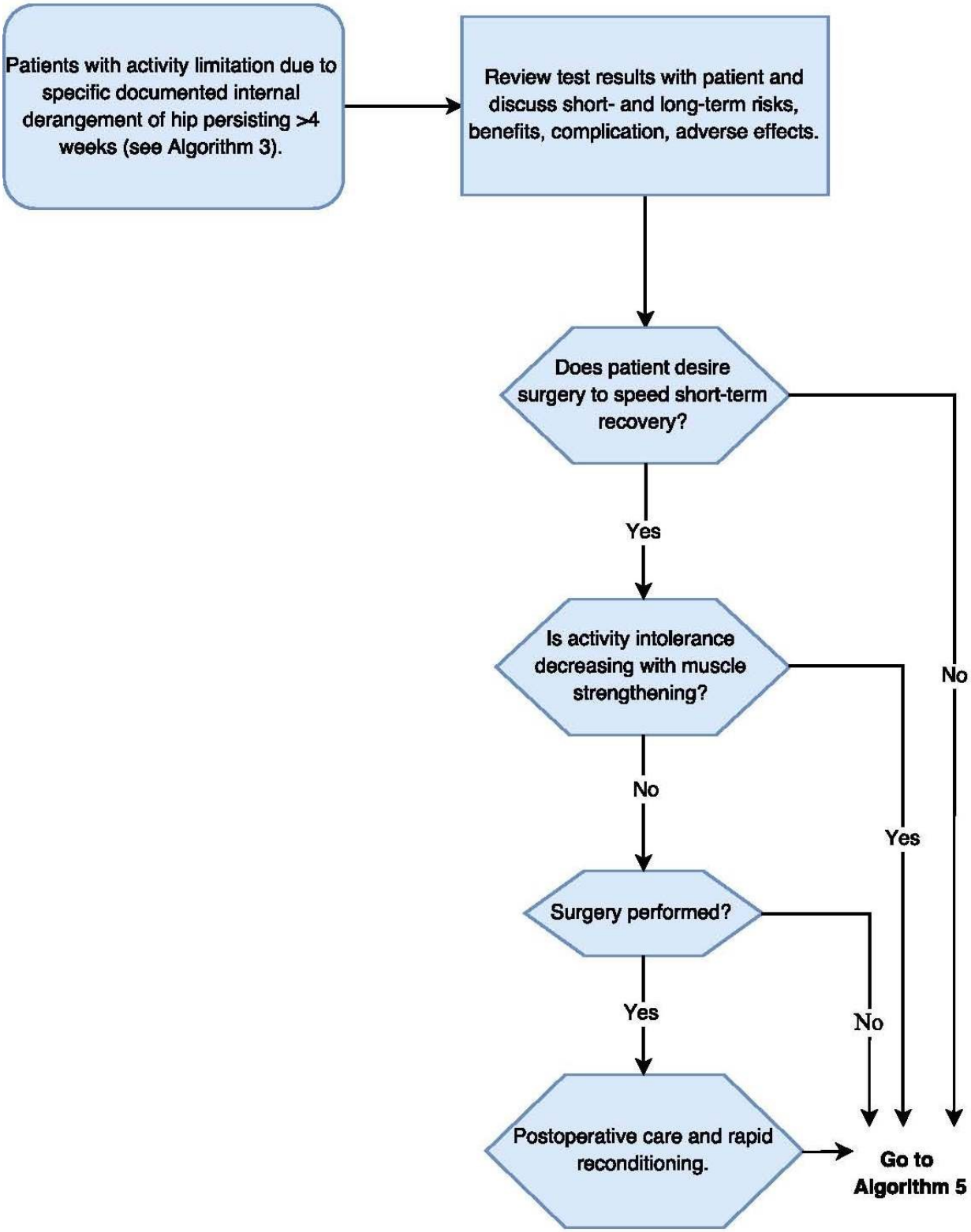
Algorithm 2. Initial and Follow-up Management of Hip and Groin Disorders



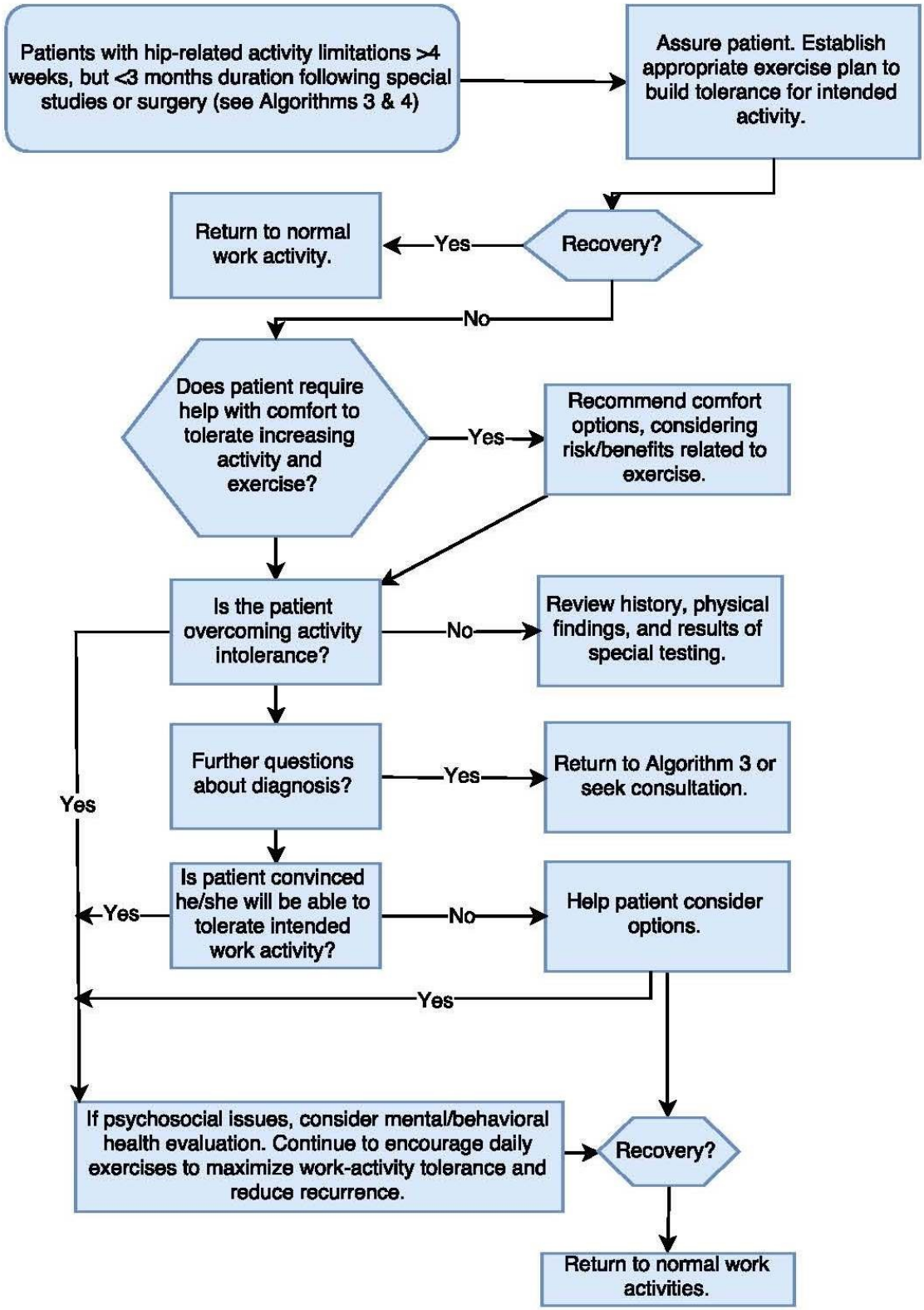
Algorithm 3. Evaluation of Slow-to-Recover Patients with Hip and Groin Disorders (Symptoms >4 Weeks)



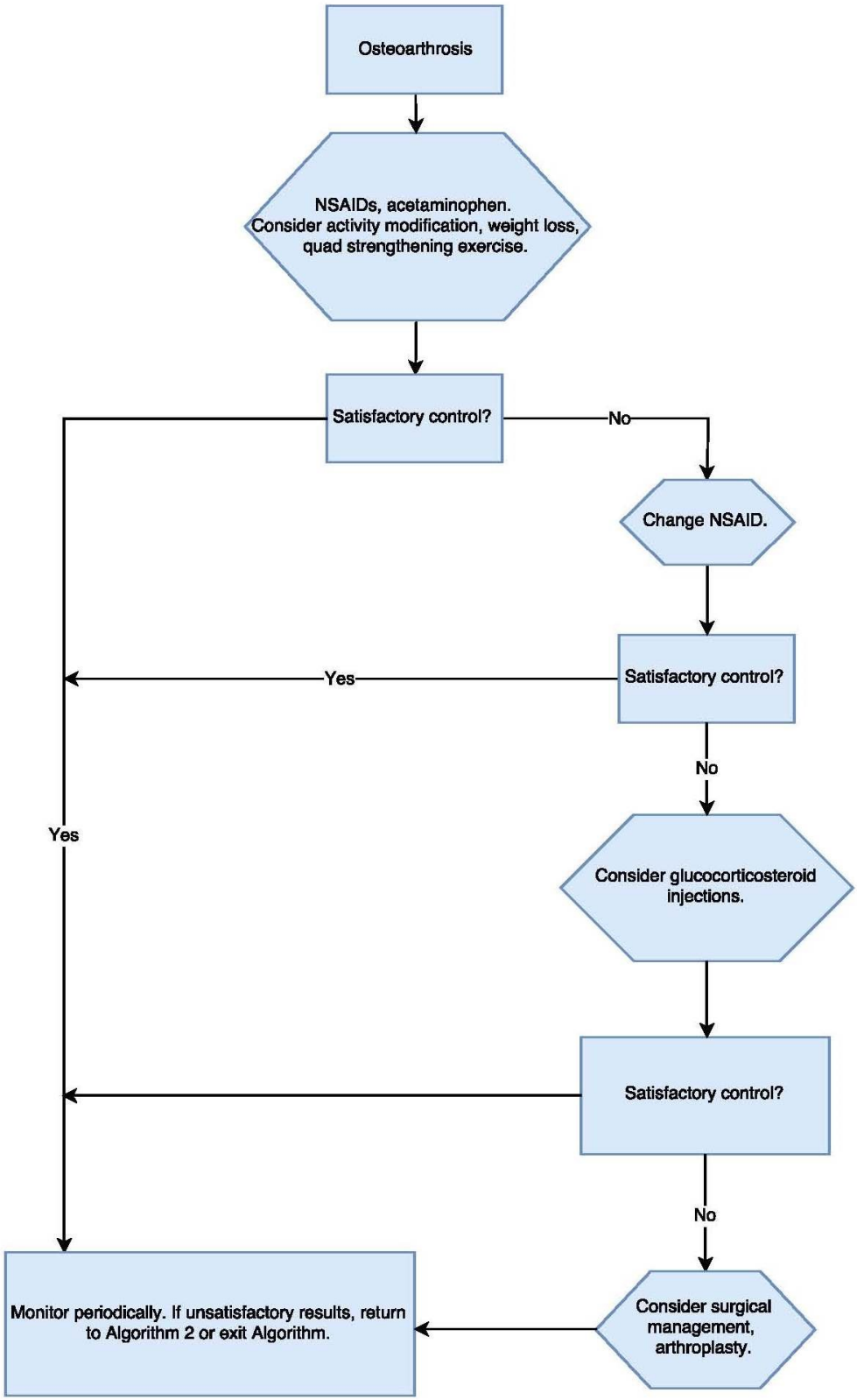
Algorithm 4. Surgical Considerations for Patients with Anatomic Evidence of Torn Labrum or Ligament and Persistent Hip Symptoms



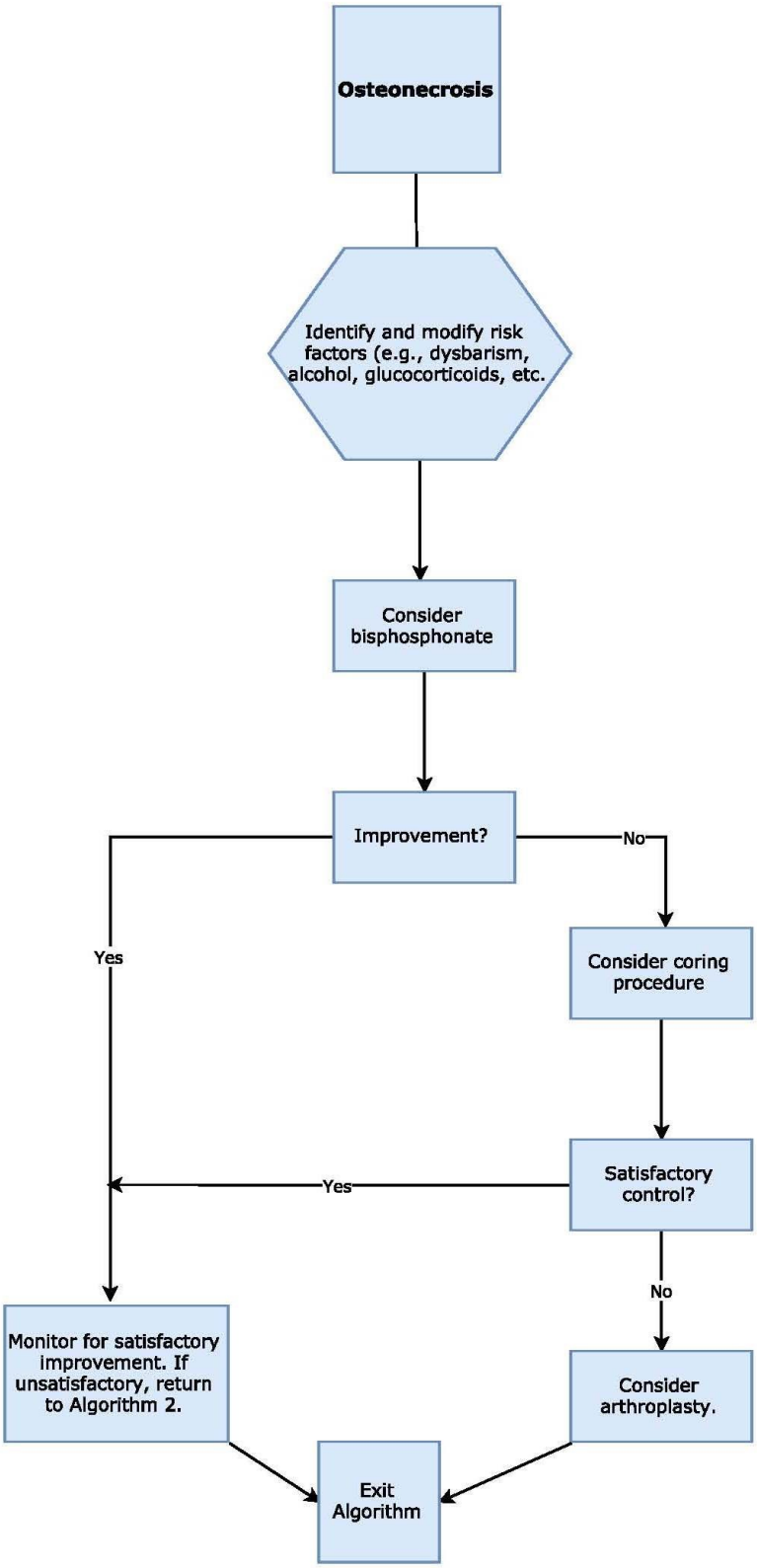
Algorithm 5. Further Management of Hip and Groin Disorders



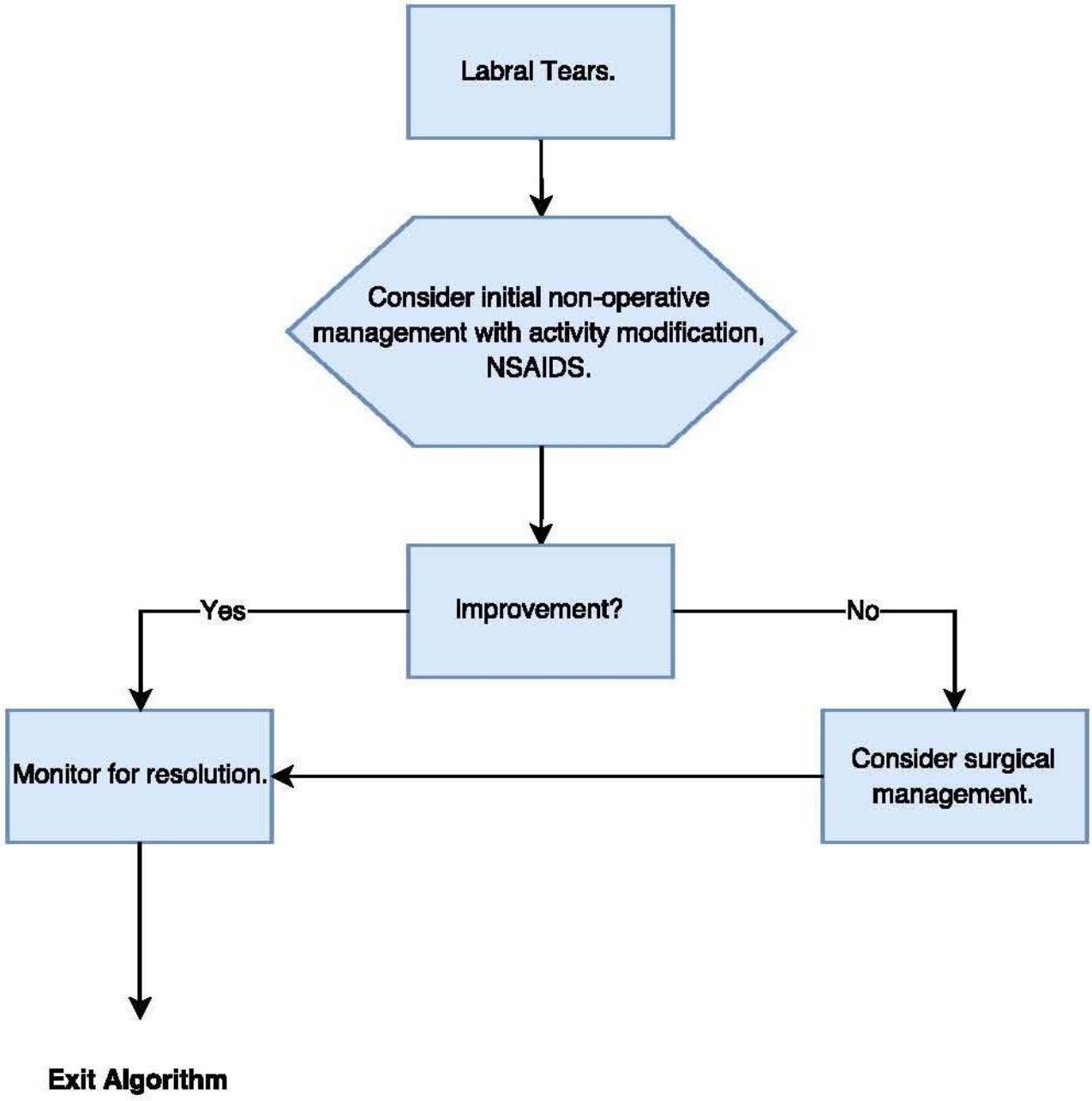
Algorithm 6. Management of Osteoarthrosis for Patients with Hip and Groin Symptoms



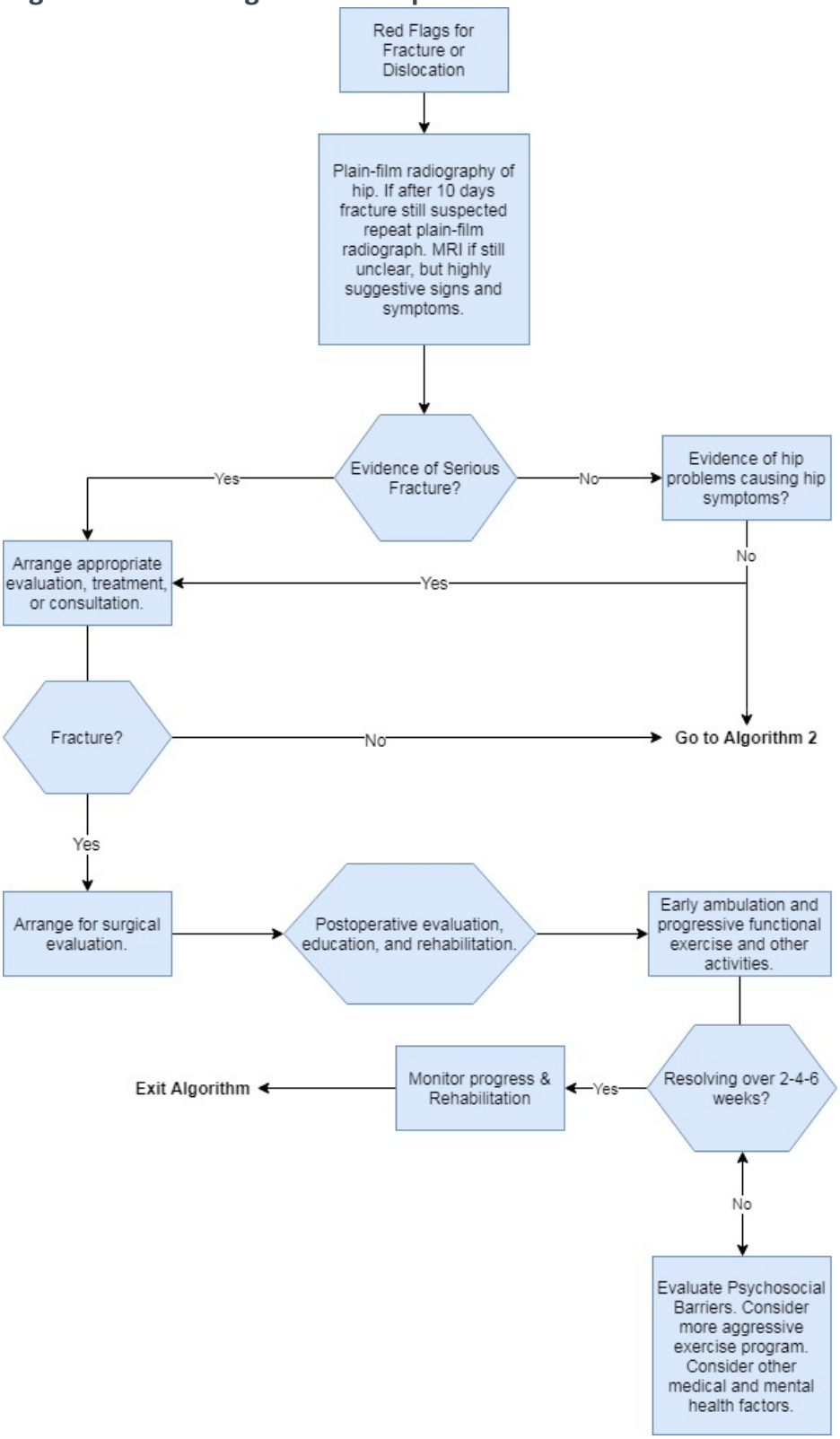
Algorithm 7. Management of Osteonecrosis for Patients with Hip and Groin Symptoms



Algorithm 8. Management of Labral Tears for Patients with Hip and Groin Symptoms



Algorithm 9. Management of Hip Fractures



Hip Osteoarthrosis

Summary of Recommendations

The following summary table contains recommendations for evaluating and managing hip osteoarthrosis from the Evidence-based Hip and Groin Disorders Panel. These recommendations are based on critically appraised higher quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

Antibodies for Diagnosing Hip Pain.....Recommended, Evidence (C)
C-Reactive Protein for Diagnosing Hip Pain.....Recommended, Evidence (C)
Erythrocyte Sedimentation Rate for Diagnosing Hip Pain.....Recommended, Evidence (C)
Other Non-Specific Inflammatory Markers for Diagnosing Hip Pain.....Recommended, Evidence (C)
Arthroscopic Examinations for Diagnosing Hip Osteoarthrosis.....Not Recommended, Insufficient Evidence (I)
Bone Scans for Diagnosing Hip Pain.....Recommended, Insufficient Evidence (I)
Cytokines for Diagnosing Hip Pain.....See Chronic Pain Guideline.
Computerized Tomography for Routine Diagnosis of Hip Osteoarthrosis.....Not Recommended, Insufficient Evidence (I)
Computerized Tomography for Recurrent Post-Arthroplasty Dislocations.....Recommended, Insufficient Evidence (I)
Helical Computerized Tomography (CT scans) for Diagnosing Hip Pain.....Recommended, Insufficient Evidence (I)
Local Anesthetic Injections for Diagnosing Hip Pain.....Recommended, Insufficient Evidence (I)
Electromyography, including Nerve Conduction Studies, for Diagnosing Peripheral Nerve Entrapments.....Recommended, Insufficient Evidence (I)
Functional Capacity Evaluations for Diagnosing Hip Pain.....See Chronic Pain Guideline.
Magnetic Resonance Imaging for Routine Evaluation of Hip Joint Pathology.....Not Recommended, Insufficient Evidence (I)
Radiographs (X-rays) for Diagnosis of Hip Osteoarthrosis.....Recommended, Evidence (C)
Ultrasound for Diagnosis of Hip Osteoarthrosis.....No Recommendation, Insufficient Evidence (I)
Fall Protection.....Recommended, Insufficient Evidence (I)
Ergonomic Interventions.....No Recommendation, Insufficient Evidence (I)
Aerobic Exercise for Hip Osteoarthrosis.....Moderately Recommended, Evidence (B)
Stretching Exercises for Hip Osteoarthrosis.....Recommended, Insufficient Evidence (I)
Strengthening Exercises for Hip Osteoarthrosis.....Moderately Recommended, Evidence (B)
Hydrotherapy (Aquatic Therapy) for Hip Osteoarthrosis.....Moderately Recommended, Evidence (B)
Tai Chi for Hip Osteoarthrosis.....Recommended, Insufficient Evidence (I)
Gait Training for Hip Osteoarthrosis.....No Recommendation, Insufficient Evidence (I)
Antibiotics for Hip Surgery.....Moderately Recommended, Evidence (B)
Norepinephrine Reuptake Inhibitors for Hip Osteoarthrosis.....No Recommendation, Insufficient Evidence (I)
Selective Serotonin Reuptake Inhibitors (SSRIs) for Hip Pain.....Not Recommended, Insufficient Evidence (I)

Anti-Convulsant Agents (including Gabapentin and Pregabalin) for Hip Osteoarthrosis or Hip Pain ..... No Recommendation, Insufficient Evidence (I)
Gabapentin for Preoperative/Perioperative Hip Pain ..... Moderately Recommended, Evidence (B)
NSAIDs for Hip Osteoarthrosis ..... Strongly Recommended, Evidence (A)
NSAIDs for Patients with Known Cardiovascular Disease or Multiple Risk Factors for Cardiovascular Disease ..... Recommended, Insufficient Evidence (I)
Acetaminophen for Hip Osteoarthrosis ..... Moderately Recommended, Evidence (B)
Acetaminophen or Aspirin as First-Line Therapy for Patients with Cardiovascular Disease Risk Factors ..... Strongly Recommended, Evidence (A)
Proton Pump Inhibitors and Misoprostol for Patients at Risk for GI Adverse Effects ..... Strongly Recommended, Evidence (A)
Sucralfate for Patients at Risk for GI Adverse Effects ..... Moderately Recommended, Evidence (B)
H2 Blockers for Patients at Risk for GI Adverse Effects ..... Recommended, Evidence (C)
Opioids for Hip Pain ..... See Chronic Pain Guideline.
Skeletal Muscle Relaxants for Hip Pain ..... Recommended, Insufficient Evidence (I)
Capsicum for Hip Pain ..... Recommended, Insufficient Evidence (I)
Topical NSAIDs for Hip Osteoarthrosis ..... Not Recommended, Insufficient Evidence (I)
Lidocaine Patches for Hip Osteoarthrosis ..... Not Recommended, Insufficient Evidence (I)
Eutectic Mixture of Local Anesthetics (EMLA) for Hip Osteoarthrosis ..... Not Recommended, Insufficient Evidence (I)
Other Creams/Ointments for Hip Osteoarthrosis ..... Not Recommended, Insufficient Evidence (I)
Tumor Necrosis Factor-Alpha Blockers for Hip Osteoarthrosis or Other Hip Pain ..... Not Recommended, Insufficient Evidence (I)
Nerve Growth Factor Inhibitors for Hip Osteoarthrosis ..... Moderately Not Recommended, Evidence (B)
Glucosamine Sulfate for Hip Osteoarthrosis ..... No Recommendation, Insufficient Evidence (I)
Chondroitin Sulfate for Hip Osteoarthrosis ..... No Recommendation, Insufficient Evidence (I)
Methylsulfonylmethane for Hip Osteoarthrosis ..... No Recommendation, Insufficient Evidence (I)
Complementary or Alternative Treatments or Dietary Supplements for Hip Pain ..... No Recommendation, Insufficient Evidence (I)
Herbal and Other Preparations for Hip Pain ..... No Recommendation, Insufficient Evidence (I)
Canes and Crutches for Hip Pain ..... Recommended, Insufficient Evidence (I)
Orthotics, Shoe Insoles, and Shoe Lifts for Hip Pain ..... Recommended, Insufficient Evidence (I)
Magnets and Magnetic Stimulation for Hip Osteoarthrosis or Other Hip Pain ..... Not Recommended, Insufficient Evidence (I)
Physical Therapy and Occupational Therapy for Hip Osteoarthrosis ..... Recommended, Insufficient Evidence (I)
Manipulation or Mobilization for Hip Osteoarthrosis ..... No Recommendation, Insufficient Evidence (I)
Massage for Hip Osteoarthrosis ..... No Recommendation, Insufficient Evidence (I)
Reflexology for Hip Osteoarthrosis or Other Hip Pain ..... Not Recommended, Insufficient Evidence (I)
Cryotherapy, Home Use, for Hip Osteoarthrosis ..... Recommended, Insufficient Evidence (I)
Cryotherapy, Postoperative ..... Recommended, Evidence (C)
Diathermy for Hip Osteoarthrosis or Other Hip Pain ..... No Recommendation, Insufficient Evidence (I)
Infrared Therapy for Hip Osteoarthrosis or Other Hip Pain ..... No Recommendation, Insufficient Evidence (I)
Ultrasound for Hip Osteoarthrosis or Other Hip Pain ..... No Recommendation, Insufficient Evidence (I)
Low-level Laser Therapy for Hip Osteoarthrosis or Other Hip Pain ..... No Recommendation, Insufficient Evidence (I)
Self-Application of Low-Tech Heat Therapy for Hip Osteoarthrosis ..... Recommended, Insufficient Evidence (I)
Electrical Stimulation Therapies for Hip Osteoarthrosis or Other Hip Pain ..... No Recommendation, Insufficient Evidence (I)
Transcutaneous Electrical Stimulation (TENS) for Hip Osteoarthrosis or Other Hip Pain ..... No Recommendation, Insufficient Evidence (I)
Acupuncture for Hip Osteoarthrosis ..... Recommended, Evidence (C)

Intraarticular Glucocorticosteroid Injections for Hip Osteoarthrosis ..... Moderately Recommended, Evidence (B)
Intraarticular Hip Viscosupplementation Injections for Hip Osteoarthrosis ..... No Recommendation, Insufficient Evidence (I)
Platelet-Rich Plasma Injections for Hip Osteoarthrosis ..... No Recommendation, Insufficient Evidence (I)
Prolotherapy Injections for Hip Pain ..... No Recommendation, Insufficient Evidence (I)
Botulinum Injections for Hip Osteoarthrosis or Other Hip Disorders ..... No Recommendation, Insufficient Evidence (I)
Glucosamine Sulfate Intra-Muscular Injections for Hip Osteoarthrosis ..... No Recommendation, Insufficient Evidence (I)
Glucosamine Sulfate Intra-articular Injections for Hip Osteoarthrosis ..... No Recommendation, Insufficient Evidence (I)
Pre-Operative Autologous Blood Donation ..... No Recommendation, Insufficient Evidence (I)
Hip Arthroplasty ..... Strongly Recommended, Evidence (A)
Bilateral Hip Arthroplasty ..... Recommended, Evidence (C)
Metal-on-Metal Resurfacing Hip Arthroplasty ..... Recommended, Evidence (C)
Osteotomy for Hip Osteoarthrosis ..... Recommended, Insufficient Evidence (I)
Acupuncture for Hip Arthroplasty ..... Moderately Recommended, Evidence (B)
Hip Resurfacing for Osteoarthrosis ..... Moderately Recommended, Evidence (B)
Pre-operative Education for Arthroplasty ..... Moderately Recommended, Evidence (B)
Pre- and Post-Operative Rehabilitation ..... Moderately Recommended, Evidence (B)
Post-operative Exercise and/or Rehabilitation Program ..... Moderately Recommended, Evidence (B)
Late Post-operative Exercises for Patients with Significant Weakness or Unsteady Gait ..... Recommended, Evidence (C)
Late Post-operative Exercises for Patients with Mild Reductions ..... No Recommendation, Insufficient Evidence (I)
Post-operative Work, Avocational Activities, and Sports ..... No Recommendation, Insufficient Evidence (I)
Prevention of Venous Thromboembolism ..... See Hip Fracture.
Psychological Services ..... See Chronic Pain Guideline.
Rehabilitation Services for Delayed Recovery ..... See Chronic Pain Guideline.

Related Terms

- Arthritis
- Arthropathy
- Arthrosis
- Degenerative Arthritis
- Degenerative Arthrosis
- Degenerative Joint Disease
- Non-inflammatory Arthritis
- Osteoarthritis
- Osteoarthrosis
- Rheumatism

Introduction

Hip degenerative joint disease (DJD) is most commonly caused by osteoarthrosis (OA). Although *osteoarthritis* is the more common name for this entity, *osteoarthrosis* is considered to be more technically precise because classic inflammation is absent [449, 450]. Other arthritic disorders that cause degenerative joint disease include inflammatory autoimmune disorders such as rheumatoid arthritis [450], systemic lupus erythematosus [451], and psoriasis [452]; hemochromatosis [453]; and crystal diseases such as gout [454], pseudogout [455, 456], and apatites [457]. Because these latter disorders are nonoccupational, they are not discussed in this guideline.

Joints in the body (other than intervertebral discs) are typically filled with synovial fluid, lined with synovium, and encapsulated with ligaments to allow for low-friction movement between adjacent bones. OA is an age-related degenerative change in the joint, particularly affecting the cartilage on the articular surface, which leads to thinning of that cartilage. Patients with OA develop pain on movement and stiffness. OA may develop in only one joint after a significant traumatic injury such as fracture [254, 458], in which case it is often delayed by many years. If the injury was occupational, then the subsequent osteoarthrosis is also considered—at least in part—to be occupational.

The common pathway for hip OA involves sufficient destruction of the joint by various causes that may be indistinguishable on radiograph. Thus, the correct interpretation of findings consistent with possible OA on radiograph is usually degenerative joint disease, but not osteoarthrosis. Hip OA has been reported to occur with nearly equal frequency in both sexes, whereas women are at greater risk for OA in other joints; the reason for this difference is somewhat unclear. There is a predisposition for patients who already have OA in one or two joints to develop OA in other joint groups. Several genetic factors have been identified [65, 244, 260, 275-277].

In general, hip OA is thought to be gradually progressive, although evidence also suggests significant improvements are possible with weight loss and exercise [459]. However, quality studies on the long-term prognosis of patients with OA are noticeably weak. One systematic review reported no changes in functional status among hip OA patients over a 3-year period of follow-up, although conflicts with other available studies were noted [66].

Diagnostic Criteria

The diagnostic criteria for hip OA are as follows:

Symptoms

- Non-radiating hip pain
- Morning stiffness or stiffness on standing after prolonged sitting
- Sleep disturbance sometimes present
- Mood disturbance usually not present
- Other joints are often affected by OA

Signs

- Range of motion (ROM) generally reduced, especially hip internal rotation
- May be normal when mild
- Frequently have signs of OA in other joints (e.g., wrists, fingers, knees)
- Findings are most often symmetrical, unless there is a prior history of unilateral significant trauma (e.g., fracture)

Tests and Results

- X-rays are usually ordered to help secure diagnosis
- Other diagnostic tests should be ordered only if they target the specific body part and there is a potential for meaningful intervention

Hip OA is classified by grading the severity of radiographic findings. Hip OA is also classified by pain and functional levels (e.g., WOMAC), which may not correlate well with the severity suggested by radiographs.

Diagnostic Recommendations

Hip osteoarthrosis may be evaluated for systemic risks to help identify alternate treatments and attempt to prevent the destruction of other joints, particularly if inflamatory mechanisms are present [290].

Antibodies for Diagnosing Hip Pain

Recommended.

Antibodies are recommended to assist in diagnosing hip pain, including differentiating inflammatory rheumatic disorders from hip osteoarthrosis.

Strength of Evidence – Recommended, Evidence (C)
Level of Confidence – **High**

Indications:	Undiagnosed patients with either systemic arthropathies and/or peripheral neuropathies, or patients with incomplete evaluations. Diagnostic testing should generally include sedimentation rate. Other tests may include rheumatoid factor, antinuclear antibody level, and others. Testing is advisable even if other diagnostic testing finds another disorder (e.g., occupational neurotoxin in presence of peripheral neuropathy) to assure there is not another, treatable, contributing factor, especially if explanation of the symptoms is incomplete.
Benefits:	Diagnosing an unknown condition. Providing an opportunity to prevent destruction of joints.
Harms:	Negligible. False-positive results would be common if used amongst patients with low pre-test probabilities.
Frequency/Dose/Duration:	One evaluation. A second evaluation may be indicated with a significant change in symptoms. It is also reasonable to repeat testing after a period of a year or two because initial negative test results are known to occasionally become positive with the passage of time.
Rationale:	Rheumatoid panels are helpful in select circumstances to confirm inflammatory arthritides and are thus recommended for use among those with symptoms suggestive of possible rheumatoid disorders. There are increasing numbers of quality studies suggesting the presence of low-grade inflammatory mediators in OA patients [460-462].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: C-Reactive Protein, CRP, Erythrocyte Sedimentation Rate, ESR, ESP, Inflammatory Markers; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 16 articles in PubMed, 429 in Scopus, 4 in CINAHL, 0 in Cochrane Library, 1690 in Google Scholar, and 10 from other sources. We considered for inclusion 1 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 4 from other sources. Of the 6 articles considered for inclusion, 3 diagnostic studies and 2 systematic studies met the inclusion criteria. A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: antibodies; hip osteoarthritis, hip degenerative joint disease, hip osteoarthrosis, hip degenerative arthritis; sensitivity, specificity, predictive value of tests, gold-standard, accurate, accuracy, precision, precise, test. We found and reviewed 8 articles in PubMed, 12 in Scopus, 0 in CINAHL, 26 in Cochrane Library, 2430 in Google Scholar, and 0 from other sources. We considered for inclusion 3 from

PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

C-Reactive Protein for Diagnosing Hip Pain

Recommended.

C-reactive protein is recommended to assist in diagnosing hip pain, including differentiating inflammatory rheumatic disorders from hip osteoarthrosis.

Strength of Evidence – Recommended, Evidence (C)
Level of Confidence – **High**

Indications:	Used as a non-specific inflammatory indicator. Undiagnosed patients with either systemic arthropathies and/or peripheral neuropathies, or patients with incomplete evaluations. Diagnostic testing should generally include sedimentation rate, which is also non-specific. Other tests may include rheumatoid factor and antinuclear antibody level, among others. Testing is advisable even if other diagnostic testing finds another disorder (e.g., occupational neurotoxin in presence of peripheral neuropathy) to assure there is not another treatable contributing factor, especially if the explanation of the symptoms is incomplete.
Benefits:	Diagnosing an unknown condition. Providing an opportunity to prevent destruction of joints.
Harms:	Negligible. False-positive results would be common if used amongst patients with low pre-test probabilities.
Frequency/Dose/Duration:	One evaluation. A second evaluation may be indicated with a significant change in symptoms. It is also reasonable to repeat testing after a period of a year or two because initial negative test results are known to occasionally become positive with the passage of time.
Rationale:	Rheumatoid panels are helpful in select circumstances to confirm inflammatory arthritides and are thus recommended for use among those with symptoms suggestive of possible rheumatoid disorders. There are increasing numbers of quality studies suggesting the presence of low-grade inflammatory mediators in OA patients [460-462].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: C-Reactive Protein, CRP, Erythrocyte Sedimentation Rate, ESR, ESP, Inflammatory Markers; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 16 articles in PubMed, 429 in Scopus, 4 in CINAHL, 0 in Cochrane Library, 1690 in Google Scholar, and 10 from other sources. We considered for inclusion 1 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 4 from other sources. Of the 6 articles considered for inclusion, 3 diagnostic studies and 2 systematic studies met the inclusion criteria. A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: antibodies; hip osteoarthritis, hip degenerative joint

disease, hip osteoarthrosis, hip degenerative arthritis; sensitivity, specificity, predictive value of tests, gold-standard, accurate, accuracy, precision, precise, test. We found and reviewed 8 articles in PubMed, 12 in Scopus, 0 in CINAHL, 26 in Cochrane Library, 2430 in Google Scholar, and 0 from other sources. We considered for inclusion 3 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Erythrocyte Sedimentation Rate for Diagnosing Hip Pain

Recommended.

Erythrocyte sedimentation rate [463] is recommended to assist in diagnosing hip pain, including differentiating inflammatory rheumatic disorders from hip osteoarthrosis.

Strength of Evidence – Recommended, Evidence (C)
Level of Confidence – **High**

Indications:	Used as a non-specfic indicator of inflammation. Undiagnosed patients with either systemic arthropathies and/or peripheral neuropathies, or patients with incomplete evaluations. Diagnostic testing should generally include sedimentation rate. Other tests may include rheumatoid factor, antinuclear antibody level, and others. Testing is advisable even if other diagnostic testing finds another disorder (e.g., occupational neurotoxin in presence of peripheral neuropathy) to assure there is not another treatable contributing factor, especially if the explanation of the symptoms is incomplete.
Benefits:	Diagnosing an unknown condition. Providing an opportunity to prevent destruction of joints.
Harms:	Negligible. False-positive results would be common if used amongst patients with low pre-test probabilities.
Frequency/Dose/Duration:	One evaluation. A second evaluation may be indicated with a significant change in symptoms. It is also reasonable to repeat testing after a period of a year or two because initial negative test results are known to occasionally become positive with the passage of time.
Rationale:	Rheumatoid panels are helpful in select circumstances to confirm inflammatory arthritides and are thus recommended for use among those with symptoms suggestive of possible rheumatoid disorders. There are increasing numbers of quality studies suggesting presence of low-grade inflammatory mediators in OA patients [460-462].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: C-Reactive Protein, CRP, Erythrocyte Sedimentation Rate, ESR, ESP, Inflammatory Markers; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 16 articles in PubMed, 429 in Scopus, 4 in CINAHL, 0 in Cochrane Library, 1690 in Google Scholar, and 10 from other sources. We considered for inclusion 1 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 4 from other sources. Of the 6 articles considered for inclusion, 3 diagnostic studies and 2 systematic studies met the inclusion criteria. A comprehensive

literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: antibodies; hip osteoarthritis, hip degenerative joint disease, hip osteoarthrosis, hip degenerative arthritis; sensitivity, specificity, predictive value of tests, gold-standard, accurate, accuracy, precision, precise, test. We found and reviewed 8 articles in PubMed, 12 in Scopus, 0 in CINAHL, 26 in Cochrane Library, 2430 in Google Scholar, and 0 from other sources. We considered for inclusion 3 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Other Non-Specific Inflammatory Markers for Diagnosing Hip Pain

Recommended.

Other non-specific inflammatory markers are recommended to assist in diagnosing hip pain, including differentiating inflammatory rheumatic disorders from hip osteoarthrosis.

Strength of Evidence – Recommended, Evidence (C)
Level of Confidence – **High**

Indications:	Undiagnosed patients with either systemic arthropathies and/or peripheral neuropathies, or patients with incomplete evaluations. Diagnostic testing should generally include sedimentation rate. Other tests may include rheumatoid factor, antinuclear antibody level, and others. Testing is advisable even if other diagnostic testing finds another disorder (e.g., occupational neurotoxin in presence of peripheral neuropathy) to assure there is not another, treatable, contributing factor, especially if explanation of the symptoms is incomplete.
Benefits:	Diagnosing an unknown condition. Providing an opportunity to prevent destruction of joints.
Harms:	Negligible. False-positive results would be common if used amongst patients with low pre-test probabilities.
Frequency/Dose/Duration:	One evaluation. A second evaluation may be indicated with a significant change in symptoms. It is also reasonable to repeat testing after a period of a year or two as initial testing is known to occasionally become positive with the passage of time.
Rationale:	Rheumatoid panels are helpful in select circumstances to confirm inflammatory arthritides and are thus recommended for use among those with symptoms suggestive of possible rheumatoid disorders. There are increasing numbers of quality studies suggesting presence of low-grade inflammatory mediators in OA patients [460-462].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: C-Reactive Protein, CRP, Erythrocyte Sedimentation Rate, ESR, ESP, Inflammatory Markers; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 16 articles in PubMed, 429 in Scopus, 4 in CINAHL, 0 in Cochrane Library, 1690 in Google Scholar, and 10 from other sources. We considered for inclusion 1 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from

Cochrane Library, 0 from Google Scholar, and 4 from other sources. Of the 6 articles considered for inclusion, 3 diagnostic studies and 2 systematic studies met the inclusion criteria. A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: antibodies; hip osteoarthritis, hip degenerative joint disease, hip osteoarthrosis, hip degenerative arthritis; sensitivity, specificity, predictive value of tests, gold-standard, accurate, accuracy, precision, precise, test. We found and reviewed 8 articles in PubMed, 12 in Scopus, 0 in CINAHL, 26 in Cochrane Library, 2430 in Google Scholar, and 0 from other sources. We considered for inclusion 3 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Arthroscopic Examinations for Diagnosing Hip Osteoarthrosis

Not Recommended.

Arthroscopic examinations are not recommended solely to diagnose hip osteoarthrosis. However, there are multiple recommended indications for hip arthroscopy (e.g., labral tear, intraarticular body, femoroacetabular impingement, unclear diagnosis after other tests are performed, other mechanical symptoms) [466]. (See other specific hip disorders.)

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	The diagnosis of hip OA is generally straightforward and does not necessitate or benefit from arthroscopy. Thus, arthroscopy is not recommended as a routine diagnostic procedure. However, there are multiple indications for hip arthroscopy where treatment successes are present, such as treatment of a mechanical defect (e.g., labral tear, intraarticular body, femoroacetabular impingement, other mechanical symptoms). (See Hip Arthroscopy Treatment.) Complication rates from hip arthroscopic procedures range from 1.3 to 1.6% [467-469]. More serious injuries tend to be related to nerve retraction, neuropraxias, infection, or complex regional pain syndrome [467-473]. By analogy with the knee joint, where quality evidence has demonstrated a lack of efficacy of chondroplasty [474], chondroplasty of the hip joint is not recommended [475, 476].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: arthroscopy, arthroscopic examination; hip osteoarthritis, hip degenerative joint disease, hip osteoarthritis, hip degenerative arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 19 articles in PubMed, 13 in Scopus, 8 in CINAHL, 5 in Cochrane Library, 101 in Google Scholar, and 0 from other sources. We considered for inclusion 3 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 3 diagnostic studies and 0 systematic studies met the inclusion criteria.

Bone Scans for Diagnosing Hip Pain

Recommended.

Bone scanning is recommended for select use in patients with acute, subacute, or chronic hip pain to assist in the diagnosis of osteonecrosis, neoplasms, or other conditions with increased polyosthotic bone metabolism, particularly when more than one joint needs to be evaluated.

Strength of Evidence – Recommended, Insufficient Evidence (I)

Level of Confidence – **Moderate**

Indications:	Patients with hip pain with suspicion of osteonecrosis, Paget's disease, neoplasm, or other increased polyosthotic bone metabolism.
Benefits:	Diagnosing an unknown condition.
Harms:	Negligible. Low-level radiation exposure.
Frequency/Dose/Duration:	One evaluation. A second evaluation may be indicated with a significant change in symptoms, generally after more than 3 months.
Rationale:	Bone scanning may be a helpful diagnostic test to evaluate suspected metastases, primary bone tumors, infected bone (osteomyelitis), inflammatory arthropathies, or trauma (e.g., occult fractures). Bone scanning is generally not indicated for evaluation of hip OA. It may be helpful in patients with suspected early AVN, but without x-ray changes. In patients where the diagnosis is felt to be secure, there is not an indication for bone scanning because it does not alter treatment or management. Bone scanning is minimally invasive, has minimal potential for adverse effects (essentially equivalent to a blood test), but is high cost. It is also generally inferior to MRI.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: bone scans, bone scintigraphy, arthroscopy, arthroscopic examination; hip osteoarthritis, hip degenerative joint disease, hip osteoarthritis, hip degenerative arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 19 articles in PubMed, 567 in Scopus, 4 in CINAHL, 39 in Cochrane Library, 17,000 in Google Scholar (only went through first 100), and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Cytokines for Diagnosing Hip Pain

See Chronic Pain Guideline.

Computerized tomography (CT scan) is sometimes used to evaluate hip pain [477-480].

Computed Tomography for Routine Diagnosis for Hip Osteoarthrosis

Not Recommended.

CT scans are not indicated for routine diagnosis of hip OA.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Level of Confidence – **Moderate**

Computed Tomography for Recurrent Post-Arthroplasty Dislocations

Recommended.

CT scans are selectively recommended to evaluate recurrent post-arthroplasty dislocations.

Strength of Evidence – Recommended, Insufficient Evidence (I)
Level of Confidence – **Moderate**

Indications:	Recurrent dislocations after arthroplasty with need for CT beyond simple x-ray. Patients with a need for imaging beyond CT, but contraindicatations for MRI.
Benefits:	Imaging to help explain dislocations and plan treatment.
Harms:	Negligible. Radiation exposure.
Frequency/Dose/Duration:	One evaluation. A second evaluation is rarely needed.
Rationale:	Computed tomography is considered to be superior to MRI for imaging of most hip abnormalities where advanced imaging of calcified structures is required. A contrast CT study is minimally invasive, has few if any adverse effects, is costly, and is recommended for select use of recurrent dislocations after arthroplasty.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: computerized tomography, x-ray computer tomography, cone-beam computed tomography, spiral cone-beam computed tomography, spiral computer tomography, emission-computed single-photon tomography, emission-computer tomography; hip osteoarthritis, arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 80 articles in PubMed, 838 in Scopus (Went through first 100), 39 in CINAHL, 32 in Cochrane Library, 3560 in Google Scholar, and 1 from other sources. We considered for inclusion 5 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 6 articles considered for inclusion, 3 diagnostic studies and 0 systematic studies met the inclusion criteria.

Helical Computerized Tomography (CT scans) for Diagnosing Hip Pain

Recommended.

Helical CT is recommended for select patients with acute, subacute, or chronic hip pain for whom advanced imaging of bony structures is thought to be potentially helpful (e.g., suspicion of fracture). Helical CT is also recommended for patients who need advanced imaging but have contraindications for MRI.

Strength of Evidence – Recommended, Insufficient Evidence (I)

Level of Confidence – **Moderate**

Indications:	Select patients with acute, subacute, or chronic hip pain who need advanced bony structure imaging (e.g., clinical suspicion of fracture). Patients needing advanced imaging, but with contraindications for MRI (e.g., implanted hardware) are also candidates. Helical CT is generally helpful for vascular concerns, reduces motion artifact and speeds scanning time. For most orthopedic conditions, helical CT offers little advantage over plain CT.
Benefits:	Imaging to help inform diagnosis and plan treatment.
Harms:	Negligible. Radiation exposure.
Frequency/Dose/Duration:	One evaluation. A second evaluation is rarely needed.
Rationale:	Helical CT scanning has been largely replaced by MRI. However, it has been thought to be superior to MRI for evaluating subchondral fractures, although a definitive study has not been reported [481]. In addition, for patients who have contraindications for MRI (e.g., implanted ferrous metal) but require evaluation of AVN, helical CT is recommended. Helical CT has few if any adverse effects, but is costly. It is recommended for use in select patients.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: helical computerized axial tomography scan, helical CAT scan, helical CT scan, computerized tomography, X-Ray computed tomography, cone-beam computed tomography, spiral cone-beam computed tomography, spiral computed tomography, emission-computed single-photon tomography, emission-computed tomography; hip osteoarthritis, hip degenerative joint disease, hip osteoarthritis, hip degenerative arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 80 articles in PubMed, 849 in Scopus (reviewed the first 100), 39 in CINAHL, 32 in Cochrane Library, 3650 in Google Scholar, and 0 from other sources. We considered for inclusion 5 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 5 articles considered for inclusion, 0 randomized trials and 4 systematic studies met the inclusion criteria.

Local anesthetic injections have been used to attempt to differentiate the pain origin(s) [482-484].

Local Anesthetic Injections for Diagnosing Hip Pain

Recommended.

Local anesthetic injections are recommended to assist in diagnosing the cause of hip pain.

Strength of Evidence – Recommended, Insufficient Evidence (I)

Level of Confidence – **Moderate**

Indications:	Moderate to severe hip pain of uncertain cause.
Benefits:	Potential to explain the source of pain and plan treatment.

Harms:	Rare infection risk and other injection risks.
Frequency/Dose/Duration:	One injection. A second evaluation is rarely needed. Intraarticular hip injections with anesthetic agents are generally thought to be better if performed with a glucocorticosteroid as it generally accomplishes both diagnostic and therapeutic purposes simultaneously, although occasionally a simple anesthetic injection may be helpful in select cases.
Rationale:	Local anesthetic injections for diagnostic purposes are helpful for confirming a diagnostic impression, although there are no quality studies evaluating these injections for purposes of evaluating hip pain (for therapeutic injections, see Injections). These injections are also sometimes used to differentiate pain from a distant site, such as the knee or spine. Diagnostic injections include intraarticular injections (hip or knee), ilioinguinal, genitofermoral, saphenous, and lumbar epidurals. Local nerve block or sacroiliac joint injection should be used to assist in diagnosis. Immediate and delayed results of injection(s) should be recorded.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Local anesthetic injections, local anesthetic, local anesthesia; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 7 articles in PubMed, 178 in Scopus, 98 in CINAHL, 7 in Cochrane Library, 1030 in Google Scholar (Went through first 100), and 9 from other sources. We considered for inclusion 3 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 3 from other sources. Of the 9 articles considered for inclusion, 6 diagnostic studies and 0 systematic studies met the inclusion criteria.

Electromyography, including Nerve Conduction Studies, for Diagnosing Peripheral Nerve Entrapments

Recommended.

Electrodiagnostic studies are selectively recommended to assist in the diagnosis of subacute or chronic peripheral nerve entrapments, including the lateral cutaneous nerve to the thigh (meralgia paresthetica).

Strength of Evidence – Recommended, Insufficient Evidence (I)
Level of Confidence – **Moderate**

Indications:	Patients with subacute or chronic paresthesias with or without pain, particularly if the diagnosis is unclear. Generally, should not be obtained for symptoms of under 3 weeks duration.
Benefits:	Identification of nerve abnormalities, including meralgia paresthetica, although most cases do not require electrodiagnostic confirmation.
Harms:	Negligible
Frequency/Dose/Duration:	Generally, only obtained at presentation. Rarely re-assessed if a diagnosis remains unclear, symptoms progress, or months have passed.
Rationale:	Electrodiagnostic studies may assist in confirming peripheral nerve entrapments, such as the lateral cutaneous nerve to the thigh. There are no quality studies to identify EMG studies as being effective for changing the course of treatment for hip pain, although there are such studies in other joints. These studies are minimally invasive, have

minimal potential for adverse effects (essentially equivalent to a blood test), are moderately costly, and are selectively recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Electromyography, nerve conduction; hip osteoarthritis, hip joint degenerative disease, hip degenerative arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 5 articles in PubMed, 52 in Scopus, 2 in CINAHL, 23 in Cochrane Library, 1,300 in Google Scholar, and 0 from other sources. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 2 diagnostic studies and 0 systematic studies met the inclusion criteria.

Functional Capacity Evaluations for Diagnosing Hip Pain

See Chronic Pain guideline.

Magnetic resonance imaging [488] is used as a test for select hip joint problems. It is considered the imaging test of choice for soft tissues. MRI is the gold standard for evaluating osteonecrosis after x-rays [81, 489, 490]. It is also used to quantify the volume of affected tissue, including marrow edema, which is inversely correlated with prognosis [491-495].

Magnetic Resonance Imaging for Routine Evaluation of Hip Joint Pathology

Not Recommended.

MRI is not recommended for routine evaluation of acute, subacute, or chronic hip joint pathology, including degenerative joint disease. There are other indications for MRI, such as gluteus medius tendinosis/tears, osteonecrosis, femoroacetabular impingement, and evaluation of masses. (See sections on other Hip Disorders.)

Strength of Evidence – Not Recommended, Insuffcient Evidence (I)
Level of Confidence – **Moderate**

Rationale: MRI has not been evaluated in quality studies for hip OA with subsequent improvements in clinical outcomes [38]. However, MRI findings consistent with OA are likely to be particularly helpful for soft tissue abnormalities. There is low-quality evidence that MRI may be less sensitive for the detection of subchondral fractures than helical CT or plain radiographs in patients with osteonecrosis [481]. MRI has been suggested for the evaluation of patients with symptoms lasting more than 3 months [496-498]. Because there are concerns that MRI is inferior to MR arthrography, particularly for evaluating the labrum [499], MRI without arthrography is recommended for evaluating the joint but not the labrum. There are reports of patient with negative MRIs in whom gluteus medius tendon tears were found at surgery; thus, MRIs may have similar limitations for imaging tendons in the hip joint as in the shoulder [500]. MRI is not invasive, has no adverse effects (aside from issues of claustrophobia or complications of medication), but it is costly. MRI is not recommended for routine hip imaging, but it is recommended for select hip joint pathology, particularly involving concerns regarding soft tissue pathology.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date

limits using the following terms: magnetic resonance imaging, MRI; hip osteoarthritis, hip denegerative joint disease, hip arthrosis, hip degenerative arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 93 articles in PubMed, 948 in Scopus, 39 in CINAHL, 100 in Cochrane Library, 24,600 in Google Scholar, and 0 from other sources. We considered for inclusion 17 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 18 articles considered for inclusion, 11 randomized trials and 2 systematic studies met the inclusion criteria.

Radiographs (X-rays) for Diagnosis of Hip Osteoarthrosis

Recommended.

Radiographs (x-rays) are recommended to assist in diagnosing hip osteoarthrosis.

Strength of Evidence – Recommended, Evidence (C)
Level of Confidence – **High**

Indications:	Nearly all patients with hip pain thought to potentially have hip OA.
Benefits:	Identification of hip degenerative joint disease/OA. Helps identify severity by radiographs.
Harms:	Negligible
Frequency/Dose/Duration:	Generally, only obtained at presentation. Occasionally x-rayed again at follow-up to assess later progression. X-rays may be obtained postoperatively to document success of arthroplasty.
Rationale:	X-rays are helpful for the evaluation of hip OA and to diagnose hip OA [502-504]. Although there is some evidence that MRI may be superior for imaging cartilage [503], there is no quality evidence to justify the expense of MRI for routine OA diagnostic purposes. X-rays are non-invasive, are low to moderate cost, and have little risk of adverse effects. They are helpful in the diagnosis of hip OA and therefore are recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Roentgenogram, X-ray, radiography; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; Sensitivity and Specificity, Predictive Value of Tests, Gold-standard, accurate, accuracy, precision, precise, test. We found and reviewed 1 article in PubMed, 368 in Scopus, 6 in CINAHL, 191 in Cochrane Library, 101 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 7 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 9 articles considered for inclusion, 6 diagnostic studies and 2 systematic studies met the inclusion criteria.

Ultrasound for Diagnosis of Hip Osteoarthrosis

No Recommendation.

There is no recommendation for the use of ultrasound to diagnose hip OA. There are other potential indications for diagnostic ultrasound, such as evaluation for gluteus medius tendinopathies, greater trochanteric bursitis, greater trochanteric pain syndrome/lateral hip pain, groin strains, sports hernias, femoroacetabular impingement, hip instability, dislocation, ligamentum teres ruptures, labral tears, or post-arthroplasty chronic pain where peri-articular masses are suspected.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Moderate**

Rationale:	Ultrasound has been found to be helpful in evaluating tendinopathies, including tendon ruptures. There is no clear indication for the use of ultrasound to evaluate osteoarthrosis. Ultrasound is not invasive, has no adverse effects, and is moderately costly. It is recommended for disorders with soft tissue pathology, but not for diagnosing hip OA.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasound, Ultrasonography, Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 35 articles in PubMed, 375 in Scopus, 20 in CINAHL, 7 in Cochrane Library, 2495 in Google Scholar, and 3 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 2 randomized trials and 0 systematic studies met the inclusion criteria.

Treatment Recommendations

Many patients with hip OA control their pain adequately for many years by avoiding activities that significantly provoke symptoms and by using over-the-counter medications. Due to the deep nature of the hip joint, topical agents, heat, and ice may be less helpful for hip OA than for OA in other joints. Because OA is generally characterized by morning stiffness or stiffness (and pain) after long periods of inactivity or in association with unaccustomed increases in activity, patients may benefit from education, environmental and activity modification, and strategies for participation in meaningful occupations. Regular participation in programs stressing aquatic or gentle aerobics (e.g., walking programs) or strengthening exercises may be beneficial, especially if they are individualized to the patient's diagnosis, prior and desired activity levels, and overall preferences [459]. Weight loss is indicated for patients who are overweight or obese [68-79, 510], and evidence increasingly suggests meaningful clinical improvements with weight loss among those with lower extremity OA [459].

Nonsteroidal anti-inflammatory drugs (NSAIDs) are most commonly used for patients with OA. Chronic NSAID therapy, especially in the elderly, may warrant the ancillary use of proton pump inhibitors, H2 histamine blocking agents, or misoprostol to provide prophylaxis against adverse gastrointestinal effects. Selective Cox-2 inhibitors are also used due to lower risks of gastrointestinal effects. Tricyclic antidepressants, dual reuptake inhibiting antidepressants (i.e., SSNRIs), and acetaminophen may benefit certain patients. Older patients with significant comorbidities, including renal impairment and medications, should be prescribed medications more cautiously.

Invasive procedures are not indicated for managing most OA patients, unless the condition cannot be satisfactorily controlled with other non-invasive treatments. In such cases, intraarticular injections with glucocorticosteroids are sometimes used. The evidence for viscosupplementation is unclear and the subject is controversial.

In advanced cases, joint replacement is often performed, with excellent results for nearly all patients. For major surgery, post-operative rehabilitation is generally relatively short, due largely to the excellent operative results.

Nonprescription analgesics (acetaminophen or NSAIDs) may provide sufficient pain relief for most patients with acute and subacute hip pain from hip OA. Education about hip pain should begin at the first visit. Weight loss is indicated if the patient is overweight or obese. If treatment response is inadequate (i.e., if symptoms and activity limitations continue) or the physician judges the condition limitations to be more significant, prescribed NSAIDs, acetaminophen, or physical methods are generally added. Co-morbid conditions, invasiveness, adverse effects, cost, and physician and patient preferences guide the choice of treatment.

This guideline recommends interventions with quality evidence of proven efficacy. Known complication rates and safety profiles, if available, should always be utilized in decision making and were considered in developing this guideline. In addition to those treatments reviewed herein, there are many other theoretically potential treatments possible for management of hip OA. However, in the absence of moderate- to high-quality studies supporting their efficacy [511], these other interventions are not recommended and are indicated as **Not Recommended, Insufficient Evidence (I)**.

Work and Activity Modifications

There are subtle differences in the way that activities and activity modifications are typically managed for acute versus chronic hip OA pain. Acute pain may benefit from some activity limitations, while chronic pain is not improved with activity limitations. Acute hip OA pain may be modestly improved by avoiding those occupational and non-occupational activities that result in a *substantial* increase in pain. However, in general there is little meaningfully gained from activity limitations in the management of hip OA.

Work activity modifications may be necessary during the treatment course for patients with hip OA pain. Advice on how to avoid aggravating activities that at least temporarily increase hip OA pain includes a review of work duties to decide whether or not modifications can be accomplished without employer notification and to determine whether modified duty is appropriate and available. Maintaining patients at the maximal levels of activity, including work activities, is strongly recommended as it is in their best interest.

The first step in determining whether work activity modifications are required usually involves a discussion with the patient regarding whether he or she has control over his or her job tasks. In such cases where the worker can make modifications (e.g., receive assistance to lift a box or alternate sitting and standing as needed), there may be no requirement to write any restrictions even if the pain is limiting. In some situations, it may be advisable to confirm this report with the patient's supervisor to signal to the supervisor that the person is under treatment. In

some cases, specified limitations may be a better strategy. Assessment of work activities and potential for modifications may also be facilitated by a worksite visit and analysis by a health care provider with appropriate training (e.g., typically a physician, occupational therapist, physical therapist, or some ergonomists).
Work limitations should be tailored by taking into account the following factors:

1) job physical requirements;
2) the safety of the tasks, in consideration of the diagnosed condition, age, and relevant biomechanical limitations;
3) severity of the hip OA problem;
4) work organizational issues (overtime, work allocation, wage incentives); and
5) the patient's understanding of his or her condition.

Sometimes it is necessary to write limitations or to prescribe activity levels that are above what the patient feels he or she can do, particularly when the patient feels that sedentary activity is advisable. In such cases, the physician should be careful to not overly restrict the patient; education about the pain problem and the need to remain active should be provided.
Common limitations involve modifying the weight of objects lifted, frequency of lifts, and posture – all while taking into account the patient's capabilities. For severe cases of acute hip OA pain, frequent initial limitations for occupational and non-occupational activities include the following:

- No lifting of more than 10 pounds
- No prolonged or repeated bending (flexion)
- No prolonged or repeated crouching and squatting
- Avoidance of prolonged, low frequency, high-amplitude whole body vibration
- Alternate sitting and standing frequently

These work (and home) activity guidelines are generally reassessed with consideration of gradual increases in activity recommended so that patients with severe non-specific hip OA pain evolve off modified duty in no more than 6 to 12 weeks. The amount of weight handled can be progressively increased. An alternative is to return the patient at first to 1 to 2 hours a day on his or her prior full-duty job, with the remainder of the day spent at modified duty. The number of hours of full duty work can be increased every 1 to 2 weeks.
There are hip OA patients who initially present with severe pain and dysfunction. In those cases, workplace limitations are more likely to be needed, especially in physically demanding jobs. Those patients may need workplace limitations until arthroplasty is performed.
There is no quality evidence that limitations are required among hip OA patients after a successful arthroplasty. Generally, limitations are not needed post-operatively.
The physician may recommend work and activity modifications or ergonomic redesign of the workplace to facilitate recovery and prevent recurrence of the problem [512]. Physicians may refer patients for an ergonomic evaluation to be conducted on-site by a qualified professional such as an ergonomist, occupational or physical therapist, or other health safety specialist. The employer's role is to accommodate activity limitations and prevent further problems through ergonomic changes that may help return an employee to full activity. In some cases, it may be desirable to conduct an ergonomic analysis of the activities that are thought to be contributing to the symptoms, although there are no validated ergonomic survey instruments for the lower extremity. However, it is important for the patient, physician, and employer to know that there are no quality studies regarding ergonomic interventions to prevent hip OA or other hip/groin conditions, nor are there quality studies regarding return to work and secondary prevention. Thus, suggested changes to the work environment are necessarily empiric.
Because falls result in considerable hip morbidity (including fractures) and fall protection equipment has resulted in far fewer fatalities in industry over the past few decades, fall protection is a priority for preventing acute injuries.

Fall protection to decrease risk of falls may involve any combination of administrative controls, education, personal protective equipment, and strengthening/balance exercises [513-519].

Fall Protection

Recommended.

Measures to prevent falls are recommended.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Those at risk of falls; those who have either fallen or nearly fallen, irrespective of incurring an injury
Benefits:	Potential to reduce frequency and severity of falls
Harms:	Negligible
Frequency/Dose/Duration:	Depends on intervention. Some interventions such as education and PPE involve one appointment, but may involve a second to ascertain success, barriers, and adherence. Exercise programs may involve course(s) of therapy and transitioning to independent home exercise programs.
Rationale:	Falls are associated with high costs, morbidity, and mortality in occupational, non-occupational, and elderly populations. Although there are no quality studies demonstrating efficacy of fall protection for hip problems, fall protection measures would likely be successful but have not yet been demonstrated. Exercise programs targeting strength and balance also should reduce the risk of falls and severity. Fall protection is not invasive, has low adverse effects, is low to moderate cost, and is thought to be effective and thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: fall prevention, fall protection; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 46 in Scopus, 0 in CINAHL, 13 in Cochrane Library, 2470 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 6 from Google Scholar, and 0 from other sources. Of the 9 articles considered for inclusion, 2 randomized trials and 4 systematic studies met the inclusion criteria.

ERGONOMIC INTERVENTIONS

No Recommendation.

There is no recommendation for or against the use of ergonomic interventions to prevent or facilitate recovery from hip or groin disorders, including hip OA.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale:	Ergonomic interventions for upper extremity disorders have been attempted in numerous workplace settings. However, there are no quality studies evaluating these interventions for the lower extremity. (In the upper extremity, some interventions thought beneficial were found to be unhelpful.) Thus, without quality evidence, there is no recommendation for or against the use of ergonomic interventions to prevent or facilitate recovery from hip OA or other hip/groin disorders. However, because falls continue to cause morbidity and deaths, fall protection equipment is recommended (see Fall Protection).
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ergonomic interventions; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 36 in Scopus, 0 in CINAHL, 11 in Cochrane Library, 373 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 1 systematic studies met the inclusion criteria.

Exercise

Exercises have been utilized for treatment of osteoarthrosis, including aerobic, strengthening, and flexibility exercises [520-549]. There are reports of low physical activity levels in arthritic patients [550] and some evidence for efficacy of strengthening exercises among these patients [533]. Others have concluded that there is little evidence in support of efficacy of strengthening and aerobic exercise in hip OA patients and no evidence to support home versus group therapy [524]. Multiple studies have attempted to examine effectiveness for patients with rheumatoid arthritis [551, 552]. There are many studies involving knee pain patients [522, 530, 553-562] (see ACOEM Knee Disorders guideline's Exercise section); however, whether those results are generalizable to patients with hip pain is unclear and many studies mixed knee and hip osteoarthrosis patients. Although some research indicates that there is a lack of evidence supporting efficacy, others have opined that "exercise may be the most effective, malleable, and inexpensive modality available to achieve optimal outcomes for people with osteoarthritis" [563].

Available research consists mostly of low- to moderate-quality trials (see Exercise evidence table). Some research has included both inflammatory conditions as well as osteoarthrosis; thus, the entire body of exercise-related articles has been included. Most studies have combined different exercises into programs that at least partially obscure the effects of a specific exercise prescription (e.g., flexibility versus aerobic versus strengthening). However, some patterns appear to be present in the available literature. Although these recommendations are

specific to hip or knee osteoarthrosis, these recommendations also appear to apply to the rheumatoid arthritis patient, because materially different results were not found with that population (see Exercise evidence table).

Aerobic Exercise for Hip Osteoarthrosis

Aerobic exercise has been used for treatment of hip OA (e.g., swimming, walking, or cycling) [564-571].

Activity Modification and Exercise

Aerobic exercise is moderately recommended for treatment of hip osteoarthrosis.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Hip osteoarthrosis. Patients with significant cardiac disease or potential for cardiovascular disease should be evaluated prior to instituting vigorous exercises following ACSM *Guidelines for Exercise Testing and Prescription,* 10th ed. [572] for health screening and risk stratification. A self-directed program is recommended for all patients. Supervised programs may be particularly indicated for patients who require supervision to initiate a program or otherwise need assistance with motivation or concomitant fear avoidant belief training for a few appointments to help initiate the program.
Benefits:	Improved physical fitness, mood, self-esteem, and motor performance.
Harms:	Negligible
Frequency/Dose/Duration:	Frequency is unclear. Walking at least 4 times a week at 60% of predicted maximum heart rate (220 - age = maximum heart rate) is recommended [573, 574]. Aquatic-based exercise is an option (see Hydrotherapy (Aquatic Therapy) for Hip Osteoarthrosis). Nearly all patients should be encouraged to maintain aerobic exercises on a long-term basis for fitness purposes, including lower extremity muscle strength, as well as to maintain optimal health. Ssuccessive sets of 5-6 formal PT appointments should be based on incremental functional gain.
Indications for Discontinuation:	Intolerance (rarely occurs), development of other disorders
Rationale:	There are multiple RCTs addressing exercise for hip and/or knee osteoarthrosis patients. Because there is not a strong rationale for believing there are major differences in efficacy for hip versus knee OA, this summary assumes the outcomes are similar in both sets of patients. Most of these studies combined different exercises. Some exercise programmatic components were unstructured and others did not clearly describe the interventions. These limitations restrict drawing strong evidence-based conclusions regarding any single intervention. Yet, there are quality studies comparing exercise to non-exercise controls that allow evidence-based conclusions to be drawn on the relative value of aerobic, stretching, and strengthening exercises. Authors of a meta-analysis concluded the literature demonstrates efficacy of exercises for hip osteoarthrosis patients, especially for those containing strengthening exercises [533]. However, a high-quality trial of knee OA suggests while both aerobic and resistance

training are helpful, aerobic exercises are modestly superior to resistance training and far superior to an educational control [558], which suggests weight bearing may be beneficial and raises questions about which exercise may be superior for hip osteoarthrosis patients. All quality studies including a major component of documented compliance with increased aerobic exercise found benefits of aerobic exercise [568, 573, 575]. Strengthening exercise results appear similar. There is not clear superiority of aerobic or strengthening exercises or vice versa. The available quality evidence suggests aerobic and strengthening exercises are superior to flexibility or range of motion exercises [573]. Some but not all data suggest increased exercise intensity results in superior outcomes. Not all studies that have assessed inflammatory markers and joint scores among those with OA or RA have found reductions in erythrocyte sedimentation rates and lower joint scores among those exercising. Pool-based programs have been evaluated and evidence of superiority of water-based programs is lacking (see Aquatic Therapy below).

Problems with compliance and persistence with exercise programs after discharge are considerable. Evidence is mixed regarding whether supervised exercise programs are necessary or whether home-based programs are sufficient. Physicians need to encourage ongoing patient compliance with these programs. Exercise programs are not invasive, have low adverse effects, and are low to moderate cost depending on the number of supervised appointments. Programs emphasizing aerobic and strengthening exercises are moderately recommended and stretching is recommended for patients with considerable reductions in range of motion that do not appear fixed.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: stair climbing, elliptical training, indoor rower, stair master, stationary bicycle, treadmill, jogging, walking, cycling, running, cross country skiing, cross country running, Nordic walking, inline skating, rowing, kickboxing, skipping rope, jump rope, circuit training, jumping jacks, 5BX, XBX, aerobic exercise, aerobics, aerobic exercises, exercise, cardio exercise, cardio exercises, aerobic programs, aerobics programs, aerobic exercise therapy; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthritis, Hip Degenerative Arthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 467 articles in PubMed, 767 in Scopus, 95 in CINAHL, 7 in Cochrane Library, 752 in Google Scholar, and 22 from other sources. We considered for inclusion 17 from PubMed, 6 from Scopus, 7 from CINAHL, 1 from Cochrane Library, 5 from Google Scholar, and 22 from other sources. Of the 58 articles considered for inclusion, 29 randomized trials and 22 systematic studies met the inclusion criteria.

Stretching Exercises for Hip Osteoarthrosis

Recommended.

Stretching exercises are recommended for select patients with significant reductions in range of motion that are not thought to be fixed deficits.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Patients with significant reductions in range of motion that are thought to be non-fixed deficits, particularly that impair function (e.g., limitations based on stiffness or disuse rather than osteophytes).
Benefits:	Improved range of motion, self-esteem, and motor performance
Harms:	Negligible
Frequency/Dose/Duration:	Generally taught as home exercises in 1 to 3 appointments. Additional appointments may be needed for motivation, but progressive functional benefit should be documented.
Indications for Discontinuation:	Worsening of symptoms, identification that deficits are fixed, or achievement of exercise program goals.
Rationale:	There are no quality trials documenting efficacy of stretching. Stretching may help improve range of motion for non-fixed deficits and thus is selectively recommended for patients with considerable reductions in range of motion that do not appear fixed.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: stretching, muscle stretching, stretching exercises, stretching exercise, muscle stretching exercises, stretch, flexibility, flexibility, exercise, exercises, flexible, stretching, passive, static, static passive, relaxed, relax, isometric, active, static active, ballistic, dynamic, proprioceptive neuromuscular facilitation, PNF, specific stretching; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 21 articles in PubMed, 311 in Scopus, 30 in CINAHL, 92 in Cochrane Library, 40 in Google Scholar, and 3 from other sources. We considered for inclusion 3 from PubMed, 0 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 3 from other sources. Of the 8 articles considered for inclusion, 3 randomized trials and 1 systematic studies met the inclusion criteria.

Strengthening Exercises for Hip Osteoarthrosis

Moderately Recommended.

Strengthening exercises are moderately recommended for treatment of hip osteoarthrosis.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Often added with aerobic exercises as an exercise program. In limited circumstances where range-of-motion deficits are considerable but thought to not be fixed, strengthening is sometimes added after beginning flexibility exercises.
Benefits:	Improved strength, physical fitness, mood, self-esteem and motor performance. One report suggested a potentially reduced need for arthroplasty [577].
Harms:	Negligible
Frequency/Dose/Duration:	Frequency 2 to 3 times a week for hip osteoarthrosis up to 6-8 visits and transition to home exercise program. Additional sets of PT appointments based on incremental functional gain. Supervised treatment frequency and duration is dependent on symptom severity and acuity and presence of comorbid conditions.
Indications for Discontinuation:	Development of a strain, failure to improve.
Rationale:	There are multiple RCTs addressing strengthening exercises for hip and/or knee osteoarthrosis patients. Because there is not a strong rationale for believing there are major differences in efficacy for hip versus knee OA, this summary assumes the outcomes are similar in both sets of patients. Most of these studies combined different exercises. Some exercise programmatic components were unstructured and others did not clearly describe the interventions. These limitations restrict drawing strong evidence-based conclusions regarding any single intervention. There are some quality studies comparing exercise to non-exercise controls that allow drawing evidence-based conclusions on the relative value of aerobic, stretching, and strengthening exercises. Authors of a meta-analysis concluded the literature demonstrates efficacy of exercises for hip osteoarthrosis patients, especially for those containing strengthening exercises [533]. However, a high-quality trial of knee OA suggests while both aerobic and resistance training are helpful, aerobic exercises are modestly superior to resistance training and far superior to an educational control [558], which suggests weight bearing may be beneficial and raises questions about which exercise may be superior for hip osteoarthrosis patients. There is no clear superiority of aerobic or strengthening exercises or vice versa. The available quality evidence suggests aerobic and strengthening exercises are superior to flexibility or range of motion exercises [573], Some but not all data suggest increased exercise intensity results in superior outcomes. But not all studies that have assessed inflammatory markers and joint scores among those with OA or RA have found reductions in erythrocyte sedimentation rates and lower joint scores among those exercising.

Problems with compliance and persistence with exercise programs after discharge are considerable. Evidence is mixed regarding whether supervised exercise programs are necessary or whether home-based programs are sufficient. Physicians need to encourage ongoing patient compliance with these programs. Exercise programs are not invasive, have low adverse effects, and are low to moderate cost depending on numbers of supervised appointments. Programs emphasizing aerobic and strengthening exercises are moderately recommended and stretching is recommended for patients with considerable reductions in range of motion that do not appear fixed.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: endurance training, tolerance training, exercise tolerance, strengthening exercise, weight lifting, weight bearing, weight, lifting, bearing; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthritis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 59 articles in PubMed, 101 in Scopus, 44 in CINAHL, 0 in Cochrane Library, 70 in Google Scholar, and 8 from other sources. We considered for inclusion 2 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 8 from Google Scholar, and 8 from other sources. Of the 20 articles considered for inclusion, 10 randomized trials and 10 systematic studies met the inclusion criteria.
A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Graded exercise; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 15 articles in PubMed, 1 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 10400 in Google Scholar, and 1 from other sources. We considered for inclusion 4 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 5 articles considered for inclusion, 3 randomized trials and 1 systematic studies met the inclusion criteria.

Hydrotherapy (Aquatic Therapy) for Hip Osteoarthrosis

Hydrotherapy (aquatic therapy or water-related rehabilitation) has been used for patients with hip osteoarthrosis [519, 584-586].

Moderately Recommended.

Activity Modification and Exercise

A trial of aquatic therapy is moderately recommended for patients with hip osteoarthrosis who meet the referral criteria for supervised exercise therapy and have co-morbidities (e.g., extreme obesity, significant degenerative joint disease, etc.) that preclude effective participation in a weight-bearing physical activity and who will transition to either a land-based program or a self-administered water-based program.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Self-administered exercise among those motivated towards aquatic exercise. Supervised program among those with co-morbidities warranting aquatic exercise (e.g., extreme obesity, significant degenerative joint disease) and will either transition to land-based program or self-administered water-based exercise program.
Benefits:	Improved physical fitness, mood, self-esteem and motor performance.
Harms:	Negligible
Frequency/Dose/Duration:	Begin with 3 to 4 visits a week, with demonstrated evidence of functional improvement within the first 2 weeks to justify additional visits. The program should include up to 4 weeks of aquatic therapy with progression towards a land-based, self-directed physical activity or self-directed aquatic therapy program by 6 weeks [587]. For some patients with hip osteoarthrosis, aquatic exercise may be the preferred method. In these few cases, the program should become self managed and if any membership to a pool is covered, coverage should be continued if it can be documented that the patient is using the facility at least 3 times per week and following the prescribed exercise program.
Indications for Discontinuation:	Non-tolerance, failure to progress, or reaching a 4- to 6-week timeframe.
Rationale:	A trial suggested improved pain and quality of life after 6 weeks of aquatic therapy [587]. Another moderate quality trial reported improvements in pain compared with a non-interventional control [564]. Aerobic exercise is beneficial for treatment of hip osteoarthrosis compared to no program [587]; however, evidence of superiority to land-based programs is lacking [573, 588-590]. Instead, the quality literature appears to document comparable efficacy between land- and water-based exercise programs [573, 588, 589]. Aquatic programs are performed in lukewarm rather than higher temperature. As noted previously, other forms of exercise have been shown to be effective in the treatment of hip OA, but for a few select patients who are unable to tolerate those land-based therapies, aquatic therapy is moderate cost, not invasive, and has little potential for adverse effects.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: aquatic therapy, pool therapy, swimming, aqua therapy, hydrotherapy, Ai Chi, Aqua running, Bad Ragaz Ring Method, Watsu, deep water exercise, deep water exercises, shallow water exercise, shallow water exercises; Hip

Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 36 articles in PubMed, 613 in Scopus, 9 in CINAHL, 73 in Cochrane Library, 590 in Google Scholar, and 0 from other sources. We considered for inclusion 7 from PubMed, 1 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 10 from other sources. Of the 20 articles considered for inclusion, 12 randomized trials and 5 systematic studies met the inclusion criteria.

Tai Chi for Hip Osteoarthrosis

Recommended.

Activity Modification and Exercise

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Hip OA patients who are motivated to try and adhere to a program of Tai Chi.
Benefits:	Modest reductions in pain.
Harms:	None reported. May reduce compliance with aerobic and strengthening exercises due to time commitment.
Frequency/Dose/Duration:	Generally at least 3 times/week
Indications for Discontinuation:	Non-compliance, non-tolerance, disinterest
Rationale:	There are a few quality trials of Tai Chi for treatment of hip OA [585, 596], but none documenting unequivocal efficacy and one suggests superiority of hydrotherapy [585]. Thus, Tai Chi may be reasonable for a highly motivated patient who is interested in Tai Chi as the primary exercise modality.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Tai Chi, Tai Ji; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 7 articles in PubMed, 318 in Scopus, 5 in CINAHL, 1 in Cochrane Library, 229 in Google Scholar, and 15 from other sources. We considered for inclusion 3 from PubMed, 4 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 4 from other sources. Of the 13 articles considered for inclusion, 5 randomized trials and 6 systematic studies met the inclusion criteria.

Gait Training for Hip Osteoarthrosis

Gait patterns have been used as observable indicators for rehabilitation among hip osteoarthrosis patients [597-599].

No Recommendation.

Activity Modification and Exercise

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	Gait training is not invasive, has no adverse effects, but is moderately costly depending on numbers of evaluations. There are multiple trials, but no clear evidence of efficacy and thus, there is no recommendation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: gait training, gait rehabilitation; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 9 articles in PubMed, 14in Scopus, 0 in CINAHL, 0 in Cochrane Library, 2490 in Google Scholar, and 8 from other sources. We considered for inclusion 4 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 3 from Google Scholar, and 8 from other sources. Of the 15 articles considered for inclusion, 12 randomized trials and 2 systematic studies met the inclusion criteria.

Medications

Antibiotics for Hip Surgery

Prophylactic antibiotics are considered mandatory and have been long utilized both systemically and added to cement [600-613]. Antibiotics are required for treatment of infection.

Recommended.

Medications (including topical creams)

Antibiotics are essential. One-day use of systemic prophylactic antibiotics is moderately recommended for patients undergoing surgical hip procedures. Antibiotic-impregnated cement is another recommended option. Antibiotics are also recommended for superficial and deep wound infection management.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **High**

Indications:	Patients undergoing hip surgery, especially with prostheses. Antibiotics are considered mandatory for hip surgeries, especially for those involving any prosthetic, and essential to treat superficial and deep infections.
Benefits:	Reduced risk of joint or prosthetic infection.
Harms:	Negligible
Frequency/Dose/Duration:	Single use for perioperative treatment. Per manufacturer's recommendation for treatment of infection.
Indications for Discontinuation:	Completion of a course. Resolution of infection if treating an infection.
Rationale:	There is evidence from non-randomized registry data of 10,905 hip prostheses that the risk of revision due to infection was reduced 75 to 78% with a systemic antibiotic combined with an antibiotic-impregnated cement compared with either systemic antibiotic administration or antibiotic-impregnated cement alone. The risk, if there was only antibiotic in the cement, was 6.3-fold higher, and, if the antibiotic was only systemic risk, was 4.3-fold greater [614]. There is a belief that some cases of aseptic loosening are

undiagnosed infections [600] as there were lower rates of aseptic loosening among those with both routes of antibiotic administration compared with either alone [615] and those with gentamicin cement appear to have lower rates of aseptic loosening compare with systemic antibiotics [616, 617]. In the largest comparative trial of more than 1,600 hip arthroplasties, cement with gentamicin was found to produce fewer deep infections, but more superficial infections compared with an uncontrolled arm of systemic antibiotics alone [601, 616, 617]. There is one low-quality study suggesting no difference in infection rates between cement-antibiotic and systemic antibiotic arms [618]. Thus, there is quality evidence that a combination of systemic and antibiotic-impregnated cement is important to prevent infections. There was no prosthesis survival benefit if systemic antibiotics were administered for greater than one day [619]. Numerous antibiotics have been utilized, including gentamicin, cloxacillin, dicloxacillin, probenecid, cephalexin, and phenoxymethylpenicillin [601], but there are no large-scale, head-to-head comparative trials available.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Antibiotics, anti-bacterial agents; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 23 articles in PubMed, 1111 in Scopus (reviewed first 100), 12 in CINAHL, 38 in Cochrane Library, 6250 in Google Scholar (reviewed first 100), and 109 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 7 from other sources. Of the 9 articles considered for inclusion, 7 randomized trials and 2 systematic studies met the inclusion criteria.

Norepinephrine Reuptake Inhibitors for Hip Osteoarthrosis

No Recommendation.

Medications (including topical creams)

There is no recommendation for or against the use of norepinephrine reuptake inhibiting anti-depressants for hip osteoarthrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: Norepinephrine reuptake inhibiting anti-depressants (e.g., amitriptyline, doxepin, imipramine, desipramine, nortriptyline, protriptyline, maprotiline, and clomipramine) and mixed norepinephrine and serotonin inhibitors (e.g., venlafaxine, bupropion, and duloxetine) have evidence of efficacy for treatment of chronic low back pain and other chronic pain conditions (see Low Back Disorders Guideline). There is strong evidence of lack of efficacy for treatment of nociceptive pain (e.g., LBP) with SSRIs, thus they appear unlikely to successfully treat hip pain. However, there is no quality evidence evaluating these medications for treatment of hip osteoarthrosis or other hip pain. There also are no clear analogous disorders for which evidence-based guidance may be reliably derived.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: duloxetine; selective serotonin reuptake inhibitor, norepinephrine, tricyclic antidepressant, venlafaxine; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthritis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 9 articles in PubMed, 1 in Scopus, 0 in CINAHL, 46 in Cochrane Library, 700 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic studies met the inclusion criteria.

Selective Serotonin Reuptake Inhibitors (SSRIs) for Hip Pain

Not Recommended.

Medications (including topical creams)

Selective serotonin reuptake inhibitors (SSRIs) are not recommended for treatment of acute, subacute, or chronic hip pain.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: Norepinephrine reuptake inhibiting anti-depressants (e.g., amitriptyline, doxepin, imipramine, desipramine, nortriptyline, protriptyline, maprotiline, and clomipramine) and mixed norepinephrine and serotonin inhibitors (e.g., venlafaxine, bupropion, and duloxetine) have evidence of efficacy for treatment of chronic low

	back pain and other chronic pain conditions (see Low Back Disorders Guideline). There is strong evidence of lack of efficacy for treatment of nociceptive pain (e.g., LBP) with SSRIs, thus they appear unlikely to successfully treat hip pain. However, there is no quality evidence evaluating these medications for treatment of hip osteoarthrosis or other hip pain. There also are no clear analogous disorders for which evidence-based guidance may be reliably derived.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: duloxetine; selective serotonin reuptake inhibitor, norepinephrine, tricyclic antidepressant, venlafaxine; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthritis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 9 articles in PubMed, 1 in Scopus, 0 in CINAHL, 46 in Cochrane Library, 700 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic studies met the inclusion criteria.

Since the 1960s, anti-convulsant agents have been used off-label to treat certain chronic pain syndromes [623-625], particularly neuropathic pain [626, 627]. Anti-convulsants are thought to have analgesic properties. Several have been used to manage chronic pain conditions including carbamazepine, valproic acid, gabapentin, phenytoin, clonazepam, lamotrigine, tiagabine, pregabalin, topiramate, levetiracetam, oxcarbazepine, and zonisamide (see ACOEM Chronic Pain Guideline section on anti-convulsant agents for more details).

Anti-Convulsant Agents (including Gabapentin and Pregabalin) for Hip Osteoarthrosis or Hip Pain

No Recommendation.

Medications (including topical creams)

There is no recommendation for or against the use of topiramate, gabapentin or pregabalin to treat hip osteoarthrosis or other subacute or chronic hip pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale:	There are no quality studies to support the use of anti-convulsant agents for hip OA pain patients. Quality evidence suggests topiramate is weakly effective for treatment of low back pain patients and gabapentin is unhelpful. However, there is quality evidence that gabapentin reduces need for opioids when administered as part of perioperative pain management [628-631].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Topiramate; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 18 in Scopus, 0 in CINAHL, 2 in Cochrane Library, 59 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria. A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: gabapentin, pregabalin, hip osteoarthritis, hip degenerative joint disease, hip Osteoarthritis, hip degenerative arthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 361 in Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Gabapentin is a medication that is used as an antiepileptic and an anticonvulsant drug [632], but is also used for pain relief and opioid-sparing after total hip arthroplasty [633].

Gabapentin for Preoperative/Perioperative Hip Pain

No Recommendation.

Medications (including topical creams)

Gabapentin is moderately recommendation for pre- and peri-operative use. Gabapentin is otherwise not recommended for treatment of hip OA pain.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Perioperative use, e.g., arthroplasty
Benefits:	Reduced need for opioids. Less post-operative impairment.
Harms:	Sedation , dizziness, drowsiness, weakness, fatigue, blurred vision, headache, poor coordination or balance.
Frequency/Dose/Duration:	One large successful trial used 1200mg pre-operatively and then 600mg T.I.D. for 3 days [634]. Limited use to immediate peri-operative period, usually a few days.
Indications for Discontinuation:	Completion of course, sufficient recovery, resolution of pain, intolerance, adverse effects
Rationale:	There are many randomized controlled trials suggesting gabapentin spares opioids use in the peri- to post-operative window among hip arthroplasty patients [634-640]. However, a few trials that included hip arthroplasty and/or lower extremity patients found no benefit of gabapentin compared with multimodal post-operative anesthesia such as regional anesthesia and patient-controlled anesthesia [638, 641, 642]. Gabapentin is not invasive, has low to moderate adverse effects, is low cost over a few days use, and has evidence of post-operative opioid-sparing abilities. Thus, it is recommended as a management option. Multimodal anesthesia, including durable regional blocks and patient-controlled anesthesia may be preferable due to fewer systemic adverse effects.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Gabapentin; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 97 in Scopus, 0 in CINAHL, 10 in Cochrane Library, 299 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

NSAIDs are widely used for treatment of OA [463, 643-647].

NSAIDs for Hip Osteoarthrosis

Recommended.

Medications (including topical creams)

NSAIDS are strongly recommended for the treatment of hip osteoarthrosis.

Strength of Evidence – **Strongly Recommended, Evidence (A)**
Level of Confidence – **High**

Indications:	Nearly all patients with OA who tolerate NSAIDs and need medication for management are candidates. Elderly and those with chronic diseases such as diabetes especially are candidates for co-mediation with cytoprotective agents (see Cytoprotective Agents).
Benefits:	Improved pain control with negligible risks of impairments. NSAIDs are among the best pain medications especially for cognitive demands and safety critical workers.
Harms:	Gastrointestinal adverse effects are especially prominent in those with past history of gastrointestinal bleeding, the elderly, and those with other diseases, e.g., diabetes mellitus and rheumatoid arthritis. For those, either cytoprotection (e.g., misoprostol, proton pump inhibitor, H2 blocker, sucralfate) or Cox-2 agents are advisable. There is some evidence for increased cardiovascular risks, especially in the highly and more-selective NSAIDs. There is no clear evidence of cardiovascular harm from the non-selective NSAIDs ibuprofen and naproxen. (see further discussion in Low Back Disorders Guideline). It appears that despite widespread usage, diclofenac does not have clear superiority at least for LBP where it has been trialed, yet may have somewhat increased risks for adverse cardiovascular events [188] and is neither recommended nor not recommended for use either alone or in combination with misoprostol (Arthrotec). Other adverse effects particularly in the elderly include hypertension, blood loss, renal insufficiency (as manifested by an increased creatinine), and hepatic enzyme elevations.
Frequency/Dose/Duration:	Generally, generic ibuprofen, naproxen or other older generation NSAIDs are recommended as first-line medications. Acetaminophen is a reasonable alternative, is a primary medication for mild OA, and may also be used as an adjunct to NSAID, although evidence suggests it is modestly less efficacious for OA and other typical musculoskeletal disorders (see Low Back Disorders). Over-the-counter (OTC) agents may suffice and may be tried first. COX-2 selective agents are recommended as a third- or fourth-line medications when there are contraindications for other NSAIDs and/or there are risks of GI complications; however, concomitant treatment with misoprostol, sucralfate, and proton pump inhibitors are also options for gastro-protection. For most patients, scheduled dosage, rather than as needed, may be preferable, however prescribing NSAIDs as needed is reasonable for mild or moderate symptoms. Due to the potential adverse effects from chronic use (more than 2 months) of NSAIDs, patients should be

periodically monitored for adverse effects such as hypertension, blood loss, renal insufficiency (as manifested by an increased creatinine), and hepatic enzyme elevations. Older patients and those with co-morbidities generally require more frequent monitoring.

Indications for Discontinuation: Resolution of pain, sufficient improvement to not require medication, lack of efficacy, development of adverse effects.

Rationale: There are numerous high-quality trials documenting efficacy of NSAIDs for treatment of OA [449, 463, 635, 646, 648-663]. There are a few studies of osteoarthrosis flares that also consistently document benefits [659, 664, 665]. There are no quality studies of acute, subacute or post-operative hip pain, however, by analogy to other MSDs including LBP (see Low Back Disorders guideline); successful treatment of hip pain may be reasonably anticipated. Results are positive whether considering COX-1 (non-selective) or COX-2 (selective) NSAIDs, although the magnitude of benefit is not generally large for any given medication. While there are many quality trials comparing various NSAIDs, there is no consistent quality evidence of superiority of one over another or of one class over another nor is there consistent quality evidence for superiority of enteric-coated or sustained release preparations. Most studies have not found cyclooxygenase-2 selective medications to be superior to other NSAIDs for pain control [666-668]; however, there is quality evidence they reduce risk of gastrointestinal adverse effects [666-668]. There is one quality study suggesting that evening dosing of indomethacin resulted in better pain control, but the study has not been replicated [669]. There is no similar result with the longer half-life agent celecoxib [670]. There is quality evidence that NSAIDs are less impairing than opioids, yet with comparable efficacy (see ACOEM Opioids Guideline and Low Back Disorders Guideline). For most patients, generic ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Second-line medications should include one of the other generic medications.

Due to their inhibitory effects on platelet function, non-selective COX inhibitors should be used with caution, or avoided altogether, in the post-operative period if patients are also receiving pharmacoprophylaxis (e.g., warfarin, low molecular weight heparins) to prevent venous thromboembolic disease. Concomitant use of non-selective COX inhibitors and anti-coagulation regimens may increase the risk of hemorrhage. There is also concern that COX inhibitors, particularly COX-2 inhibitors, may inhibit bone healing. Therefore, these agents should be used with caution or avoided altogether in those acute post-operative period where bone healing is required, such as in fracture repair or hip replacements where cementless acetabular and/or femoral components are utilized [671]. There is evidence that NSAIDs are as effective for pain relief as opioids, including tramadol [672, 673] and dextropropoxyphene [674], although slightly less efficacious than codeine [675, 676].

A systematic review and meta-analysis of observational studies of NSAIDs found that the risk for serious cardiovascular events was elevated in combined analyses for some NSAIDs, but not for others [677]. Many of the studies supporting these estimates were based on large pharmaceutical databases that were adequately powered to detect effects, but had limited ability to control for potential

confounding. There is one reported study of NSAIDs and myocardial infarctions that controlled for two major confounders – aspirin and body mass index [678]. Summary estimates from that study for non-selective NSAIDs suggested that they are protective against cardiovascular events. Study weaknesses included a 50% participation rate and reliance on recall. However, the FDA and American Heart Association have cautioned against the use of NSAIDs, especially COX-2 [679]. Thus, current evidence continues to be unclear if there is increased risk, no risk, or reduced risk of cardiovascular events from the use of any NSAIDs other than rofecoxib which appears to have a modestly elevated relative risk [677]. It is recommended that the risks of NSAIDs use, including cardiovascular risk factors, be discussed with patients.

Risks of gastrointestinal events are also recommended for assessment, particularly including prior history of gastrointestinal bleeding and source, length of treatment, age, smoking, diabetes mellitus and other medical factors. Those with greater risk should be considered for treatment with acetaminophen, NSAID plus misoprostol, proton pump inhibitors (see below), or a COX-2 selective agent (see NSAIDs/acetaminophen evidence table) [661, 666-668, 680, 681].

Gastrointestinal adverse events are generally considered the most significant of the risks of NSAIDs. A large volume of high- and moderate-quality evidence consistently shows proton pump inhibitors are effective for prevention and or treatment of gastric and duodenal ulcers and erosions [682-691]. There is only one quality head-to-head trial, and it found no difference in efficacy between pantoprazole and omeprazole [684]. Misoprostol has also been consistently shown to be effective compared with placebo [692-701]. Relatively fewer studies have shown sucralfate to be effective compared with placebo [702]; H2 blockers appear more effective for treatment of duodenal than gastric mucosa [703-705]. There are relatively few quality trials comparing efficacy of the different classes of agents. Pantoprazole but not lansoprazole has been found modestly superior to misoprostol [706, 707]. No difference was found between famotidine and lansoprazole [708]. Misoprostol has been reported superior to ranitidine [709, 710], cimetidine [711], and sucralfate [711, 712]. In short, while the evidence is not definitive, available quality evidence suggests proton pump inhibitors and misoprostol appear superior to H-2 blockers and sucralfate. While COX-2 selective agents have generally been recommended as either third- or fourth-line medications for routine use in osteoarthrosis patients, when there is a risk of gastrointestinal complications, they are often preferred. For patients at high risk of gastrointestinal bleeding, there is evidence that a combination of proton pump inhibitor plus COX-2 selective agent is efficacious [713]. There is consistent quality evidence that NSAIDs prevent heterotopic bone formation in post-arthroplasty patients (see NSAIDs/Acetaminophen evidence table) [714-718], although there is no quality evidence that prophylactic treatment with NSAIDs results in improved functional outcomes [714]. Still, these medications are successful at preventing heterotopic bone formation and these NSAIDs are moderately recommended for this purpose. Consideration should be given for concomitant use of gastro-protective medication for those patients treated with NSAIDs.NSAIDs are not invasive, have low

side effect profiles in a healthy working age patient population, are low cost when generic medications are used, have strong evidence of efficacy and are thus strongly recommended. The potential for NSAIDs to increase the risk of cardiovascular events needs to be carefully considered in patients and will likely require additional quality studies to fully address.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Anti-Inflammatory Agents, Non-Steroidal, non-steroidal anti-inflammatory, NSAIDS, Anti-Inflammatory Agents, Non-Steroidal; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 241 articles in PubMed, 2253 in Scopus, 222 in CINAHL, 202 in Cochrane Library, 434 in Google Scholar, and 233 from other sources. We considered for inclusion 18 from PubMed, 4 from Scopus, 3 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 233 from other sources. Of the 258 articles considered for inclusion, 252 randomized trials and 6 systematic studies met the inclusion criteria.

NSAIDs for Patients with Known Cardiovascular Disease or Multiple Risk Factors for Cardiovascular Disease

NSAIDs are recommended for patients with known cardiovascular disease or multiple risk factors for cardiovascular disease if the risks and benefits of NSAID therapy for pain are discussed.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications: Nearly all patients with OA who tolerate NSAIDs and need medication for management are candidates. Elderly and those with chronic diseases such as diabetes especially are candidates for co-medication with cytoprotective agents (see Cytoprotective Agents).

Benefits: Improved pain control with negligible risks of impairments. NSAIDs are among the best pain medications especially for cognitive demands and safety critical workers.

Harms: Gastrointestinal adverse effects are especially prominent in those with past history of gastrointestinal bleeding, the elderly, and those with other diseases, e.g., diabetes mellitus and rheumatoid arthritis. For those, either cytoprotection (e.g., misoprostol, proton pump inhibitor, H2 blocker, sucralfate) or Cox-2 agents are advisable. There is some evidence for increased cardiovascular risks, especially in the highly and more-selective NSAIDs. There is no clear evidence of cardiovascular harm from the non-selective NSAIDs ibuprofen and naproxen. (see further discussion in Low Back Disorders Guideline). It appears that despite widespread usage, diclofenac does not have clear superiority at least for LBP where it has been trialed, yet may have somewhat increased risks for adverse cardiovascular events [188] and is neither recommended nor not recommended for use either alone or in combination with misoprostol (Arthrotec). Other adverse effects

	particularly in the elderly include hypertension, blood loss, renal insufficiency (as manifested by an increased creatinine), and hepatic enzyme elevations.
Frequency/Dose/Duration:	Generally, generic ibuprofen, naproxen or other older generation NSAIDs are recommended as second-line medications. Acetaminophen is a reasonable alternative, is a primary medication for mild OA, and may also be used as an adjunct to NSAID, although evidence suggests it is modestly less efficacious for OA and other typical musculoskeletal disorders (see Low Back Disorders). Over-the-counter (OTC) agents may suffice and may be tried first. COX-2 selective agents are recommended as a third- or fourth-line medications when there are contraindications for other NSAIDs and/or there are risks of GI complications; however, concomitant treatment with misoprostol, sucralfate, and proton pump inhibitors are also options for gastro-protection. For most patients, scheduled dosage, rather than as needed, may be preferable, however prescribing NSAIDs as needed is reasonable for mild or moderate symptoms. Due to the potential adverse effects from chronic use (more than 2 months) of NSAIDs, patients should be periodically monitored for adverse effects such as hypertension, blood loss, renal insufficiency (as manifested by an increased creatinine), and hepatic enzyme elevations. Older patients and those with co-morbidities generally require more frequent monitoring.
Indications for Discontinuation:	Resolution of pain, sufficient improvement to not require medication, lack of efficacy, development of adverse effects.
Rationale:	There are numerous high-quality trials documenting efficacy of NSAIDs for treatment of OA [449, 463, 642, 646, 648-663]. There are a few studies of osteoarthrosis flares that also consistently document benefits [659, 664, 665]. There are no quality studies of acute, subacute or post-operative hip pain, however, by analogy to other MSDs including LBP (see ACOEM Low Back Disorders guideline); successful treatment of hip pain may be reasonably anticipated. Results are positive whether considering COX-1 (non-selective) or COX-2 (selective) NSAIDs, although the magnitude of benefit is not generally large for any given medication. While there are many quality trials comparing various NSAIDs, there is no consistent quality evidence of superiority of one over another or of one class over another nor is there consistent quality evidence for superiority of enteric-coated or sustained release preparations. Most studies have not found cyclooxygenase-2 selective medications to be superior to other NSAIDs for pain control [666-668]; however, there is quality evidence they reduce risk of gastrointestinal adverse effects [666-668]. There is one quality study suggesting that evening dosing of indomethacin resulted in better pain control, but the study has not been replicated [669]. There is no similar result with the longer half-life agent celecoxib [670]. There is quality evidence that NSAIDs are less impairing than opioids, yet with comparable efficacy (see ACOEM Opioids Guideline and Low Back Disorders Guideline). For most patients, generic ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Second-line medications should include one of the other generic medications. Due to their inhibitory effects on platelet function, non-selective COX inhibitors should be used with caution, or avoided altogether, in the

post-operative period if patients are also receiving pharmacoprophylaxis (e.g., warfarin, low molecular weight heparins) to prevent venous thromboembolic disease. Concomitant use of non-selective COX inhibitors and anti-coagulation regimens may increase the risk of hemorrhage. There is also concern that COX inhibitors, particularly COX-2 inhibitors, may inhibit bone healing. Therefore, these agents should be used with caution or avoided altogether in the acute post-operative period where bone healing is required, such as in fracture repair or hip replacements where cementless acetabular and/or femoral components are utilized [671]. There is evidence that NSAIDs are as effective for pain relief as opioids, including tramadol [672, 673] and dextropropoxyphene [674], although slightly less efficacious than codeine [675, 676].

A systematic review and meta-analysis of observational studies of NSAIDs found that the risk for serious cardiovascular events was elevated in combined analyses for some NSAIDs, but not for others [677]. Many of the studies supporting these estimates were based on large pharmaceutical databases that were adequately powered to detect effects, but had limited ability to control for potential confounding. There is one reported study of NSAIDs and myocardial infarctions that controlled for two major confounders – aspirin and body mass index [678]. Summary estimates from that study for non-selective NSAIDs suggested that they are protective against cardiovascular events. Study weaknesses included a 50% participation rate and reliance on recall. However, the FDA and American Heart Association have cautioned against the use of NSAIDs, especially COX-2 [679]. Thus, current evidence continues to be unclear if there is increased risk, no risk, or reduced risk of cardiovascular events from the use of any NSAIDs other than rofecoxib which appears to have a modestly elevated relative risk [677]. It is recommended that the risks of NSAIDs use, including cardiovascular risk factors, be discussed with patients.

Risks of gastrointestinal events are also recommended for assessment, particularly including prior history of gastrointestinal bleeding and source, length of treatment, age, smoking, diabetes mellitus and other medical factors. Those with greater risk should be considered for treatment with acetaminophen, NSAID plus misoprostol, proton pump inhibitors (see below), or a COX-2 selective agent (see NSAIDs/Acetaminophen evidence table) [661, 666-668, 680, 681].

Gastrointestinal adverse events are generally considered the most significant of the risks of NSAIDs. A large volume of high- and moderate-quality evidence consistently shows proton pump inhibitors are effective for prevention and or treatment of gastric and duodenal ulcers and erosions [682-684, 686-691, 719]. There is only one quality head-to-head trial, and it found no difference in efficacy between pantoprazole and omeprazole [684]. Misoprostol has also been consistently shown to be effective compared with placebo [692-701]. Relatively fewer studies have shown sucralfate to be effective compared with placebo [702]; H2 blockers appear more effective for treatment of duodenal than gastric mucosa [703-705]. There are relatively few quality trials comparing efficacy of the different classes of agents. Pantoprazole but not lansoprazole has been found modestly superior to misoprostol [706, 707]. No difference was found between

famotidine and lansoprazole [708]. Misoprostol has been reported superior to ranitidine [709, 710], cimetidine [697], and sucralfate [697, 712]. In short, while the evidence is not definitive, available quality evidence suggests proton pump inhibitors and misoprostol appear superior to H-2 blockers and sucralfate. While COX-2 selective agents have generally been recommended as either third- or fourth-line medications for routine use in osteoarthrosis patients, when there is a risk of gastrointestinal complications, they are often preferred. For patients at high risk of gastrointestinal bleeding, there is evidence that a combination of proton pump inhibitor plus COX-2 selective agent is efficacious [713].
There is consistent quality evidence that NSAIDs prevent heterotopic bone formation in post-arthroplasty patients (see NSAIDs/Acetaminophen evidence table) [714-718], although there is no quality evidence that prophylactic treatment with NSAIDs results in improved functional outcomes [714]. Still, these medications are successful at preventing heterotopic bone formation and these NSAIDs are moderately recommended for this purpose. Consideration should be given for concomitant use of gastro-protective medication for those patients treated with NSAIDs.

NSAIDs are not invasive, have low side effect profiles in a healthy working age patient population, are low cost when generic medications are used, have strong evidence of efficacy and are thus strongly recommended. The potential for NSAIDs to increase the risk of cardiovascular events needs to be carefully considered in patients and will likely require additional quality studies to fully address.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Anti-Inflammatory Agents, Non-Steroidal, non-steroidal anti-inflammatory, NSAIDS, Anti-Inflammatory Agents, Non-Steroidal; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 241 articles in PubMed, 2253 in Scopus, 222 in CINAHL, 202 in Cochrane Library, 434 in Google Scholar, and 233 from other sources. We considered for inclusion 18 from PubMed, 4 from Scopus, 3 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 233 from other sources. Of the 258 articles considered for inclusion, 252 randomized trials and 6 systematic studies met the inclusion criteria.

ACETAMINOPHEN FOR HIP OSTEOARTHROSIS

Recommended.

Medications (including topical creams)

Acetaminophen is moderately recommended for the treatment of hip osteoarthrosis.

Strength of Evidence – **Moderately**

Recommended, Evidence (B)

Level of Confidence – **Low**

Indications:	Nearly all patients with OA, particularly with mild to moderate symptoms. Those who do not tolerate NSAIDs and need medication for management are also candidates.
Benefits:	Improved pain control with negligible risks of impairments, especially cognitive, which are present with many other treatment options. Acetaminophen is among the best medications especially for safety sensitive workers.
Harms:	Hepatic effects are generally negligible if used as prescribed in working age populations. Renal adverse effects are possible, especially among chronic, high-dose users and those with other renal impairment. Hepatic toxicity in high doses or among those with other hepatic impairments (e.g., excessive alcohol consumption). Reduced dosage may be used in such settings, along with close monitoring.
Frequency/Dose/Duration:	Generally prescribed up to 3.5g/day in divided doses, usually Q.I.D. dosing. Lower doses are indicated for those who consume significant alcohol. Those with liver disease have a relative contraindication.
Indications for Discontinuation:	Resolution of pain, sufficient improvement to not require medication, lack of efficacy, development of adverse effects.
Rationale:	Acetaminophen has been shown to be superior to placebo for treatment of hip OA [721]. Acetaminophen (or the analog, paracetamol) may be a reasonable alternative for treatment of acute, subacute, post-operative or chronic hip pain [657, 724], although quality evidence is available that documents acetaminophen is consistently less efficacious in comparison with NSAIDs [654, 722, 725-729] and at least two quality trials with placebo comparisons have been negative including one with a large sample size of 779 patients [654, 730]. An FDA advisory committee recommended reduction of the maximum dose to 650mg, which is less than the 1gm dose used in most quality trials, thus the degree of successful treatment of osteoarthrosis with lower doses of acetaminophen is currently somewhat unclear. All trials that compared acetaminophen with NSAIDs found either that the NSAID significantly reduced pain more than acetaminophen or the differences, while not statistically significant, favored the NSAID [654, 722, 725-729, 731]. One trial found superior onset of symptom relief at 2 hours into treatment with ibuprofen compared to paracetamol with relief continuing for the full 2-week duration of the trial. These findings are consistent with quality evidence for treatment of low back pain (see Low Back Disorders guideline). Thus, there is quality evidence that NSAIDs are more efficacious than acetaminophen for pain relief of musculoskeletal conditions including osteoarthrosis. Sub-analyses have suggested NSAIDs are particularly more efficacious for

	those with more severe osteoarthrosis (see NSAIDs/acetaminophen evidence table). However, evidence also indicates higher rates of gastrointestinal adverse effects among NSAID users and generally lower overall adverse effects profiles for acetaminophen, providing rational for utilization of acetaminophen to treat some patients and some recommend acetaminophen as the initial treatment. Acetaminophen is not invasive, has low adverse effects, is low cost, has evidence of efficacy and is thus moderately recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acetaminophen; paracetamol; ibuprofen, Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 43 articles in PubMed, 648 in Scopus, 18 in CINAHL, 8 in Cochrane Library, 654 in Google Scholar, and 21 from other sources. We considered for inclusion 9 from PubMed, 4 from Scopus, 3 from CINAHL, 1 from Cochrane Library, 3 from Google Scholar, and 20 from other sources. Of the 40 articles considered for inclusion, 13 randomized trials and 7 systematic studies met the inclusion criteria.

Acetaminophen or Aspirin as First-Line Therapy for Patients with Cardiovascular Disease Risk Factors

Recommended.

Medications (including topical creams)

Acetaminophen or aspirin are strongly recommended as the first-line therapy for patients with cardiovascular disease risk factors.

Strength of Evidence – **Strongly**

Recommended, Evidence (A)

Level of Confidence – **Low**

Indications:	Nearly all patients with OA, particularly with mild to moderate symptoms. Those who do not tolerate NSAIDs and need medication for management are also candidates.
Benefits:	Improved pain control with negligible risks of impairments, especially cognitive, which are present with many other treatment options. Acetaminophen is among the best medications especially for safety sensitive workers.
Harms:	Hepatic effects are generally negligible if used as prescribed in working age populations. Renal adverse effects are possible, especially among chronic, high-dose users and those with other renal impairment. Hepatic toxicity in high doses or among those with other hepatic impairments (e.g., excessive alcohol consumption). Reduced dosage may be used in such settings, along with close monitoring.
Frequency/Dose/Duration:	Generally prescribed up to 3.5g/day in divided doses, usually Q.I.D. dosing. Lower doses are indicated for those who consume significant alcohol. Those with liver disease have a relative contraindication.
Indications for Discontinuation:	Resolution of pain, sufficient improvement to not require medication, lack of efficacy, development of adverse effects.
Rationale:	Acetaminophen has been shown to be superior to placebo for treatment of hip OA [721]. Acetaminophen (or the analog,

paracetamol) may be a reasonable alternative for treatment of acute, subacute, post-operative or chronic hip pain [657, 724], although quality evidence is available that documents acetaminophen is consistently less efficacious in comparison with NSAIDs [654, 722, 725-729] and at least two quality trials with placebo comparisons have been negative including one with a large sample size of 779 patients [654, 730]. An FDA advisory committee recommended reduction of the maximum dose to 650 mg, which is less than the 1gm dose used in most quality trials, thus the degree of successful treatment of osteoarthrosis with lower doses of acetaminophen is currently somewhat unclear.

All trials that compared acetaminophen with NSAIDs found either that the NSAID significantly reduced pain more than acetaminophen or the differences, while not statistically significant, favored the NSAID [654, 722, 725-729, 731]. One trial found superior onset of symptom relief at 2 hours into treatment with ibuprofen compared to paracetamol with relief continuing for the full 2-week duration of the trial. These findings are consistent with quality evidence for treatment of low back pain (see Low Back Disorders guideline). Thus, there is quality evidence that NSAIDs are more efficacious than acetaminophen for pain relief of musculoskeletal conditions including osteoarthrosis. Sub-analyses have suggested NSAIDs are particularly more efficacious for those with more severe osteoarthrosis (see NSAIDs/acetaminophen evidence table). However, evidence also indicates higher rates of gastrointestinal adverse effects among NSAID users and generally lower overall adverse effects profiles for acetaminophen, providing rational for utilization of acetaminophen to treat some patients and some recommend acetaminophen as the initial treatment. Acetaminophen is not invasive, has low adverse effects, is low cost, has evidence of efficacy and is thus moderately recommended.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acetaminophen; paracetamol; ibuprofen, Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 43 articles in PubMed, 648 in Scopus, 18 in CINAHL, 8 in Cochrane Library, 654 in Google Scholar, and 21 from other sources. We considered for inclusion 9 from PubMed, 4 from Scopus, 3 from CINAHL, 1 from Cochrane Library, 3 from Google Scholar, and 20 from other sources. Of the 40 articles considered for inclusion, 13 randomized trials and 7 systematic studies met the inclusion criteria.

Proton Pump Inhibitors and Misoprostol for Patients at Risk for GI Adverse Effects

Recommended.

Medications (including topical creams)

Concomitant prescriptions of cytoprotective medications are recommended for patients at increased risk for gastrointestinal bleeding from NSAIDs.

Strength of Evidence – **Strongly Recommended, Evidence (A)**

Level of Confidence – **High**

Indications:	Patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, the elderly, diabetics, and cigarette smokers. Physicians are cautioned that H2 blockers might not protect from gastric ulcers [703-705].
Benefits:	Reduced risk of gastrointestinal bleeding
Harms:	Generally minor adverse effects. PPIs have long term risks of fractures, hypomagnesemia, QT prolongation, kidney disease, vitamin B12 deficiency, iron deficiency.
Frequency/Dose/Duration:	Dose and frequency for proton pump inhibitors, sucralfate, and H2 blockers are as recommended by manufacturer. Duration is the extent of the NSAID therapy; use is at times permanent for those with recurrent bleeds or other complications.
Indications for Discontinuation:	Resolution of need for NSAID, discontinuation of NSAID, adverse effects, non-compliance.
Rationale:	Risks of gastrointestinal events are also recommended for assessment, particularly including prior history of gastrointestinal bleeding and source, length of treatment, age, smoking, diabetes mellitus and other medical factors. Those with greater risk should be considered for treatment with acetaminophen, NSAID plus misoprostol, proton pump inhibitors (see below), or a COX-2 selective agent (see NSAIDs/acetaminophen evidence table) [661, 666-668, 680, 681]. Gastrointestinal adverse events are generally considered the most significant of the risks of NSAIDs. A large volume of high- and moderate-quality evidence consistently shows proton pump inhibitors are effective for prevention and or treatment of gastric and duodenal ulcers and erosions [682-684, 686-691, 719]. There is only one quality head-to-head trial, and it found no difference in efficacy between pantoprazole and omeprazole [684]. Misoprostol has also been consistently shown to be effective compared with placebo [692-701]. Relatively fewer studies have shown sucralfate to be effective compared with placebo [702]; H2 blockers appear more effective for treatment of duodenal than gastric mucosa [703-705]. There are relatively few quality trials comparing efficacy of the different classes of agents. Pantoprazole but not lansoprazole has been found modestly superior to misoprostol [706, 707]. No difference was found between famotidine and lansoprazole [708]. Misoprostol has been reported superior to ranitidine [709, 710], cimetidine [697], and sucralfate [697, 712]. In short, while the evidence is not definitive, available quality evidence suggests proton pump inhibitors and misoprostol appear superior to H-2 blockers and sucralfate. While COX-2 selective agents have generally been recommended as either third- or fourth-line medications for routine use in osteoarthrosis patients, when there is a risk of gastrointestinal complications, they are often preferred. For patients at high risk of gastrointestinal bleeding, there is evidence that a combination of proton pump inhibitor plus COX-2 selective agent is efficacious [713].

Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cytoprotective agents, proton pump inhibitors, misoprostol, sucralfate, H2 blockers; hip osteoarthritis, hip degenerative joint disease, hip osteoarthritis, hip degenerative arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 5 articles in PubMed, 18 in Scopus, 5 in CINAHL, 25 in Cochrane Library, 10 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 2 systematic studies met the inclusion criteria.

SUCRALFATE FOR PATIENTS AT RISK FOR GI ADVERSE EFFECTS

Recommended.

Medications (including topical creams)

Concomitant prescriptions of cytoprotective medications are recommended for patients at increased risk for gastrointestinal bleeding from NSAIDs.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **High**

Indications:	Patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, the elderly, diabetics, and cigarette smokers. Physicians are cautioned that H2 blockers might not protect from gastric ulcers [703-705].
Benefits:	Reduced risk of gastrointestinal bleeding
Harms:	Generally minor adverse effects. PPIs have long term risks of fractures, hypomagnesemia, QT prolongation, kidney disease, vitamin B12 deficiency, iron deficiency.
Frequency/Dose/Duration:	Dose and frequency for proton pump inhibitors, sucralfate, and H2 blockers are as recommended by manufacturer. Duration is the extent of the NSAID therapy; use is at times permanent for those with recurrent bleeds or other complications.
Indications for Discontinuation:	Resolution of need for NSAID, discontinuation of NSAID, adverse effects, non-compliance.
Rationale:	Risks of gastrointestinal events are also recommended for assessment, particularly including prior history of gastrointestinal bleeding and source, length of treatment, age, smoking, diabetes mellitus and other medical factors. Those with greater risk should be considered for treatment with acetaminophen, NSAID plus misoprostol, proton pump inhibitors (see below), or a COX-2 selective agent (see NSAIDs/acetaminophen evidence table) [661, 666-668, 680, 681]. Gastrointestinal adverse events are generally considered the most significant of the risks of NSAIDs. A large volume of high- and moderate-quality evidence consistently shows proton pump inhibitors

are effective for prevention and or treatment of gastric and duodenal ulcers and erosions [682-684, 686-691, 719]. There is only one quality head-to-head trial, and it found no difference in efficacy between pantoprazole and omeprazole [684]. Misoprostol has also been consistently shown to be effective compared with placebo [692-701]. Relatively fewer studies have shown sucralfate to be effective compared with placebo [702]; H2 blockers appear more effective for treatment of duodenal than gastric mucosa [703-705]. There are relatively few quality trials comparing efficacy of the different classes of agents. Pantoprazole but not lansoprazole has been found modestly superior to misoprostol [706, 707]. No difference was found between famotidine and lansoprazole [708]. Misoprostol has been reported superior to ranitidine [709, 710], cimetidine [697], and sucralfate [711, 712]. In short, while the evidence is not definitive, available quality evidence suggests proton pump inhibitors and misoprostol appear superior to H-2 blockers and sucralfate. While COX-2 selective agents have generally been recommended as either third- or fourth-line medications for routine use in osteoarthrosis patients, when there is a risk of gastrointestinal complications, they are often preferred. For patients at high risk of gastrointestinal bleeding, there is evidence that a combination of proton pump inhibitor plus COX-2 selective agent is efficacious [713].

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cytoprotective agents, proton pump inhibitors, misoprostol, sucralfate, H2 blockers; hip osteoarthritis, hip degenerative joint disease, hip osteoarthritis, hip degenerative arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 5 articles in PubMed, 18 in Scopus, 5 in CINAHL, 25 in Cochrane Library, 10 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 2 systematic studies met the inclusion criteria.

H2 Blockers for Patients at Risk for GI Adverse Effects

Recommended.

Medications (including topical creams)

Concomitant prescriptions of cytoprotective medications are recommended for patients at increased risk for gastrointestinal bleeding from NSAIDs.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **High**

Indications: Patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, the elderly, diabetics, and cigarette smokers. Physicians are cautioned that H2 blockers might not protect from gastric ulcers [703-705].

Benefits:	Reduced risk of gastrointestinal bleeding
Harms:	Generally minor adverse effects. PPIs have long term risks of fractures, hypomagnesemia, QT prolongation, kidney disease, vitamin B12 deficiency, iron deficiency.
Frequency/Dose/Duration:	Dose and frequency for proton pump inhibitors, sucralfate, and H2 blockers are as recommended by manufacturer. Duration is the extent of the NSAID therapy; use is at times permanent for those with recurrent bleeds or other complications.
Indications for Discontinuation:	Resolution of need for NSAID, discontinuation of NSAID, adverse effects, non-compliance.
Rationale:	Risks of gastrointestinal events are also recommended for assessment, particularly including prior history of gastrointestinal bleeding and source, length of treatment, age, smoking, diabetes mellitus and other medical factors. Those with greater risk should be considered for treatment with acetaminophen, NSAID plus misoprostol, proton pump inhibitors (see below), or a COX-2 selective agent (see NSAIDs/acetaminophen evidence table) [661, 666-668, 680, 681]. Gastrointestinal adverse events are generally considered the most significant of the risks of NSAIDs. A large volume of high- and moderate-quality evidence consistently shows proton pump inhibitors are effective for prevention and or treatment of gastric and duodenal ulcers and erosions [682-691]. There is only one quality head-to-head trial, and it found no difference in efficacy between pantoprazole and omeprazole [684]. Misoprostol has also been consistently shown to be effective compared with placebo [692-701]. Relatively fewer studies have shown sucralfate to be effective compared with placebo [702]; H2 blockers appear more effective for treatment of duodenal than gastric mucosa [703-705]. There are relatively few quality trials comparing efficacy of the different classes of agents. Pantoprazole but not lansoprazole has been found modestly superior to misoprostol [706, 707]. No difference was found between famotidine and lansoprazole [708]. Misoprostol has been reported superior to ranitidine [709, 710], cimetidine [697], and sucralfate [697, 712]. In short, while the evidence is not definitive, available quality evidence suggests proton pump inhibitors and misoprostol appear superior to H-2 blockers and sucralfate. While COX-2 selective agents have generally been recommended as either third- or fourth-line medications for routine use in osteoarthrosis patients, when there is a risk of gastrointestinal complications, they are often preferred. For patients at high risk of gastrointestinal bleeding, there is evidence that a combination of proton pump inhibitor plus COX-2 selective agent is efficacious [713].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cytoprotective agents, proton pump inhibitors, misoprostol, sucralfate, H2 blockers; hip osteoarthritis, hip degenerative joint disease, hip osteoarthritis, hip degenerative arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic,

systematic review, retrospective, and prospective studies. We found and reviewed 5 articles in PubMed, 18 in Scopus, 5 in CINAHL, 25 in Cochrane Library, 10 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 2 systematic studies met the inclusion criteria.

Opioids for Hip Pain

See ACOEM Opioids Guideline.

Skeletal Muscle Relaxants for Hip Pain

Recommended.

Muscle relaxants are selectively recommended as a short course for acute and subacute, moderate to severe hip pain from muscle spasm that is unrelieved by NSAIDs, avoidance of exacerbating exposures or other conservative measures.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	A short course for acute and subacute, moderate to severe hip pain from muscle spasm secondary to other conditions (e.g., OA) that is unrelieved by NSAIDs, avoidance of exacerbating exposures or other conservative measures.
Benefits:	Reduced pain
Harms:	Somnolence, fatigue, reduced alertness.
Frequency/Dose/Duration:	Short course only for hip pain recommended. Initial dose in evening (not during workdays or if patient operates a motor vehicle, though daytime use acceptable if minimal CNS-sedating effects). If significant daytime somnolence results, particularly if it interferes with performance of conditioning exercises and other components of the rehabilitation process or treatment plan, discontinue or prescribe a reduced dose. Duration for exacerbations of chronic pain is limited to a couple weeks. Longer term treatment is generally not indicated.
Indications for Discontinuation:	Resolution of pain, non-tolerance, significant sedating effects that carry over into the daytime, other adverse effects.
Rationale:	There are no quality studies of these agents for treatment of patients with hip pain. Skeletal muscle relaxants have been evaluated in quality studies evaluating chronic back and neck [744-746] (see Chronic Pain and Low Back Disorders Guidelines), although there are far more studies on acute low back pain [747]. The quality of the studies comparing these agents to placebo are likely overstated due to the unblinding that would be inherent in taking a drug with substantial CNS-sedating effects. The adverse effect profile is concerning [748], with CNS sedation rates ranging from approximately 25 to 50% and a low but definite risk of abuse [749, 750]. Thus, prescriptions for skeletal muscle relaxants for daytime use should be carefully weighed against the need to drive vehicles, operate machinery, or otherwise

engage in occupations where mistakes in judgment may have serious consequences (e.g., crane operators, air traffic controllers, construction workers, etc.). Skeletal muscle relaxants have beneficial uses, particularly for nocturnal administration to normalize sleep patterns disrupted by skeletal muscle pain, as well as for daytime use among the few patients who do not suffer from the CNS-depressant effects. They are low cost if generic medications are prescribed. Skeletal muscle relaxants are not recommended for continuous management of subacute or chronic hip pain, although they may be reasonable options for select acute pain exacerbations or for a limited trial as a 3rd- or 4th-line agent in more severely affected patients in whom NSAIDs and exercise have failed to control symptoms.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Skeletal Muscle Relaxants, Neuromuscular Agents; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthritis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 2 articles in PubMed, 3 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 87 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Topical medications include patches, capsaicin and sports creams, NSAIDs, wheatgrass cream, dimethyl sulfoxide (DMSO), N Acetylcysteine (NAC), and Eutectic Mixture of Local Anesthetics (EMLA). Capsaicin is applied to the skin as a cream or ointment and is thought to reduce pain by stimulating other nerve endings (effective through distraction). Rado-Salil ointment is a proprietary formulation of 14 agents, the two most common being menthol (55.1%) and methylsalicylate (26.5%). There are many other commercial products that similarly cause a warm or cool feeling in the skin. All of these agents are thought to work through a counter-irritant mechanism (i.e., feel the dermal sensation rather than the pain). Topical NSAIDs have been used to treat many different MSDs, including arthritis, lateral epicondylitis, and other tendinosis [751, 752]. Many different NSAIDs are compounded, including ibuprofen, naproxen, ketoprofen, piroxicam, and diclofenac [753-755].

Capsicum for Hip Pain

Recommended.

Capsicum is recommended for short-term treatment of acute or subacute hip pain as well as for acute exacerbations of chronic hip pain as a counterirritant.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Level of Confidence – **Low**

Indications: Temporary flare ups of chronic hip pain or acute or subacute hip pain.

Benefits: Reduced pain

Harms:

Irritation, intolerance, reduction in dermal pain fibers

Frequency/Dose/Duration: Duration of use for patients with chronic pain is limited to an acute flare-up period, generally lasting no more than 2 weeks. Not to be used continuously or for more than 1 month as the cost is high compared to alternative treatments of greater or equal efficacy and the patient should be transitioning to an active treatment program. Caution should be exerted to avoid application near the genitals.

Indications for Discontinuation: Resolution of pain, completion of a course, intolerance, other adverse effects.

Rationale: Evidence of efficacy for topical medications and patches is relatively sparse for any disorder and not available for hip pain although there are some quality studies suggesting short- to intermediate-term benefits for some of these agents for more superficial tissues (see Chronic Pain, Elbow Disorders, and Hand, Wrist, and Forearm Disorders Guidelines). Capsicum is recommended as a counterirritant option for treatment of hip pain based on analogy to treatment of low back pain and other chronic pain conditions [756, 757].

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: capsicum patch, capsaicin patch; hip osteoarthritis, hip degenerative joint disease, hip osteoarthritis, hip degenerative arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 0 in Scopus, 0 in CINAHL, 2 in Cochrane Library, 169 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Topical NSAIDs for Hip Osteoarthrosis

Not Recommended.

Topical NSAIDs are not recommended to treat hip OA.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There is no evidence of efficacy and the target tissue is too deep to support a probable basis for efficacy. Topical applications of anesthetic agents over large areas are thought to carry significant risk of potentially fatal adverse effects [758]. These topical agents are not recommended for treatment of hip OA.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: topical NSAIDs, lidocaine patches, eutectic mixture of local anesthetics, creams, ointments; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly;

systematic, systematic review, retrospective, and prospective studies. We found and reviewed 3 articles in PubMed, 82 in Scopus, 0 in CINAHL, 32 in Cochrane Library, 30 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic study met the inclusion criteria.

Lidocaine Patches for Hip Osteoarthrosis

Not Recommended.

Lidocaine patches are not recommended to treat hip OA.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There is no evidence of efficacy and the target tissue is too deep to support a probable basis for efficacy. Topical applications of anesthetic agents over large areas are thought to carry significant risk of potentially fatal adverse effects [758]. These topical agents are not recommended for treatment of hip OA.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: topical NSAIDs, lidocaine patches, eutectic mixture of local anesthetics, creams, ointments; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 3 articles in PubMed, 82 in Scopus, 0 in CINAHL, 32 in Cochrane Library, 30 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic study met the inclusion criteria.

Eutectic Mixture of Local Anesthetics (EMLA) for Hip Osteoarthrosis

Not Recommended.

Eutectic mixture of local anesthetics (EMLA) is not recommended to treat hip OA.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There is no evidence of efficacy and the target tissue is too deep to support a probable basis for efficacy. Topical applications of anesthetic agents over large areas are thought to carry significant risk of potentially fatal adverse effects [758]. These topical agents are not recommended for treatment of hip OA.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: topical NSAIDs, lidocaine patches, eutectic mixture of local anesthetics, creams, ointments; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip

Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 3 articles in PubMed, 82 in Scopus, 0 in CINAHL, 32 in Cochrane Library, 30 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic study met the inclusion criteria.

Other Creams/Ointments for Hip Osteoarthrosis

Not Recommended.

Other creams/ointments are not recommended to treat hip OA.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There is no evidence of efficacy and the target tissue is too deep to support a probable basis for efficacy. Topical applications of anesthetic agents over large areas are thought to carry significant risk of potentially fatal adverse effects [758]. These topical agents are not recommended for treatment of hip OA.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: topical NSAIDs, lidocaine patches, eutectic mixture of local anesthetics, creams, ointments; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 3 articles in PubMed, 82 in Scopus, 0 in CINAHL, 32 in Cochrane Library, 30 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic study met the inclusion criteria.

A variety of tumor necrosis factor (TNF) alpha blockers, including infliximab (a chimeric monoclonal antibody directed against TNF-alpha), etanercept (a recombinant molecule comprising part of the TNF receptor plus the constant region of human immunoglobulin G1 that binds to TNF-alpha), and adalimumab (an IgG1 monoclonal antibody that binds to TNF-alpha) are used for rheumatologic and other inflammatory disorders. However, use of these agents for inflammatory rheumatological disorders is beyond the scope of this guideline.

Tumor Necrosis Factor-Alpha Blockers for Hip Osteoarthrosis or Other Hip Pain

Not Recommended.

Tumor necrosis factor-alpha blockers are not recommended for treatment of osteoarthrosis or acute, subacute, or chronic hip pain, including other non-inflammatory hip disorders.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	One moderately quality trial suggests no significant outcomes differences, although there was less osteolysis. Because the treatment is invasive, has adverse effects, is high cost, and there are no clear clinical benefits, it is not recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: tumor necrosis factor-alpha blockers; hip osteoarthritis, hip degenerative joint disease, hip osteoarthritis, hip degenerative arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 1 articles in PubMed, 787 in Scopus, 2 in CINAHL, 2 in Cochrane Library, 812 in Google Scholar, and 1 from other sources. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 5 articles considered for inclusion, 1 randomized trial and 1 systematic study met the inclusion criteria.

Nerve Growth Factor Inhibitors for Hip Osteoarthrosis

Not Recommended.

Medications (including topical creams)

Nerve growth factor inhibitors are moderately not recommended for the treatment of hip osteoarthrosis.

Strength of Evidence – **Moderately Not Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Rationale:	There are many moderate quality trials, however, the dropout and complication rates are high and multiple trials were put on hold due to adverse effects [645]; thus, nerve growth inhibitors are moderately not recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Tanezumab; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis, nerve growth factor inhibitor, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 7 articles in PubMed, 18

in Scopus, 6 in CINAHL, 14 in Cochrane Library, 197 in Google Scholar, and 2 from other sources. We considered for inclusion 5 from PubMed, 0 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 1 from Google Scholar, and 2 from other sources. Of the 9 articles considered for inclusion, 6 randomized trials and 1 systematic studies met the inclusion criteria.

Glucosamine Sulfate, Chondroitin Sulfate, and/or Methylsulfonylmethane for Hip Osteoarthrosis

No Recommendation.

Medications (including topical creams)

There is no recommendation for or against the use of glucosamine sulfate 1,500mg daily (single or divided dose), chondroitin sulfate, and/or methylsulfonylmethane for the treatment of hip osteoarthrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Benefits:

Potential reduced or delayed need for joint replacement

Harms:

Negligible

Rationale:

There has been some debate over the efficacy of these preparations in reducing pain, improving function, and slowing the progression of the joint space narrowing in osteoarthrosis (see glucosamine evidence table). Four quality studies have followed knee joint spaces with x-rays [779-782] and one has followed the hip joint [783]. Three studies utilized glucosamine sulfate [780, 781, 783], while two utilized chondroitin sulfate [779, 782]. Three studies demonstrated preservation of joint spaces compared with placebo, including some suggestions that over 3 years there was no joint space narrowing in the active treatment group [780-782]. The study that was negative was the study of the hip joint [783], but the data also appeared to trend towards efficacy in both symptoms and x-ray findings. One of the chondroitin sulfate studies [779] found some beneficial x-ray findings, but the joint space was not statistically significant. Thus, while studies that utilized x-rays suggest benefits from treatment of knee osteoarthrosis with either glucosamine sulfate or chondroitin sulfate, quality evidence utilizing x-ray studies of efficacy for treating hip OA is not available.

There are 13 quality studies that included a comparison of glucosamine sulfate with placebo (see glucosamine evidence table). Of the 5 highest quality studies, one [784] was negative but trended toward benefits. There are 4 quality studies that included a comparison of chondroitin sulfate with placebo [779, 782, 784, 785]. The studies on chondroitin are somewhat mixed, as two suggest x-ray benefits as noted above, but symptoms did not improve in 2 studies [782, 784], although one trended toward benefit [784]. One quality study included an assessment of MSM and found it appeared

beneficial [786]. Overall, the studies suggest benefits at rates well above chance associations.

Three studies compared these treatments with traditional NSAIDs [785] or acetaminophen [787]. Glucosamine hydrochloride, chondroitin sulfate, or a combination thereof was not superior to celecoxib 200mg per day [785]. However, the combination was successful for treating moderate to severe osteoarthrosis compared with placebo [785]. Two studies found glucosamine sulfate comparable to ibuprofen 1,200 mg per day [788, 789]. Acetaminophen was found to be inferior to glucosamine sulfate [787].

Glucosamine, alone or in combination with chondroitin, appears to provide first- or second-line therapy for patients with osteoarthrosis of the knee. These preparations are not invasive, appear safe and do not result in gastrointestinal erosions or the other common side effects of NSAIDS, are relatively inexpensive, and provide modest relief of knee osteoarthrosis pain, particularly in patients with more advanced pain. These medications may also modify or slow the progression of knee OA as measured by slowing of cartilage destruction and joint narrowing, although the clinical significance of this effect has not been fully identified. There is preferential evidence for the use of the sulfate salt rather than the hydrochloride formulation of glucosamine. There are two quality studies involving MSM [786], with one suggesting efficacy [778]. There is some evidence that a single daily dose may be more effective than divided doses. Thus, there is quality evidence that glucosamine with or without chondroitin is efficacious for treatment of osteoarthrosis. However, concerns have been raised regarding the use of different glucosamine formulations (hydrochloride versus sulfate), the difference in frequency and dosage strength, and the duration and severity of disease of the study populations [790]. The dose has not been standardized and reportedly ranges widely in available preparations. Therefore, due to lack of uniformity and standardization in preparations, some inconsistency in studies, the fact that most of the studies involved the knee, and that the single study of hip treatment including x-rays was statistically negative [783], there is no recommendation for or against the use of these preparations for hip OA.

One trial assessing additive benefit of omega-3 fatty acids and DHEA to glucosamine found no additive benefit from addition of omega-3 fatty acids [791]. A moderate quality trial found evidence of benefit in WOMAC ratings at 26 weeks with MSM compared with placebo [778].

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis, 2-Amino-2-Deoxyglucose, 2 Amino 2 Deoxyglucose, Hespercorbin, Glucosamine Sulfate, Sulfate, Glucosamine, Dona, Dona S, Xicil, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 43 articles in PubMed, 0 in Scopus, 19 in CINAHL, 68 in Cochrane Library, 33 in Google Scholar, and 0 from other sources. We considered for inclusion 11 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from

Cochrane Library, 0 from Google Scholar, and 23 from other sources. Of the 34 articles considered for inclusion, 27 randomized trials and 7 systematic studies met the inclusion criteria.
A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Chondroitin, Chondroitin Sulfate ; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 25 articles in PubMed, 77 in Scopus, 13 in CINAHL, 3 in Cochrane Library, 1150 in Google Scholar, and 7 from other sources. We considered for inclusion from 3 PubMed, 2 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 4 from Google Scholar, and 7 from other sources. Of the 17 articles considered for inclusion, 8 randomized trials and 9 systematic studies met the inclusion criteria.
A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis Methylsulfonylmethane, methyl sulfone, Dimethyl sulfone controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 2 in Scopus, 0 in CINAHL, 3 in Cochrane Library, 330 in Google Scholar, and 1 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 1 from other sources. Of the 4 articles considered for inclusion, 2 randomized trials and 2 systematic studies met the inclusion criteria.

Complementary or Alternative Treatments or Dietary Supplements for Hip Pain

No Recommendation.

Medications (including topical creams)

There is no recommendation for or against complementary or alternative treatments or dietary supplements, etc. for treatment of acute, subacute, or chronic hip pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	As there is no evidence of efficacy and they have not been shown to produce meaningful benefits or improvements in functional outcomes, complementary and alternative treatments including dietary supplements, etc., there is no recommendation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: completementary treatments, alternative treatments, homeopathic treatments, dietary supplements, vitamins, spiritual therapy, aromatherapy, neural therapy, craniosacral therapy; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized,

randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 23 articles in PubMed, 22 in Scopus, 30 in CINAHL, 153 in Cochrane Library, 898 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 2 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 5 articles considered for inclusion, 3 randomized trials and 2 systematic studies met the inclusion criteria.

Herbal and Other Preparations for Hip Pain

No Recommendation.

Medications (including topical creams)

There is no recommendation for or against use of willow bark (Salix), ginger extract, rose hips, camphora molmol, maleluca alternifolia, angelica sinensis, aloe vera, thymus officinalis, menthe peperita, arnica montana, curcuma longa, tancaetum parthenium, and zingiber officinicalis, avocado soybean unsaponifiables, oral enzymes, topical copper salicylate, S-Adenosylmethionine, and diacerein harpagoside for treatment of acute, subacute, or chronic hip pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale:

Most of these agents have no quality evidence available (e.g., Camphora molmol, Maleluca alternifolia, Angelica sinensis, Aloe vera, Thymus officinalis, Menthe peperita, Arnica Montana, Curcuma longa, Tancaetum parthenium, Harpagoside) for management of hip pain. Some have conflicting results (e.g., willow bark (Salix), rose hips, avocado soybean unsaponifiables, and ginger extract). Still others have no quality studies comparing the active ingredient with placebo (e.g., S-Adenosylmethionine, harpagoside, oral enzymes) and one agent appears ineffective (copper salicylate).

There are some remedies for which there is evidence with regards to the management of acute low back pain and osteoarthrosis. White willow bark (Salix) extract has been studied in low back pain. A principal ingredient is salicin, with salicylic acid as the principal metabolite. Daily doses of 240mg salicin, approximately equivalent to 50mg of acetylsalicylate (which was sufficiently low as to suggest that this may not be the sole reason for its analgesic effect), have been shown to be more effective than placebo in alleviating pain and improving physical impairment scores in patients with acute low back pain, with gastrointestinal complaints occurring no more frequently than with placebo. Topical copper salicylates have also been used for treatment of arthritis [806, 807]. Extract of *Harpagophytum procumbens* (devil's claw root) has been used in Europe to treat musculoskeletal symptoms with some evidence that it may relieve acute low back pain, acute episodes of chronic low back pain, and osteoarthrosis more effectively than placebo in doses that have consisted of the equivalent of 50 to 100mg of harpagoside daily. Mild gastrointestinal upset has been reported at higher doses. Other treatments include ginger extract [808-815], rose hips [816-825], s-adenosylmethionine [826-834], Camphora molmol, Maleluca alternifolia, Angelica sinensis, Aloe vera, Thymus officinalis, Menthe peperita, Arnica Montana, Curcuma longa, Tancaetum parthenium, avocado soybean unsaponifiables [835-840], willow bark extract [841, 842], copper salicylate [806], and oral enzymes [843-847].

Diacerein is an alternative pharmaceutical therapy developed to treat osteoarthrosis which has purported inhibitory action on interleukin-1,

metalloproteases, and other inflammatory mediators which are involved in cartilage destruction in *in vivo* and animal models including inflammatory arthropathies [848-856]. It also stimulates prostaglandin E_2 synthesis and does not affect phospholipase A_2, cyclooxygenase [78], or lipooxygenase, and thus does not affect the gastric mucosa as do NSAIDs [857]. Diacerein has been used as a disease-modifying agent in patients with moderately progressive joint narrowing [805, 858-860]. It is available by prescription in only a few Asian and European countries, and is not currently available in the U.S. The adverse effect profile is generally significantly higher than placebo, most commonly due to higher incidence of diarrhea [849, 861] and darkening of the urine and the magnitude of its effects on pain are small [850]. Diacerein may not be a treatment option for most patients. Optimal dose has been suggested to be 50mg twice daily [849]. It may be an alternative to NSAIDs as a second- or third-line treatment particularly for patients with a history of upper gastrointestinal bleeding as it appears to be potentially associated with lower rates of gastric lesions [857]. However, one quality study suggests NSAIDs are superior to diacerein for relief of pain [861].

Diacerein is not currently available in the United States. There are a few quality studies of diacerein specific to the knee joint or combining hip and knee osteoarthrosis patients included in this analysis [849, 862-871]. Five high- or moderate-quality studies that compared diacerein against placebo demonstrated modest pain relief from diacerein [849, 858, 863, 872, 873]. A study to establish dose-response showed statistically significant improvement of symptoms with 50, 100, and 150mg daily dose, but with fewer side effects and best efficacy with the 100 mg per day group [849]. There is evidence suggesting the effects of diacerein last weeks to months after cessation of therapy [861, 863], which is not found among those on an NSAID [861]. In addition to the symptomatic relief qualities reported, there is one moderate quality study that demonstrated a significant difference in joint space narrowing versus placebo [858]. A 2x2 factorial study comparing diacerein, tenoxicam, diacerein with tenoxicam and placebo demonstrated early efficacy of tenoxicam. However, after 4 weeks, the diacerein plus placebo also reached statistically significantly better symptomatic relief than placebo alone [861]. There was no added synergistic effect, such that the diacerein plus tenoxicam group was no better or worse than by themselves. Examination of diacerein efficacy in two studies that used diacerein as one of the control arms rather than the main active research arm were not as conclusive in favor of diacerein. A comparison of diacerein to hyaluronic acid intra-articular injections over 1 year did not demonstrate diacerein to be more effective than an oral placebo, but the study had significant methodological weaknesses to make conclusions uncertain, as a possible placebo effect of intra-articular injection may have masked oral diacerein treatment [874]. Two studies comparing diacerein to *Harpagophytum procumbens* (devil's claw root) demonstrated both to be effective in improving scores over baseline, but there was no placebo group for comparison [875, 876]. None of these agents has had a standardized dose, resulting in a lack of clarity of patient dosing. All of the studies comparing the agent to a standard NSAID dose found the NSAID superior; only those with lower

doses of NSAIDs sometimes found evidence suggesting equivalency (see Herbal and Other Preparations evidence table). These agents are not invasive, have unclear adverse effect profiles, and over time are moderate to high cost. Thus, there is no recommendation for or against use of these agents.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: diacerein, Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthritis, Hip Degenerative Arthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 26 articles in PubMed, 19 in Scopus, 2 in CINAHL, 19 in Cochrane Library, 541 in Google Scholar, and 10 from other sources. We considered for inclusion 2 from PubMed, 0 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 3 from Google Scholar, and 10 from other sources. Of the 17 articles considered for inclusion, 10 randomized trials and 7 systematic studies met the inclusion criteria.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: herbal preparations, plant preparations, willow bark, Salix, ginger extract, rose hips, camphora molmol, maleluca alternifolia, angelica sinensis, aloe vera, thymus officinalis, menthe peperita, arnica montana, curcuma longa, tancaetum parthenium, zingiber officinicalis, avocado soybean unsaponifiables, oral enzymes, topical copper salicylate, S-Adenosylmethionine, diacerein harpagoside; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 22 articles in PubMed, 40 in Scopus, 0 in CINAHL, 4 in Cochrane Library, 456 in Google Scholar, and 18 from other sources. We considered for inclusion 3 from PubMed, 0 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 4 from Google Scholar, and 18 from other sources. Of the 26 articles considered for inclusion, 19 randomized trials and 2 systematic studies met the inclusion criteria.

Devices and Equipment

Devices and equipment are heavily used in the elderly, but generally much less used in employed workers whose recovery is typically much faster. Regardless, there are infrequent exceptions. Some patients with hip pain might benefit from limited use of devices, particularly as an assistive aid towards regaining improved or full function. These aids include crutches, walkers, and canes. However, aids might also be detrimental for individuals whose function declines with the aid. In general, devices are recommended when there is either: 1) improvement expected and the device is part of a plan to regain normal function or improve function; or 2) the device is essential to achieve the maximum function possible within the limits of fixed defects. Other devices that are infrequently used in employed populations include aids for dressing, bathing, toileting, and tub transfers (e.g., sock aids, long handled dressing devices, tub transfer chairs/benches, hoists, raised toilet seats).

Canes and Crutches for Hip Pain

Recommended.

Devices

Canes and crutches are selectively recommended for moderate to severe acute hip or groin pain or subacute and chronic hip or groin pain, including hip OA, where the device is used to advance the activity level. Walkers may be required for the most debilitated as aids to advance walking.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Disabling, moderate to severe chronic hip OA where risks of increasing debility are outweighed by device use that increases mobility.
Benefits:	Improve mobility, walking distance.
Harms:	Inadvertent increase dependency and debility.
Indications for Discontinuation:	Resolution (e.g., post-operative recovery)
Rationale:	For acute injuries, crutches and canes may be helpful during the recovery and/or rehabilitative phase to increase functional status (e.g., from wheelchair to walker to cane). Other than such circumstances, the use of assistive devices, including wheelchairs, canes, and crutches, is not recommended. For chronic hip pain, crutches may paradoxically increase disability through debility. In those circumstances, institution or maintenance of advice for use of crutches or canes should be carefully considered against potential risks.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: ambulatory devices, canes, shoe insoles, crutches, braces, orthotics; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 5 articles in PubMed, 327 in Scopus, 7 in CINAHL, 57 in Cochrane Library, 68 in Google Scholar, and 7 from other sources. We considered for inclusion 0 from PubMed, 8 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 7 from other sources. Of the 17 articles considered for inclusion, 0 randomized trials and 17 systematic studies met the inclusion criteria.

Orthotics, shoe insoles, and shoe lifts commonly prescribed for low back pain (see Low Back Disorders Guideline section on shoe lifts/orthotics), and more specifically for individuals who have lower extremities that are substantially different in length, referred to as "leg length discrepancies" – generally defined as more than 2 to 3cm. These discrepancies are theoretically linked to increased risk of LBP, and may be of consequence with hip pain. In theory, shoe lifts may ameliorate this leg length discrepancy and thereby reduce LBP or hip pain.

Orthotics, Shoe Insoles, and Shoe Lifts for Hip Pain

Recommended.

Devices

Orthotics, shoe insoles, or shoe lifts are selectively recommended for patients with significant leg length discrepancy and hip pain felt to be a consequence of that discrepancy.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Significant leg length discrepancy (usually at least 2cm), with hip pain or another adverse health attribute thought to be related to the discrepant length.
Benefits:	Reduce pain, improve mobility, walking distance.
Harms:	Negligible
Indications for Discontinuation:	Lack of efficacy
Rationale:	There are no quality studies of these devices for hip OA and other hip pain patients. These devices are not invasive, have few adverse effects, and are low cost. Thus, they are recommended for select patients with significant leg length discrepancies felt to be producing or contributing to symptoms.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: ambulatory devices, canes, shoe insoles, crutches, braces, orthotics; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 5 articles in PubMed, 327 in Scopus, 7 in CINAHL, 57 in Cochrane Library, 68 in Google Scholar, and 7 from other sources. We considered for inclusion 0 from PubMed, 8 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 7 from other sources. Of the 17 articles considered for inclusion, 0 randomized trials and 17 systematic studies met the inclusion criteria.

High-intensity magnetic stimulation purportedly causes depolarization of nerves and appears to result in an anti-nociceptive effect in rats [877]. Proponents believe that electromagnetic fields have therapeutic value in the treatment of musculoskeletal disorders.

Magnets and Magnetic Stimulation for Hip Osteoarthrosis or Other Hip Pain

Not Recommended.

Devices

Magnets and magnetic stimulation is not recommended for treatment of osteoarthrosis or acute, subacute, or chronic hip pain.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There is no significant evidence from which to draw conclusions on the utility of magnets as a treatment modality for hip OA or acute, subacute, or chronic hip pain. However, there is evidence for lack of efficacy in the treatment of low back pain [878]. Magnets are not invasive, have no adverse effects, and are low cost. Other treatments have proven efficacy.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnets, Magnetic stimulation; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 1 articles in PubMed, 86 in Scopus, 3 in

CINAHL, 2 in Cochrane Library, 1600 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 3 articles considered for inclusion, 0 randomized trials and 3 systematic studies met the inclusion criteria.

Allied Health

Physical and occupational therapy have been used for hip osteoarthrosis. Many studies have shown mixed results for helping hip osteoarthrosis and pain in patients who engage in therapy coupled with their normal course of treatment [136, 587, 879, 880].

Physical Therapy and Occupational Therapy for Hip Osteoarthrosis

Recommended.

Activity Modification and Exercise

Physical therapy and occupational therapy are recommended for treatment of hip OA.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **High**

Indications:	Patients in need of structured exercise program. Also, those in need of increasing activity levels under supervision, including post-operatively. See exercise recommendations.
Benefits:	Self-perceived quality of life, faster recovery, and shortened hospitalization time (which decreases costs). Quicker recovery and return to work with accelerated independence.
Harms:	Negligible
Frequency/Dose/Duration:	Two to three appointments/week for 2-3 weeks to start. Additional sets of appointments should be based on documented incremental functional gain.
Indications for Discontinuation:	Achievement of plateau, maximum improvement, non-compliance, intolerance.
Rationale:	Physical and occupational therapy are used to treat patients, especially those who need assistance with the institution and progression of exercise programs and adaptive strategies for success with meaningful occupations. There are no quality studies of efficacy, but there are many studies of the interventions employed by therapists showing varying degrees of efficacy. Therapy is not invasive, has low adverse effects, is moderate to high cost in aggregate, is often helpful for patient treatment and recovery and is thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Physical Therapy, Occupational Therapy; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 187 articles in PubMed, 5 in Scopus, 489 in CINAHL, 0 in Cochrane Library, 3670 in Google Scholar, and 2 from other sources. We considered for inclusion 16 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 2 from other sources. Of the 19

articles considered for inclusion, 4 randomized trials and 1 systematic studies met the inclusion criteria.

Manipulation or Mobilization for Hip Osteoarthrosis

No Recommendation.

Allied Health Interventions

There is no recommendation for or against the use of manipulation or mobilization for treatment of hip osteoarthrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:

There is one high-quality trial comparing manipulation with sham for treatment of hip OA in hospitalized patients suggesting lack of efficacy [884]. Another trial found no additive benefit of manipulation added to exercise [885]. A moderate quality trial found either exercise (aerobic, strengthening and stretching) or manual therapy (individualized ROM procedures) in addition to usual care to be superior to usual care, and no clear advantage of additive therapy with manual therapy plus exercise [879, 886]. One moderate quality trial suggested an individualized manual therapy treatment was superior to exercise [535]; however, the exercises appear to have emphasized range of motion and included little if any aerobic or strengthening. Two more moderate quality studies also found lack of clear evidence of efficacy [576, 879]. There are no quality trials comparing either manipulation or mobilization with an exercise regimen or other treatment program with known level of efficacy.
Thus, there is no clear evidence of efficacy for manipulation or mobilization in treating hip osteoarthrosis [535]. There is one high-quality study of manipulation in hospitalized hip patients that found a lack of efficacy [826]. However, this study did not include treatment to the hip or knee. Manipulation and mobilization are not invasive, have relatively few adverse effects on the hip joint, are moderately costly in aggregate, but in the absence of clear evidence of efficacy, there is no recommendation.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: manipulation, mobilization; hip osteoarthritis, hip osteoarthrosis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 340 articles in PubMed, 119 in Scopus, 23 in CINAHL, 34 in Cochrane Library, 1,620 in Google Scholar, and 2 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 4 articles considered for inclusion, 4 randomized trials and 0 systematic studies met the inclusion criteria.
A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Chiropractic Treatment, Osteopathic Manipulative Treatment (OMT); Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis;

controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 1 articles in PubMed, 7 in Scopus, 6 in CINAHL, 1 in Cochrane Library, 97 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 2 randomized trials and 0 systematic studies met the inclusion criteria.

Massage for Hip Osteoarthrosis

No Recommendation.

Allied Health Interventions

There is no recommendation for or against the use of massage for hip osteoarthrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale: Massage is a commonly used treatment for musculoskeletal pain, but few studies evaluated disorders other than LBP [889-891]. Although massage is not invasive and has few adverse effects, it cannot readily reach the hip joint and is moderate to high cost (when professionally administered), depending on the number of treatments. Other treatments are available with documented efficacy.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: massage; hip osteoarthritis, hip osteoarthrosis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 12 articles in PubMed, 28 in Scopus, 3 in CINAHL, 12 in Cochrane Library, 766 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Reflexology is a type of massage that applies pressure to various body parts through specific hand and finger techniques. Reflexology is based on a system of zones and reflex areas that reflect an image of the body on the feet and hands, with a premise that such work effects a physical change to the body. There is no use of oil or lotion [888, 892].

Reflexology for Hip Osteoarthrosis or Other Hip Pain

Not Recommended.

Allied Health Interventions

Reflexology is not recommended for treatment of hip osteoarthrosis or acute, subacute, or chronic hip pain.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Rationale:	There are no quality studies of reflexology for hip pain. It also has not been shown to be efficacious for the treatment of chronic LBP in a moderate-quality study [893]. Other treatments have been shown to be efficacious.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: reflexology; hip osteoarthritis, hip osteoarthrosis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 12 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 27 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Acupuncture is used to treat pain [929]. There are multiple approaches, although traditional Chinese acupuncture involves an "energetic" flow of energy called "qi" through channels (meridians). The manipulation and insertion of an acupuncture needle into acu-point creates a range of sensations described as heavy, tingling, and dull-deep, which are called "de qi" [913, 930, 931].

Acupuncture for Hip Osteoarthrosis

Recommended.

Activity Modification and Exercise

Acupuncture is recommended for select patients in the treatment of chronic osteoarthrosis of the hip as an adjunct to more efficacious treatments.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Low**

Indications:	Moderate to severe chronic osteoarthrosis of the hip. Prior treatments should include NSAIDs, weight loss, and exercise including a graded walking program and strengthening exercises.
Benefits:	Potential to improve pain control and advance functional exercises and conditioning.
Harms:	Negligible in experienced hands. Pneumothoraces have occurred and puncture of other internal organs has occurred, but should not occur in skilled hands.
Frequency/Dose/Duration:	A limited course of 6 appointments [929] with a clear objective and functional goals to be achieved. Additional appointments would require documented functional benefits, lack of plateau in measures and probability of obtaining further benefits. There is quality evidence that traditional acupuncture needle placement is unnecessary [932]. Additional sets of 6 appointments should only occur based on documented incremental functional gain.
Indications for Discontinuation:	Resolution, intolerance, non-compliance including non-compliance with aerobic and strengthening exercises.
Rationale:	There are a few quality studies that evaluate acupuncture for treatment of hip osteoarthrosis; more studies address knee osteoarthrosis [930, 933, 934]. Some have concluded that evidence suggests there is no effect of acupuncture on pain [838]. One trial evaluated gluteal trigger points [935]; otherwise, there are no other quality studies for other hip conditions. Some trials have combined acupuncture with electrical currents and others have applied electrical currents to acupuncture sites. For treatment of musculoskeletal conditions, there are no quality studies to show clear benefit of electroacupuncture over needling, and there is one trial of de qi suggesting lack of efficacy [913]. There continue to be some questions about efficacy of acupuncture [936] with concerns about biases, e.g., attention and expectation bias in these study designs as well as adequacy of placebo acupuncture treatments [937, 938]. All four quality studies that included hip osteoarthrosis patients suggest benefits from acupuncture, although the techniques used vary widely [930, 932, 939, 940]. These trials included comparisons with no acupuncture [930], routine care [940], and exercise and advice [941]. One trial compared electroacupuncture, hydrotherapy, and education, finding electroacupuncture superior [939]. The fourth quality study found that traditional needle placement is unnecessary [932], which is similar to the evidence-based conclusion for acupuncture for low back

pain (see Low Back Disorders guideline). Studies reporting results after the cessation of acupuncture have nearly all found lasting benefits [930, 939, 941], although there are no long-term follow-up studies reported. High-quality studies for all of these potential indications with sizable populations and long follow-up periods are needed. Acupuncture when performed by experienced professionals is minimally invasive, has minimal adverse effects, and is moderately costly. Despite significant reservations regarding its true mechanism of action, a limited course of acupuncture may be recommended for treatment of hip osteoarthrosis as an adjunct to a conditioning and weight loss program. Acupuncture is recommended to assist in increasing functional activity levels more rapidly. Primary attention should remain on the conditioning program. Acupuncture is not recommended for those not involved in a conditioning program or who are non-compliant with graded increases in activity levels.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms Acupunture, acupotomy, Electro acupuncture, acupressure, acupuncture therapy, warm needling, dry needling, needling, de-qi, warm, dry, pressure, electric current, needle; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 27 articles in PubMed, 179 in Scopus, 7 in CINAHL, 12 in Cochrane Library, 191 in Google Scholar, and 7 from other sources. We considered for inclusion 10 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 7 from other sources. Of the 21 articles considered for inclusion, 9 randomized trials and 6 systematic studies met the inclusion criteria

Hot and Cold Therapies

It has been proposed that cold and heat have therapeutic benefits by modifying the disease processes. For example, cold allegedly reduces acute inflammation and swelling, whereas heat purportedy speeds healing through increased blood supply. Many forms of heat therapy have been used to treat musculoskeletal pain, including hot packs, moist hot packs, sauna, warm baths, infrared, diathermy, and ultrasound. The depth of penetration of some heating agents is minimal because transmission is via conduction or convection, but other modalities have deeper penetration [894].

Cold or cryotherapies involve applications of cold or cooling devices to the skin. They have been used for treatment of non-operative pain and post-operative pain [895-900].

Cryotherapy, Home Use, for Hip Osteoarthrosis

Recommended.

Activity Modification and Exercise

Cryotherapies are recommended for home use if efficacious for the treatment of hip osteoarthrosis.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications: Hip OA and patients desiring to use non-medicinal treatments. Others may benefit as well.

Benefits:	Improved pain
Harms:	Negligible.
Frequency/Dose/Duration:	Education regarding home cryotherapy application may be part of the treatment if cold is effective at reducing pain.
Indications for Discontinuation:	Achievement of plateau, maximum improvement, lack of efficacy, non-compliance, intolerance.
Rationale:	There are no quality studies of cryotherapy for hip OA outside of perioperative management. Cryotherapy is not invasive, has minimal adverse effects, is low cost when self-applied, and thus is recommended despite absence of efficacy.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cryotherapy, Heat-Cold Application; Hip Osteoarthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 10 articles in PubMed, 148 in Scopus, 40 in CINAHL, 16 in Cochrane Library, 1570 in Google Scholar (Went through first 100), and 1 from other sources. We considered for inclusion 1 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 1 randomized trial and 0 systematic studies met the inclusion criteria.

CRYOTHERAPY, POSTOPERATIVE

Cryotherapy is recommended for treatment of hip arthroplasty and surgery patients.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Low**

Indications:	Perioperative and immediate post-operative hip OA patients.
Benefits:	Improved pain control, reduced opioids need.
Harms:	Negligible.
Frequency/Dose/Duration:	Pain relief with cold therapy for the first 4 post-operative days [895]. This includes cold compression.
Indications for Discontinuation:	Achievement of plateau, maximum improvement, lack of efficacy, intolerance, including exacerbation of LBP.
Rationale:	There is one moderate-quality trial that addresses cryotherapies; however, it addressed post-operative arthroplasty patients and suggested benefits with significantly lower pain scores [895]. There are no quality trials that evaluate cryotherapy for treatment of other hip conditions. Among post-operative patients, earlier reductions in pain scores and improved mobility may assist in reducing post-operative complications including DVTs, thus cryotherapies including more expensive cryotherapy delivered by machines which are moderately costly appear justifiable and are recommended for these post-operative patients. For other patients, self applications of cryotherapies using towels or reusable devices are non-invasive, minimal cost, and without complications. While cryotherapy is generally not helpful in patients with osteoarthrosis, a small minority may find benefit, thus, cryotherapy is recommended as a potential distractant or counter-irritant. Other forms of cryotherapy can be

considerably more expensive, including chemicals or cryotherapeutic applications in clinical settings and are not recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cryotherapy, Heat-Cold Application; Hip Osteoarthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 10 articles in PubMed, 148 in Scopus, 40 in CINAHL, 16 in Cochrane Library, 1570 in Google Scholar (went through first 100), and 1 from other sources. We considered for inclusion 1 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 1 randomized trial and 0 systematic studies met the inclusion criteria.

Diathermy for Hip Osteoarthrosis or Other Hip Pain

No Recommendation.

Hot and Cold Therapies

There is no recommendation for or against the use of diathermy for the treatment of hip osteoarthrosis or for patients with acute, subacute, or chronic hip pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There are no quality studies evaluating the use of diathermy, infrared, or ultrasound for patients with hip pain. Ultrasound and diathermy are reportedly ineffective for treatment of knee arthritis patients [555, 902]. One trial for hip OA suggested ultrasound had benefits, but had tiny sample sizes [904]. Although it is not invasive and has low complication rates, this modality is moderate to high cost depending on the number of treatments. Quality studies are needed to form evidence-based recommendations.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Diathermy; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 9 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 144 in Google Scholar, and 2 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 1 systematic studies met the inclusion criteria.

Infrared Therapy for Hip Osteoarthrosis or Other Hip Pain

No Recommendation.

Hot and Cold Therapies

There is no recommendation for or against the use of infrared therapy for treatment of hip osteoarthrosis or for patients with acute, subacute, or chronic hip pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There are no quality studies evaluating the use of diathermy, infrared, or ultrasound for patients with hip pain. Ultrasound and diathermy are reportedly ineffective for treatment of knee arthritis patients [555, 902]. One trial for hip OA suggested ultrasound had benefits, but had tiny sample sizes [904]. Although it is not invasive and has low complication rates, this modality is moderate to high cost depending on the number of treatments. Quality studies are needed to form evidence-based recommendations.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Infrared therapy, Infrared rays; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 2 articles in PubMed, 9 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 1300 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 1 systematic study met the inclusion criteria.

Ultrasound for Hip Osteoarthrosis or Other Hip Pain

No Recommendation.

Hot and Cold Therapies

There is no recommendation for or against the use of ultrasound for treatment of hip osteoarthrosis or for patients with acute, subacute, or chronic hip pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale: There are no quality studies evaluating the use of diathermy, infrared, or ultrasound for patients with hip pain. Ultrasound and diathermy are reportedly ineffective for treatment of knee arthritis patients [555, 902]. One trial for hip OA suggested ultrasound had benefits, but had tiny sample sizes [904]. Although it is not invasive and has low complication rates, this modality is moderate to high cost depending on the number of treatments. Quality studies are needed to form evidence-based recommendations.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasound, ultrasonography; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 916 articles in PubMed, 1112 in Scopus, 8 in CINAHL, 15 in Cochrane Library, 2310 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google

Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 0 systematic studies met the inclusion criteria.

Low-level laser therapy uses low-intensity irradiation, such that the response can be considered to be due to the radiation and not heat [905]. It has been used for treating low back pain, orthodontic pain [906], hair loss [907], and rheumatoid arthritis [908].

Low-level Laser Therapy for Hip Osteoarthrosis or Other Hip Pain

No Recommendation.

Hot and Cold Therapies

There is no recommendation for or against the use of low-level laser therapy for treatment of osteoarthrosis or acute, subacute, or chronic hip pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	The few available studies that have evaluated low-level laser therapy for treatment of osteoarthrosis conflict on the efficacy [909]. There are no quality studies evaluating low-level laser therapy for the treatment of osteoarthrosis of the hip, a particularly deep joint. Low-level laser therapy is not invasive, has few adverse effects, but is costly; thus, without evidence of efficacy, there is no recommendation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: “laser therapy, low-level”, low level laser therapy, LLLT, low level light therapy; Hip Osteoarthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 6 articles in PubMed, 290 in Scopus, 14 in CINAHL, 44 in Cochrane Library, 5140 in Google Scholar (Went through first 100), and 0 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Self-application of low-tech heat therapy is a form of thermotherapy where an individual uses less advanced heating methods to heat the area on their own. Heat therapy is often used as a non-pharmaceutical treatment in pain management [910, 911].

Self-Application of Low-Tech Heat Therapy for Hip Osteoarthrosis

Recommended.

Activity Modification and Exercise

Self-application of low-tech heat therapy is recommended for treatment of osteoarthrosis.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Hip OA and patients desiring to use non-medicinal treatments. Others may benefit as well.
Benefits:	Improved pain
Harms:	Negligible.
Frequency/Dose/Duration:	Applications may be periodic or continuous. Applications should be home-based as there is no evidence for efficacy of provider-based heat treatments. Primary emphasis should generally be on functional restoration program elements, rather than on passive treatments in patients with chronic pain.
Indications for Discontinuation:	Intolerance, increased pain, development of a burn, other adverse event.
Rationale:	Self-application of heat using towels or reusable devices is non-invasive, minimal cost, and without complications. While they are generally not helpful in patients with osteoarthrosis, heat therapy may be helpful in a small minority, and thus is recommended as potential distractant or counter-irritant. Other forms of heat can be considerably more expensive, including chemicals or therapeutic applications in clinical settings and are not recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: heat therapy, local hyperthermia, thermotherapy; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 15 articles in PubMed, 374 in Scopus, 2 in CINAHL, 20 in Cochrane Library, 7290 in Google Scholar (Went through first 100), and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Electrical Therapies

Electrical stimulation therapy is a therapeutic approach that has been used to treat pain and atrophy [912]. There are several types of electrical stimulation therapy including: high-voltage galvanic, H-wave stimulation, interferential therapy (IFT or IT), iontophoresis, microcurrent, percutaneous electrical nerve stimulation (PENS), de qi, sympathetic electrotherapy, and transcutaneous electrical stimulation (TENS) [913, 914]. The mechanism(s) of action, if any, are unclear.

Electrical Stimulation Therapies for Hip Osteoarthrosis or Other Hip Pain

No Recommendation.

Electrical Therapies

There is no recommendation for or against the use of electrical therapies outside of research settings for the treatment of hip osteoarthrosis or acute, subacute, or chronic hip pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There are no quality studies for any of these therapies in occupational populations with hip pain. There is one moderate quality study of de qi suggesting lack of efficacy [913]. There is one quality study suggesting efficacy of iontophoresis with sodium salicylate for hip pain in children with sickle cell disease [915]; however, applicability to occupational populations and others is unclear. These therapies are mostly non-invasive with low adverse effects, but are moderate to high cost when examined in aggregate. There is no recommendation for or against the use of these therapies. There are other treatments that are effective.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Electrical stimulation therapy, TENS, iontophoresis, PENS, sympathetic electrotherapy, microcurrent therapy, interferencial therapy, h-wave stimulation, high voltage galvanic stimulation, transcutaneous electrical nerve stimulation, percutaneous electrical nerve stimulation, Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 19 articles in PubMed, 121 in Scopus, 5 in CINAHL, 90 in Cochrane Library, 10142 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic studies met the inclusion criteria.

Transcutaneous Electrical Stimulation (TENS) for Hip Osteoarthrosis or Other Hip Pain

No Recommendation.

There is no recommendation for or against the use of TENS for hip osteoarthrosis or acute, subacute, or chronic hip pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There are no quality studies of TENS that directly address hip osteoarthrosis or other hip conditions. However, a high-quality study suggested TENS reduces pain during emergency transport [928]; thus, there is evidence to suggest TENS might be successful for this limited indication. TENS is not invasive, has low adverse effects, and is moderately costly, thus there is no recommendation for TENS as a treatment for hip disorders.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Transcutaneous Electric Nerve Stimulation, TENS, Neuromuscular Electrical Stimulation, NMES, Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthritis, Hip

Degenerative Arthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 8 articles in PubMed, 312 in Scopus, 2 in CINAHL, 55 in Cochrane Library, 336 in Google Scholar, and 1 from other sources. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 1 randomized trial and 2 systematic studies met the inclusion criteria.

Injections

Several types of injections have been used for patients with hip pain, including intraarticular glucocorticosteroid injections, viscosupplementation, platelet-rich plasma, prolotherapy and botulinum injections.

Intraarticular glucocorticosteroid injections are sometimes performed to deliver medication with minimal systemic effects to the hip joint [942-948]. Their usual purpose is to gain sufficient relief to either resume conservative medical management or to delay operative intervention. These injections are generally, although not always, performed under fluoroscopic or ultrasound guidance. Intra-articular steroid hip injection or corticosteroid injection may help to relieve inflammation and pain in a specific area of the body [949] and usually combine with the corticosteroid and local anesthetics [950, 951].

Intraarticular Glucocorticosteroid Injections for Hip Osteoarthrosis

Moderately Recommended.

Injection Therapy

Intraarticular glucocorticosteroid injections are moderately recommended for the treatment of hip osteoarthrosis.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Hip OA pain where control with NSAID(s), acetaminophen, weight loss and exercise is unsatisfactory. Ultrasound guidance is generally preferable to blind injection [952].
Benefits:	Reduction in pain and improved function typically lasting not more than 3 months.
Harms:	Infection, steroid flare, complications of an injection
Frequency/Dose/Duration:	An injection should be scheduled and the results evaluated. Medications used in the RCTs were triamcinolone hexacetonide 40mg or triamcinolone acetonide 80mg, or methylprednisolone 40mg, 80mg or 120mg (see glucocorticosteroid injection table) [953]. Anesthetics have most often been bupivacaine or mepivacaine. Multiple doses have been utilized with no head-to-head comparisons in trials; however, a comparative clinical trial found greater efficacy for methylprednisolone 80mg over 40mg [948].
Indications for Discontinuation:	A second glucocorticosteroid injection is not recommended if the first has resulted in significant reduction or resolution of symptoms. If there has not been a response to a first injection, there is less indication for a second. If the interventionalist believes the medication was not well placed and/or if the underlying condition is so severe that one steroid bolus could not be expected to adequately treat the condition, a second injection may be indicated (a second injection is

	particularly recommended to be performed under ultrasound or fluoroscopic guidance). In patients who respond with a pharmacologically appropriate several weeks of temporary, partial relief of pain, but who then have worsening pain and function and who are not interested in surgical intervention, a repeat steroid injection is an option [463]. There are not believed to be benefits beyond approximately 3 of these injections in a year. Patients requesting a 4th injection should have reassessment of conservative management measures and be counseled for possible surgical intervention.
Rationale:	There are multiple high- or moderate-quality RCTs evaluating efficacy of glucocorticosteroid injections for treatment of hip OA. Both of the highest quality trials had positive results [942, 943, 953]. The lowest quality study did not clearly document efficacy, but also was underpowered with small numbers of subjects per treatment arm [947]. Thus, the quality evidence documents efficacy of these injections. The length of benefits is somewhat unclear with approximately 3 months of benefit and no quality evidence of long-term efficacy. There are no head-to-head medication or dose comparisons to identify the optimal combination. A non-randomized study suggested methylprednisolone 80mg was superior to 40mg; however, the results need to be replicated in a quality trial [948]. The primary use of the injections appears to be to improve symptoms and delay, but not prevent, surgical intervention in most patients. There is no quality evidence to support, or require, a series of 3 injections and no quality evidence of a limit to the number of injections. There is some evidence to suggest steroid injections may be superior to hyaluronic acid injections [944, 953]. Hip injections may require ultrasound or fluoroscopy, as there are no quality trials of blind injections and all quality trials utilized it, although some physicians perform these injections without the use of fluoroscopy or ultrasound [944, 948]. Hip injections are invasive, have a low risk of adverse effects, but are relatively costly. They are an option for treatment of hip patients particularly after inadequate results from NSAID trials, exercise, or other conservative interventions.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: intra-articular steroid injections, corticosteroid, cortisone injections, injections, intraarticular; hip osteoarthritis, hip degenerative joint disease, hip osteoarthrosis, hip degenerative arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 47 articles in PubMed, 88 in Scopus, 36 in CINAHL, 3 in Cochrane Library, 376 in Google Scholar, and 2 from other sources. We considered for inclusion 23 from PubMed, 5 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 4 from other sources. Of the 32 articles considered for inclusion, 6 randomized trials and 8 systematic studies met the inclusion criteria.

Intraarticular Hip Viscosupplementation Injections for Hip Osteoarthrosis

No Recommendation.

Injection Therapy

There is no recommendation for or against intraarticular hip viscosupplementation injection for treatment of hip osteoarthrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There have been suggestions that viscosupplementation of the hip joint may be beneficial for patients with hip OA [957, 958, 960-966]; however, there are no reported trials using a placebo control. One moderate quality trial compared to bupivacaine injection suggested efficacy at up to 6 months [966]. Most systematic reviews have concluded the evidence is suggestive, but weak [945, 956, 959, 964]. Open-label trials show an approximately 50% response rate and there is some evidence of results lasting 6 months [958, 960-964, 967]. No long-term treatment trials have been reported. There were no differences seen between low- and high-molecular weight hyaluronic viscosupplementation injections [958]. Both resulted in approximately 40% reductions in pain ratings with benefits lasting 6 months. However, one high-quality and a moderate-quality trial both showed glucocorticosteroid injections are superior; thus, it was suggested they should generally be used initially [944, 953].
Injections have mostly been done under ultrasound [960-962], although they can be done under fluoroscopy [958]. These injections are invasive, have a low risk of adverse effects, are relatively costly, lack quality evidence of efficacy and thus there is no recommendation.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: hyaluronic acid injection, viscosupplementation, intra-capsular acid salt; hip osteoarthritis, hip degenerative joint disease, hip osteoarthrosis, hip degenerative arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 55 articles in PubMed, 0 in Scopus, 17 in CINAHL, 3 in Cochrane Library, 595 in Google Scholar, and 2 from other sources. We considered for inclusion 15 from PubMed, 0 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 3 from other sources. Of the 20 articles considered for inclusion, 7 randomized trials and 4 systematic studies met the inclusion criteria.

Platelet-Rich Plasma Injections for Hip Osteoarthrosis

No Recommendation.

Injection Therapy

There is no recommendation for or against intraarticular platelet-rich plasma injections for treatment of hip osteoarthrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There are no quality trials comparing PRP injections with sham or placebo for hip OA. There are two moderate quality trials comparing PRP injections with hyaluronic acid injections, however, the known level of efficacy of HA injections is under considerable debate. One trial suggested comparable results [968] and another had somewhat conflicting results on comparative effectiveness [967]. Injections are invasive, have some adverse effects, are high cost and are lacking quality data against a known standard for efficacy, thus there is no recommendation.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: platelet-rich plasma; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 9 articles in PubMed, 395 in Scopus, 8 in CINAHL, 15 in Cochrane Library, 436 in Google Scholar, and 0 from other sources. We considered for inclusion 4 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 7 articles considered for inclusion, 2 randomized trials and 4 systematic studies met the inclusion criteria.

Prolotherapy Injections for Hip Pain

Not Recommended.

Prolotherapy injections are not recommended for treatment of acute, subacute, or chronic hip pain.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale: There are no quality studies of prolotherapy injections for treatment of patients with hip OA or hip pain. The highest quality evidence for treatment of other conditions has shown no benefit of prolotherapy injections [973]. Prolotherapy injections are invasive and have a stated purpose of causing irritation and have reported adverse consequences (see Chronic Pain Guideline). These injections are invasive, have adverse effects, and are costly. There are other treatments with documented efficacy available for treatment of these patients.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: prolotherapy injections; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 260 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 160 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered

for inclusion, 0 randomized trials and 1 systematic study met the inclusion criteria.

Botox injections are a group of medications that use different forms of botulinum toxin to temporarily paralyze muscle activity [974-987].

Botulinum Injections for Hip Osteoarthrosis or Other Hip Disorders

No Recommendation.

Injection Therapy

There is no recommendation for or against the use of botulinum injections for hip osteoarthrosis or other hip disorders.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There is no quality evidence of efficacy. The injections are invasive, have potential adverse effects [988], and are costly. There are other treatment strategies with documented efficacy; thus, there is no recommendation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: botulinum injection, botox; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 2 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 0 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Intramuscular injections are utilized to administer medications that need a faster uptake in the body [989]. There is no quality research on the use of intramuscular injections with glucosamine sulfate in relation to hip osteoarthrosis.

Glucosamine Sulfate Intra-Muscular Injections for Hip Osteoarthrosis

No Recommendation.

Medications (including topical creams)

There is no recommendation for or against the use of glucosamine sulfate intra-muscular injections for the treatment of hip osteoarthrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There are no quality studies to address hip OA and thus there is no recommendation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Glucosamine Sulfate Intra-Muscular Injection; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 17 in Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Glucosamine sulfate is a popular treatment for osteoarthrosis [789, 990-992].

Glucosamine Sulfate Intra-articular Injections for Hip Osteoarthrosis

No Recommendation.

Injection Therapy

There is no recommendation for or against the use of glucosamine sulfate intra-articular injections for the treatment of hip osteoarthrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There are no quality studies to address hip OA and thus there is no recommendation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Glucosamine Sulfate Intra-articular Injections; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 4 articles in PubMed, 5 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 3 in Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Autologous blood donation has been used to attempt to reduce risks of bloodborne pathogen transmission in the event a blood transfusion is required [993-1003]. This is to increase the patients' total red blood cell mass [1004].

Pre-Operative Autologous Blood Donation

No Recommendation.

There is no recommendation for or against the use of pre-operative autologous blood donation.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There is one moderate-quality trial suggesting autologous blood donation is ineffective in healthy patients undergoing hip arthroplasty [994]. More transfusions are required for those who have donated blood pre-operatively and the costs are higher without measurable benefits. However, there are certain clinical scenarios in which pre-operative autologous blood donation may be beneficial, and the patient's age and health status needs to be considered. Therefore, there is no recommendation for or against the use of pre-operative autologous blood donation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: pre-operative autologous blood donation; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 397 in Google Scholar, and 1 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

Surgical Considerations

Hip arthroplasty has been used for several decades for treatment of hip degenerative joint disease and osteonecrosis [146, 443, 444, 600, 1005-1019]. Many patients who were active pre-operatively are able to return to work or restart sports activities [1020-1026] and cardiovascular fitness improves postoperatively [1019]. Twenty-five-year arthroplasty survival rates of 80% have been reported [443, 444], although the survival data are based on approximately 10 to 25% of the originally replaced joints due to intervening deaths. Quality evidence from controlled trials directly comparing arthroplasty with other treatments is absent likely due to the many decades the procedure has been successfully performed. More recently, hip resurfacing has been used particularly in younger patients with osteoarthrosis or osteonecrosis primarily to attempt to hopefully preserve more bone for subsequent, successful arthroplasty at an older age [1027-1033].

The most common reasons for hip arthroplasty vary from one report to the next, but include idiopathic coxarthrosis (70.6%), rheumatoid arthritis (3.1%), sequela after fracture (12.2%), and sequela after dysplasia (6.8%). Women undergo these procedures approximately 70% more frequently than men [1034]. In a population-based registry from Norway, surgical incidence peaked among those 70 to 79 years old [600], although the overall risk for hip arthritis continued rising beyond age 80. Arthroplasty rates have been projected to increase sharply over the coming decades due to aging populations [1034-1036].

Pain has been shown to be a predictor of total hip arthroplasty ($p < 0.0001$), as have visual analog scale (VAS) handicap ratings, and degree of joint space narrowing [1037]. The primary reason for failure of prosthesis is loosening. Infections occurred in large case registries in 6.1% [600], although more recent estimates are under 1% with improved antibiotic prophylaxis. Improvements in cement technique have been incorporated (see below) as well as development of cementless systems. Prosthetic surfaces have also been modified to improve prosthetic survival [1038]. Predictors of complications and poorer functional status at 1 year include female gender, single marital status, less than high school education, nonwhite ethnicity, and the Index of Co-Existent Disease (which measures asymptomatic controlled, uncontrolled and life-threatening diseases) [1039]. Some studies have suggested higher rates of osteolytic loosening among younger patients [1015]. There have been concerns about metal-on-metal designs, and a recent large metanalysis of mostly observational data of >500,000 hip arthroplasties reported an estimated 8.5% risk difference with better outcomes over 10+ years in the non-metal-on-metal designs; however, the lack of randomization produces a considerable weakness in the conclusions. Despite extensive research, quality evidence of harms is largely lacking [1040-1044]. Long-term follow-up studies of arthroplasty patients do not show increased risk for cancer [1045].

HIP ARTHROPLASTY

Strongly Recommended.

Surgical Considerations

Hip arthroplasty is strongly recommended for severe arthritides, osteonecrosis with collapse or insufficient response to non-operative treatment, or substantially symptomatic hip dysplasia.

Strength of Evidence – **Strongly Recommended, Evidence (A)**
Level of Confidence – **High**

For bilateral disease, carefully selected patients may safely undergo simultaneous bilateral hip replacement.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Low**

Metal-on-metal hip resurfacing arthroplasty is recommended for select patients.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Low**

Indications:	All of the following present: 1) severe hip degenerative joint disease, osteonecrosis with collapse or unresponsive to non-operative treatment, or hip dysplasia (x-rays may indicate moderately severe, but function may be severely impaired); 2) sufficient symptoms and functional limitations such as impairments of activities of daily living or occupational tasks, and 3) failure to successfully manage symptoms after a prolonged period of a conservative management plan that included NSAIDs, exercise, physical or occupational therapy, and where appropriate, weight reduction [614]. Most candidates for hip replacement surgery are not considered ideal for this procedure. Also consider intraarticular corticosteroids. Carefully selected patients may be candidates for bilateral arthroplastic procedures [1046-1048]. However, particular attention should be paid to pre-operative medical fitness and psychological fortitude.
Benefits:	Markedly improved function and resolved pain.
Harms:	Rare but severe complications include ~1% risk of joint infection that may necessitate removal of prosthesis and multiple additional surgical procedures to resolve and revise. Complications also include bone cement implantation syndrome (BCIS), fat emboli, venous thromboses, intropeative fractures, infected prostheses, dislocations and prothesis failure. BCIS is a constellation of hypotension, hypoxemia, cardiac dysrhythmias, and/or cardiac arrest with a mortality rate of up to 1% [1049-1053]. Studies now suggest no increase in long-term mortality rates. Some of the trials include recalled prostheses.
Rationale:	Analyzing this literature is particularly challenging as the technologies have evolved rapidly, often without any accompanying moderate- or high-quality studies. Further, literature reports are often incomplete, without a comprehensive description that includes the population treated, surgical approach, prostheses utilized, operative site preparation, instrumentation, medications or other treatments utilized (see hip arthroplasty evidence table). At times, this requires reasonable assumptions to be made regarding the predominant techniques in use at this time. Still, provided there is only one variable being tested in a given study, assumptions regarding the

generalizability of the results between those two sets of assumptions would appear to remain solid.

The vast majority of patients described in quality studies who undergo hip arthroplasty have been diagnosed with osteoarthrosis. Another large group has rheumatoid arthritis. Other sizable groups have had fractures, osteonecrosis, dysplasia, and ankylosing spondylitis [1054] (see Hip Arthroplasty evidence table). Some studies have included simultaneous, bilateral arthroplasties as crossover trials [1046, 1055, 1056].

Recommendations in this guideline are derived from careful review of available high- or moderate-quality studies [646] (see evidence table below). Alternative procedures that are not recommended may result in superior patient outcomes in experienced surgical hands. Thus, rather than immediately changing surgical technique to implement these recommendations without adequate training and practice, caution is suggested.

There is quality evidence of long-term benefits of total hip arthroplasty among patients with moderate to severe hip degenerative joint disease (osteoarthrosis or inflammatory), osteonecrosis of the hip or hip dysplasia (see Hip Arthroplasty evidence table) [443, 444, 600, 1005, 1007-1012, 1014-1019, 1057]. Long-term outcomes have included resumption of occupational activities. Since there are operative failures, it is important even with a highly successful operation to assure that non-operative means have failed to sufficiently control symptoms. The primary consideration for operative candidacy should be symptoms and functional status, rather than severity of x-ray findings. There is some evidence from moderate quality studies suggesting bilateral arthroplasties may be safe in carefully selected patients [1046, 1055, 1056]. There has been enthusiasm for hip resurfacing, particularly in younger patients [1027-1029, 1058, 1059], and 3-year survival rates have been reportedly 99.1% [1060]. However, while there is quality evidence of radiological superiority in the immediate post-operative period [1061], there is evidence suggesting somewhat worse outcomes with resurfacing [1029, 1033, 1062, 1063] (see Hip Arthroplasty evidence table). Nevertheless, survival rates over the near term suggest the procedure is successful; it is recommended as an option, particularly for younger patients [1027-1029, 1033, 1061, 1064] or those with osteonecrosis [1031, 1032].

Anterior, direct lateral, modified direct lateral, and posterior approaches to hip arthroplasty have been attempted [1054, 1065-1080]. There is a quality study comparing different approaches [1081], and one study evaluated surgical drapes [1082]. There are multiple uncontrolled studies regarding minimal incisional techniques [1067-1070, 1073, 1078, 1080]; one is moderate-quality study [1083].

Femoral and acetabular components differ by composition, coatings, and design. The various surfaces that are used on femoral and acetabular components, “stems,” are often described as smooth, porous, and hydroxyapatite coatings [1010, 1084]. Some arthroplasties are inserted with cement, some uncemented and some “hybrid” or combinations of typically uncemented cups and cemented stems [1017].

	Cement or medullary restrictors (or "plugs") are prosthetic devices inserted into the distal femoral shaft after reaming out the canal prior to placement of the cement and prosthesis [1085-1096]. The purpose of the plug is to seal off the distal canal, which allows for higher pressurization of cement [1092, 1093, 1095, 1097-1100], thus facilitating a thicker and more uniform layer of cement between the prosthesis and the bone [1097]. This is thought to result in better survival of the prosthesis [1088, 1092, 1095] (see Hip Arthroplasty evidence table). Arthroplasty is invasive, has adverse effects, is high cost, has evidence of considerable efficacy for those with severe disease and thus is selectively recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hip Arthroplasty, Hip Replacement, Total Hip Arthroplasty; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 1,611 articles in PubMed, 158 in Scopus, 633 in CINAHL, 2 in Cochrane Library, 4,890 in Google Scholar, and 3 from other sources. We considered for inclusion 31 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 3 from other sources. Of the 40 articles considered for inclusion, 80 randomized trials and 13 systematic studies met the inclusion criteria.

Osteotomy for Hip Osteoarthrosis

Recommended.

Osteotomy is recommended for the treatment of hip osteoarthrosis.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Generally performed in those with hip deformities and significant functional impairments. Indications include significant alignment abnormalities, dysplasia, Perthes, osteonecrosis, nonunion of femoral neck fracture, slipped capital femoral epiphyses, and cox vara. Generally performed on younger patients in preference to arthroplasty.
Benefits:	Improved function, pain and reduced or delayed need for arthroplasty. For fracture non-unions, usually results in healing.
Harms:	Infrequent complications include infections, venous thromboses, nerve damage, and fat emboli.
Rationale:	There are no quality trials of hip osteotomy compared with either arthroplasty or non-operative management. There is history of success with hip osteotomy procedures [1103-1106]. Osteotomy is invasive, has adverse effects, is high cost, has no quality evidence of efficacy, yet without another proven treatment for many of these advanced conditions, is selectively recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date

limits using the following terms: Osteotomy; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthritis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 132 articles in PubMed, 152 in Scopus, 98 in CINAHL, 29 in Cochrane Library, 8000 in Google Scholar, and 0 from other sources. We considered for inclusion 25 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 29 articles considered for inclusion, 2 randomized trials and 6 systematic studies met the inclusion criteria.

Acupuncture for Hip Arthroplasty

Recommended.

Surgical Considerations

Acupuncture is recommended for hip arthroplasty procedures.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Low**

Indications:	Hip arthroplasty patients.
Benefits:	Improved pain control. Reduced need for opioids.
Harms:	Negligible
Frequency/Dose/Duration:	Up to 3 post-operative days [1107, 1108].
Indications for Discontinuation:	Completed course
Rationale:	Two quality trials demonstrated efficacy of acupuncture for hip arthroplasty patients, including reducing opioid needs [1107, 1108]. Acupuncture is minimally invasive, has generally minor adverse effects, is low cost, and thus is recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: acupuncture, acupressure, acupuncture therapy, pharmacoacupuncture, auricular acupuncture, arthroplasty; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 11 articles in PubMed, 1001 in Scopus (went through first 100), 3 in CINAHL, 18 in Cochrane Library, 5600 in Google Scholar (went through first 100), and 0 from other sources. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 4 from other sources. Of the 6 articles considered for inclusion, 4 randomized trials and 0 systematic studies met the inclusion criteria.

Hip Resurfacing for Osteoarthrosis

Recommended.

Surgical Considerations

Hip resurfacing is moderately recommended for patients with hip osteoarthrosis.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Severe arthrosis with sufficient functional impairment to require surgical treatment. Resurfacing is generally attempted in younger patients in preference to arthroplasty. Revision rates are higher, but the resurfacing procedure is believed to be superior for high impact activities.

Benefits:	Improved hip function and pain. Joint survivorship is 80-96% at 10 years [1114-1117].
Harms:	Higher risk of revision than traditional arthroplasty [1044]. Infections, septic joint, deep venous thromboses, nerve damage.
Rationale:	There are multiple moderate quality trials, mostly comparing hip resurfacing with arthroplasty demonstrating comparable efficacy [1033, 1058, 1059, 1064, 1118-1124]. However, the trials have modest sample sizes that are not likely powered to detect what may or may not be meaningful differences and would only be apparent with much larger sample sizes. Some of the trials involve recalled prostheses. Hip resurfacing is invasive, has adverse effects, is high cost, has evidence of comparable efficacy with arthroplasty and thus is recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hip Resurfacing & Metal on Metal Hip Prostheses; Hip Osteoarthritis controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 139 articles in PubMed, 385 in Scopus, 10 in CINAHL, 6 in Cochrane Library, 121 in Google Scholar, and 6 from other sources. We considered for inclusion 10 from PubMed, 18 from Scopus, 3 from CINAHL, 1 from Cochrane Library, 3 from Google Scholar, and 6 from other sources. Of the 41 articles considered for inclusion, 15 randomized trials and 22 systematic studies met the inclusion criteria.

PRE-OPERATIVE EDUCATION FOR ARTHROPLASTY

Recommended.

Surgical Considerations

A pre-operative educational program is moderately recommended prior to hip arthroplasty.

Strength of Evidence – **Moderately Recommended, Evidence (B)**

Level of Confidence – **Moderate**

Indications:	Hip arthroplasty patients.
Benefits:	Improved pain control. Reduced need for opioids. May result in earlier discharge and faster recovery [1140-1142, 1146, 1147].
Harms:	Negligible
Frequency/Dose/Duration:	Components should include procedural and recovery information and use at least two modes of teaching (e.g., oral and written).
Rationale:	Most studies of educational interventions for rehabilitation of hip pain patients have demonstrated benefits (see pre-operative education evidence table). Lengths of contact have ranged widely, although most studies do not report educational contact time. Some programs encourage involvement of family members and other care givers. Better post-operative compliance with rehabilitation has been shown [1148]. A number of studies have combined exercises and other interventions with the educational interventions. However, nearly all

	studies reporting length of hospital stay have shown earlier discharge from a hospital after hip arthroplasty for the educational interventions [1140-1142, 1146, 1147], while others have shown earlier performance of activities such as stair climbing [1149]. Other studies have suggested reductions in pain and anxiety [1150].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Preoperative education, Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 28 articles in PubMed, 2319 in Scopus, 1 in CINAHL, 36 in Cochrane Library, 6770 in Google Scholar, and 23 from other sources. We considered for inclusion 3 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 12 from other sources. Of the 17 articles considered for inclusion, 14 randomized trials and 3 systematic studies met the inclusion criteria.

Rehabilitation Programs

Pre-operative rehabilitation programs have been prescribed to attempt to improve arthroplasty results and reduce complications [532, 1149, 1151-1157].

Pre- and Post-Operative Rehabilitation

Recommended.

Rehabilitation Programs

A pre-operative exercise program particularly emphasizing cardiovascular fitness, strengthening, and progressive functional activities is moderately recommended, especially for patients who exhibit evidence of weakness or unsteady gait. Education should be included. Flexibility components may be reasonable in those without fixed deficits [1149, 1153, 1155].

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	All arthroplasty patients may benefit, but particularly those with weakness or unsteady gait. Also particularly helpful for those needing supervised encouragement.
Benefits:	Improved speed of post-operative recovery. Potential for improved long-term results.
Harms:	Negligible
Frequency/Dose/Duration:	One pre-operative course; generally only one post-operative course. Most program elements require an initial appointment to educate and teach exercises followed by a home exercise program prescription. Components generally should include cardiovascular fitness, strengthening and progressive functional activites. Two or three follow-up appointments for adherence and additional exercise instruction may be needed. Patients with severe deficits may require 2 to 3 appointments a week for 4 to 6 weeks in advance of arthroplasty [1155]. Those with minimal deficits may benefit from a single appointment to teach programmatic elements for a self-directed program.

Indications for Discontinuation:	Achievement of program goals, resolution of strength or gait deficits, intolerance or non-compliance.
Rationale:	Numerous studies have evaluated post-operative rehabilitation and activity levels that appear important for recovery from hip procedures, especially for arthroplasty and hip fracture patients [1158, 1159] (see Post-Operative Rehabilitation evidence table). Considerations have included pre-operative exercise programs, post-operative activity limitations, post-operative rehabilitation programs and late rehabilitation programs several months after surgery [1160]. A moderate-quality study demonstrated there were benefits from a 6-week pre-operative exercise program that consisted of several elements broadly including cardiovascular, strengthening and flexibility exercises with 30-60-minute sessions three times a week [1155]. The benefits included reduced post-operative complications, earlier discharge and higher probability to be discharged directly to the patient's home. A second moderate-quality study also demonstrated benefits of a perioperative exercise program and also demonstrated benefits lasting 6 months after surgery [1153]. Another moderate-quality study was reported as negative using the author's main outcome of changes in Harris Hip Scores. However, all 5 post-operative milestones (e.g., walking, chair transfer, stair climbing) statistically favored the exercise group [1149].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Pre-operative rehabilitation, post-operative rehabilitation, cardiovascular fitness, flexibility, strengthening, aquatic rehabilitation, exercise program, Arthroplasty; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 68 articles in PubMed, 2664 in Scopus (Went through first 100), 18 in CINAHL, 115 in Cochrane Library, 603 in Google Scholar, and 98 from other sources. We considered for inclusion 13 from PubMed, 1 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 3 from Google Scholar, and 7 from other sources. Of the 26 articles considered for inclusion, 19 randomized trials and 6 systematic studies met the inclusion criteria.

Post-operative Exercise and/or Rehabilitation Program

Recommended.

A post-operative exercise program and rehabilitation program is moderately recommended for hip arthroplasty surgery patients.

Strength of Evidence – Moderately Recommended, Evidence (B)
Level of Confidence – **High**

The following are recommended for at least the first 6 weeks (or as long as needed):

1. Use walking aid [1126]**– Recommended, Evidence (C)**
2. Add other recommendations only if needed (e.g., elevated toilet seats, prohibiting driving) [1126] – **Recommended, Evidence (C)**

3. ADL adaptive equipment as needed (e.g., long-handled reacher or shoe horn or sock aid) – **Recommended, Insufficient Evidence (I)**

Indications:	All hip arthroplasty patients may benefit from an evaluation for needs. Programs and protocols should be closely coordinated with the treating orthopedist, particularly as patient variability is wide, although workers' compensation patients tend to be younger, in better condition, and able to advance conditioning exercises more rapidly than the elderly. Programs need to be individualized, based on factors such as preoperative condition, bone quality, surgical results, contraindications, and other medical conditions. Workers' compensation patients may benefit from immediate post-operative weight bearing [1126, 1167, 1179], progressive walking [1126], progressive stair climbing, and marching in place exercises, flexibility, and strengthening. Program advancement must be individualized based on progress.
Benefits:	Improved and faster recovery with faster attainment of functional status
Harms:	Generally negligible. For motivated patients, some therapists advance programs too slowly, unnecessarily delaying recovery.
Frequency/Dose/Duration:	Duration based primarily on progress. Program may typically be daily in hospital settings and rehabilitation inpatient settings, 2 or 3 times weekly in outpatient settings gradually tapered as home exercises are instituted and the patient's recovery advances. Courses of up to 3 months in more severe cases may be required.
Indications for Discontinuation:	Attainment of goals, achievement of plateau, non-compliance.
Rationale:	Post-operative exercises have been widely used for arthroplasty patients [1160, 1162, 1180], although a minority of motivated patients do not undertake formal rehabilitation programs. Most rehabilitation benefits appear to be realized by 3 to 6 months after surgery [1160, 1169, 1179]; however, there is evidence of persisting, measureable impairments (see Late Postoperative Exercises) [1169, 1180-1183]. Typical post-operative exercise regimens emphasize non-weight-bearing exercises that target isolated muscle groups [1184-1186]. Other exercise regimens include treadmill training [1187], high-intensity quadriceps strengthening [1188], and progressive resistance and functional training [1189]. Many programs mix these elements in an exercise regimen [1185, 1190]. No quality studies have compared these exercise regimens either between specific exercises, among exercise regimens, or with other interventions. Considering that a patient's activities of daily living require weight bearing and strength capabilities, it is recommended that those be the primary exercises emphasized. Patients with significant reductions in ranges of motion may derive benefit from adjunctive flexibility exercises. There are multiple variables that affect the timing of weight-bearing exercises after hip arthroplasty and include the prosthesis utilized, bone quality, stability of the prosthesis, prosthesis type, patient compliance, and patient balance and coordination. The following recommendations assume good bone quality, good immediate surgical results, and no contraindications to initiating a program. Quality studies have evaluated risks and benefits from immediate and early post-operative weight bearing (see below). Benefits of immediate or early post-operative weight bearing include: earlier patient transfer activities [1179], greater walking ability or distances

[1167, 1179], earlier hospital discharge [1167, 1179], and superior function muscle strength and 6-minute walk test results at 3 months [1179] attributed to an early full weight-bearing programs. No significant complications have been reported in any of the quality studies. Additionally, a radiographic comparative clinical trial found greater initial uncemented prosthesis subsidence in the immediate weight bearing group, but no differences in long-term bony in-growth or other outcomes [1168], and a quality trial found no differences in either bone in-growth or development of radiolucent lines [1167], from which the authors concluded early weight bearing may be acceptable [1167, 1168].

Earlier removal of activity limitations (including removing an abduction pillow, elevated toilet seats, elevated chairs, side sleeping and no automobile use as either driver or passenger) has been shown to lower costs, improve patient satisfaction and strongly promoted the ability to perform activities of daily living without increasing the risk of dislocation [1126, 1191]. Those in the quality trial's restricted group returned to work on average 3 weeks later (46%, 9.5 versus 6.5 weeks, p <0.001) [1126]. There is no quality study reported that evaluated removal of all limitations (A low-quality, uncontrolled study reported results from a hospital where removal of all restrictions resulted in no increased complications [1191].) Results from the quality trial [1126] suggest routine use of all of the following are potentially unnecessary: transfer in the OR with an abduction pillow, use of abduction pillows in bed, use of elevated toilet seats, use of elevated chairs, prevented from sleeping on the side, prohibited from driving and are being a passenger in a car. However, selected use may remain indicated, for example, an elevated toilet seat for someone who otherwise could not use their home toilet.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Post-operative, Exercise, Rehabilitation, weight bearing, walking, Abduction pillow, Elevated toilet seats, elevated Chairs, side sleeping, driving, adaptive equipment, activity limitation, long-handled reacher, shoe horn, sock aid, Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 95 articles in PubMed, 2665 in Scopus (Went through first 100), 11 in CINAHL, 68 in Cochrane Library, 5560 in Google Scholar (Went through first 100), and 16 from other sources. We considered for inclusion 13 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 6 from other sources. Of the 19 articles considered for inclusion, 8 randomized trials and 3 systematic studies met the inclusion criteria.

LATE POST-OPERATIVE EXERCISES AND FUNCTIONAL ACTIVITIES FOR PATIENTS WITH SIGNIFICANT WEAKNESS OR UNSTEADY GAIT

Recommended.

Surgical Considerations

A late post-operative exercise and functional activities program after arthroplasty or hip fracture emphasizing cardiovascular fitness, strengthening, resistance and progressive functional activities is recommended for patients who exhibit significant evidence of weakness or unsteady gait. A home exercise program among motivated patients may be sufficient [1190].

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Low**

Indications:	Ongoing deficits in function, gait, strength, and activity level beyond 3 months post-operatively**. There is no recommendation for those with mild reductions of questionable significance.**
Benefits:	Potential gain in function, gait, strength.
Harms:	Negligible.
Frequency/Dose/Duration:	A weight-bearing home exercise program [1194], resistance, functional and balance training program [1189]. Supervised program for those lacking self-discipline. Transition to self-administered program from supervised when able.
Indications for Discontinuation:	Lack of progressive functional gain, end of healing, non-compliance.
Rationale:	While pain is typically resolved after hip arthroplasty [1066, 1195, 1196], there is some evidence of reductions in strength and postural stability may persist months to at least 1 or 2 years after surgery [1066, 1169, 1180-1183, 1190, 1195-1199]. Total strength deficits have been estimated at approximately 10-20% compared with the unaffected side [1169, 1183]. Whether these deficits are clinically meaningful is unclear, particularly in the more functionally recovered patients [1181]. There are some low quality data suggesting muscle weakness is associated with prosthetic loosening [1182]. Some have used results from case series to recommend that strengthening exercises be continued after hip arthroplasty for at least 1 year [1169] (see Post-Operative Rehabilitation evidence table) with either a supervised or home program [1200], but with a supervised program continued for those who lack self-discipline [1182]. Components of a late phase physical or occupational therapy regimen have been thought to best emphasize weight bearing, resistance and postural stability [1183, 1198, 1200]. A non-randomized trial comparing a home exercise program including range of motion and isometric strengthening exercises versus a second home exercise program that also included eccentric muscle contractile exercises of hip abductors in a standing position versus controls with no exercise program found the home programs comparably effective [1197]. There are three quality studies that have evaluated late post-operative exercise programs for treatment of post-fracture patients [1189, 1194, 1201]. These studies have found comparable results to those for arthroplasty patients. A weight-bearing home exercise program [1194], resistance, functional and balance training programs [1189] were found to be effective. The third quality trial found aerobic exercises to have equivalent efficacy to a resistance training program [1201]. The parallel findings between the hip arthroplasty and hip fracture patients strengthen these conclusions.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Late post-operative exercise; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip

Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 4 articles in PubMed, 4 in Scopus, 3 in CINAHL, 0 in Cochrane Library, 653 in Google Scholar, and 19 from other sources. We considered for inclusion 1 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 19 from other sources. Of the 21 articles considered for inclusion, 19 randomized trials and 2 systematic studies met the inclusion criteria.

Post-operative Work, Avocational Activities, and Sports

No Recommendation.

Surgical Considerations

There is no recommendation for or against specific work, avocational activities, or sports post-operatively.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale:

There are three primary methods to assess appropriate work, avocational and sports activities for hip arthroplasty and hip fracture patients: epidemiological studies, biomechanical models, and experimental studies [1204]. The available studies from these different methods produce substantial conflicts that are not readily resolved. Because the evidence conflicts and the epidemiological studies are the gold standard for the development of quality guidance [1205-1207], this review emphasizes epidemiological studies.

Exercise recommendations are developed largely without epidemiological data. The following activities have been recommended: bicycling, ballroom dancing, croquet, golf, horseshoes, shooting, shuffleboard, swimming, doubles tennis, and walking [1204, 1208]. Activities recommended with appropriate experience included low-impact aerobics, road bicycling, bowling, canoeing, hiking, horseback riding and cross-country skiing. Activities some have advised against include baseball, basketball, football, jogging, singles tennis, and volleyball. There was no conclusion regarding square dancing, fencing, ice skating, speed walking, downhill skiing, or weight lifting [1204, 1208]. However, these recommendations do not necessarily conform with epidemiological evidence.

It has been argued that high-impact loading activities should be prohibited in hip arthroplasty patients [1182]; however, increased risk of loosening has been reported among patients who were *not* skiing compared with skiers [1021]. The same researchers also reported a longer term trend of accelerated wear in the more physically active group [1021]. Another study found an approximately 9-fold greater risk for loosening among patients engaged in no sporting activity compared with those engaged in sports (e.g., hiking, climbing, skiing, swimming, running, cycling, and tennis) [1209]. Uncemented prostheses have been reported to have less radiographic loosening in active golfers [1022]. Another study found no apparent deteriorating effect of intensive recreational activities [1020]. Higher rates of aseptic loosening are reported among men in registry studies and case series [443, 1210]; however, whether that is related to force is unknown.

Currently, the balance of the epidemiological literature does not support the argument that activity results in loosening.
Studies on prosthetic wear rates have been used to imply appropriate work limitations for the post-arthroplasty patient; however, no quality studies have been reported that address the appropriateness of work limitations. Additionally, the avocational studies reviewed above do not provide quality evidence in support of activity limitations. Thus, although reduced return-to-work status has been reported among patients with more physically demanding work [1211], there is not a strong rationale for work restrictions in the post-surgical hip population.
Quality evidence does not sufficiently support evidence-based guidance and therefore there is no recommendation for or against specific work, avocational or sporting activities.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: vocational, avocational, physical activity, sports; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 47 articles in PubMed, 88 in Scopus, 4 in CINAHL, 2 in Cochrane Library, 216 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic studies met the inclusion criteria.

PSYCHOLOGICAL SERVICES

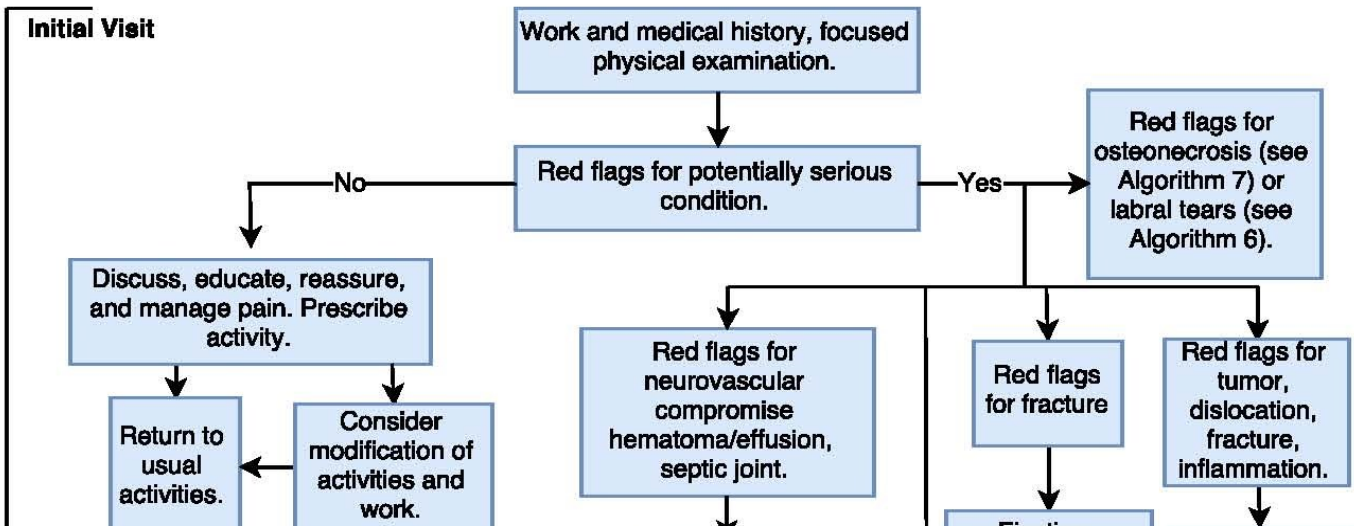
See Chronic Pain Guideline.

REHABILITATION SERVICES FOR DELAYED RECOVERY

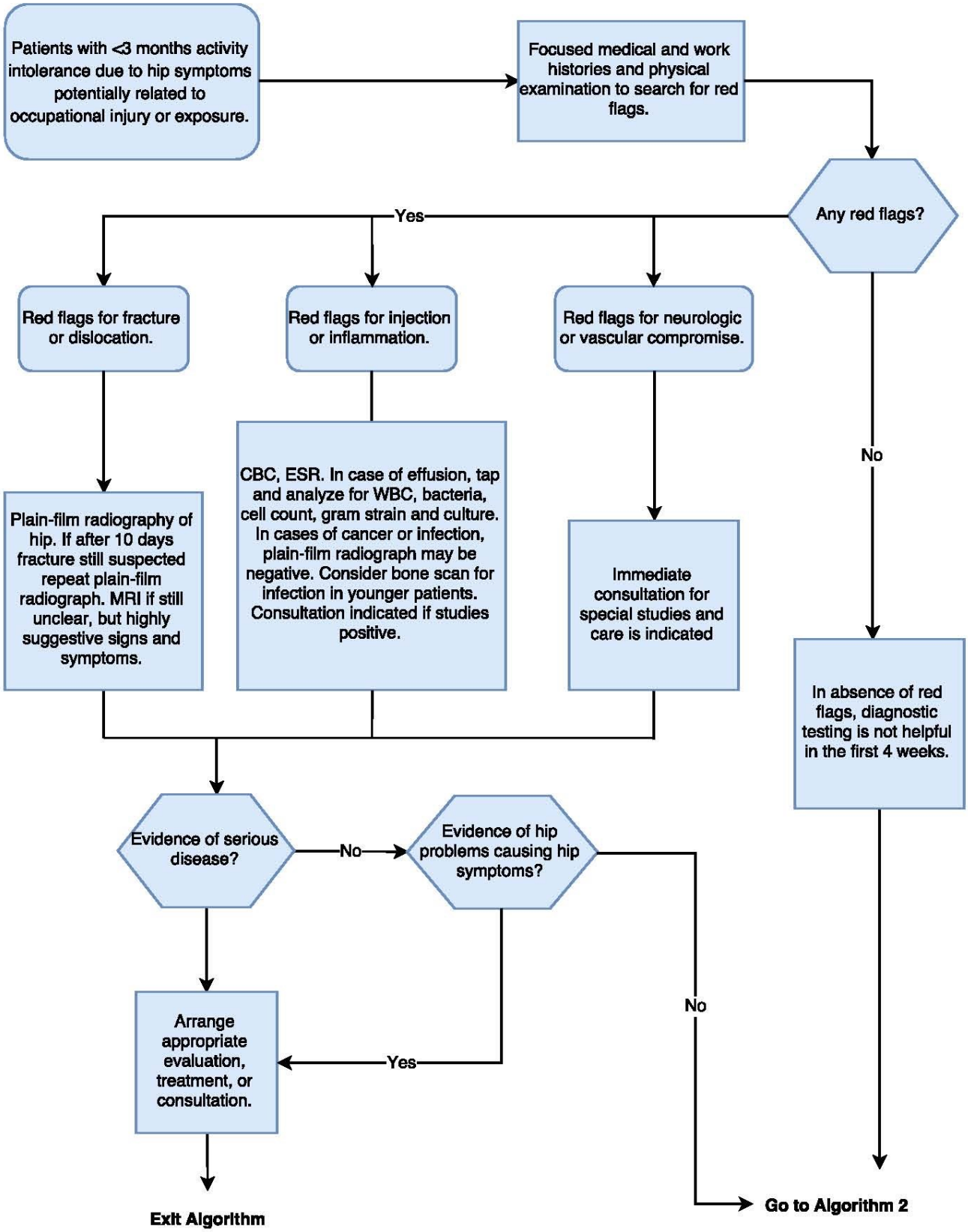
See Chronic Pain Guideline.

Algorithms

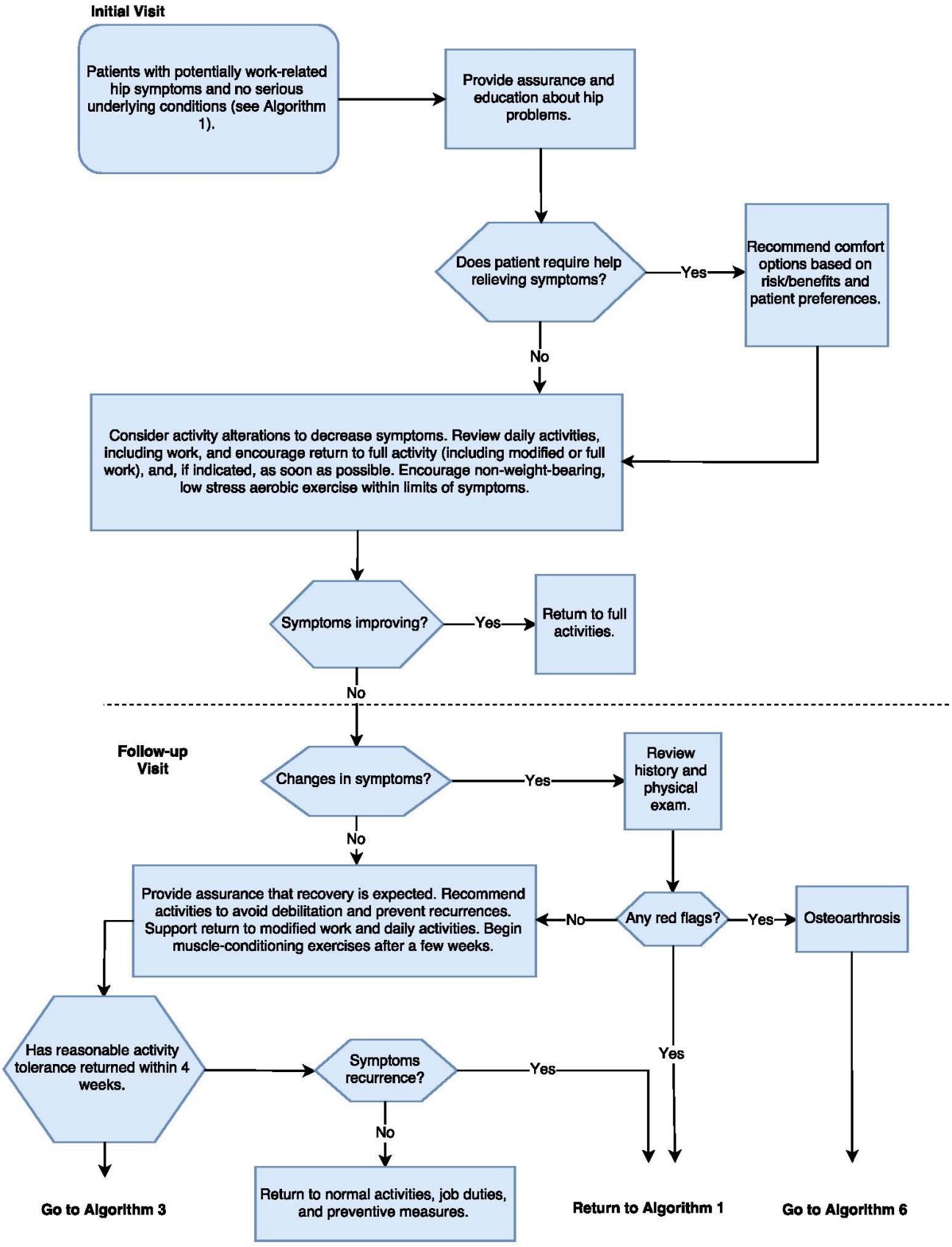
Master Algorithm. Hip and Groin Disorders treatment



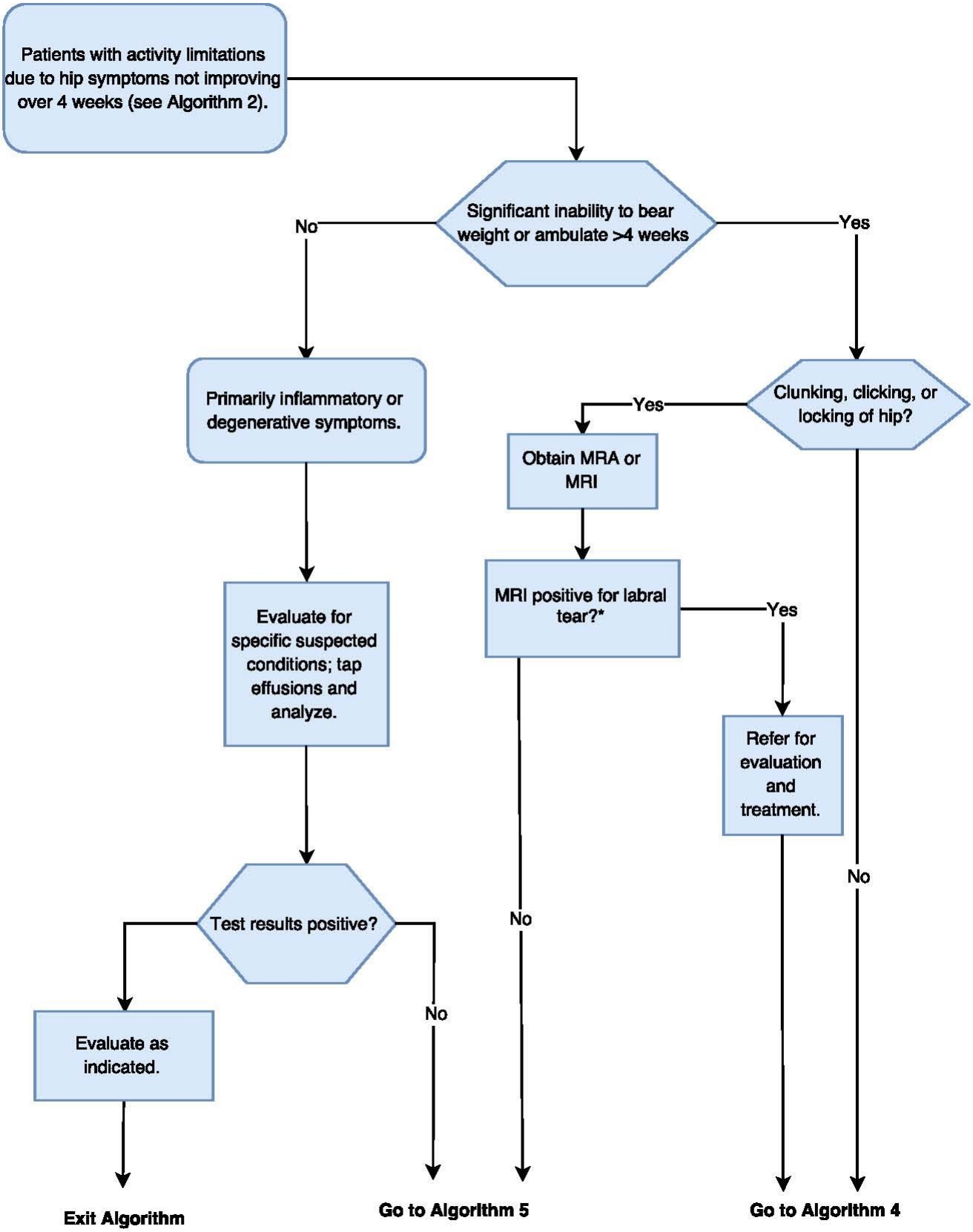
Algorithm 1. Hip and Groin Disorders initial evaluation



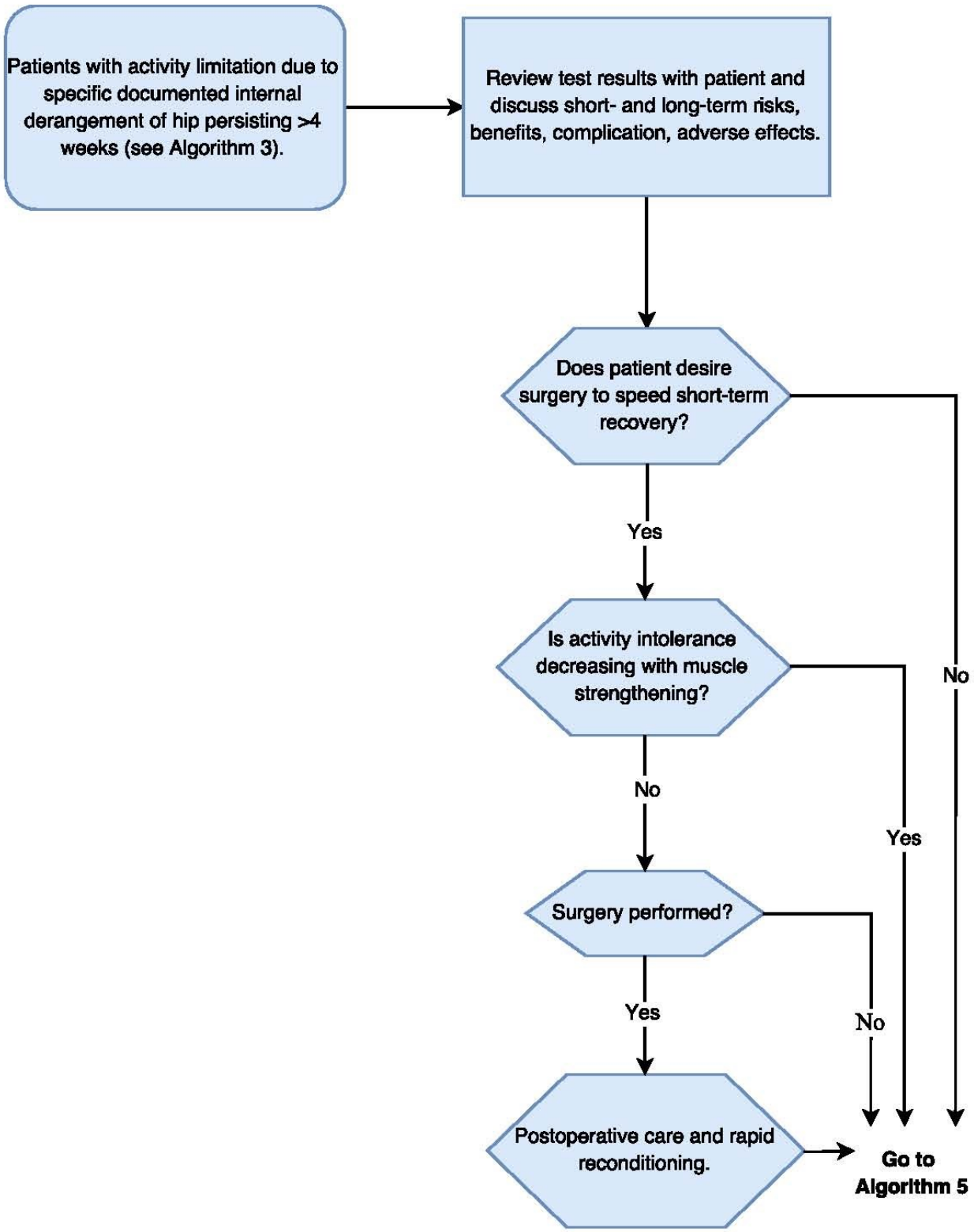
Algorithm 2. Hip and Groin Disorders initial evaluation and acute hip pain treatment.



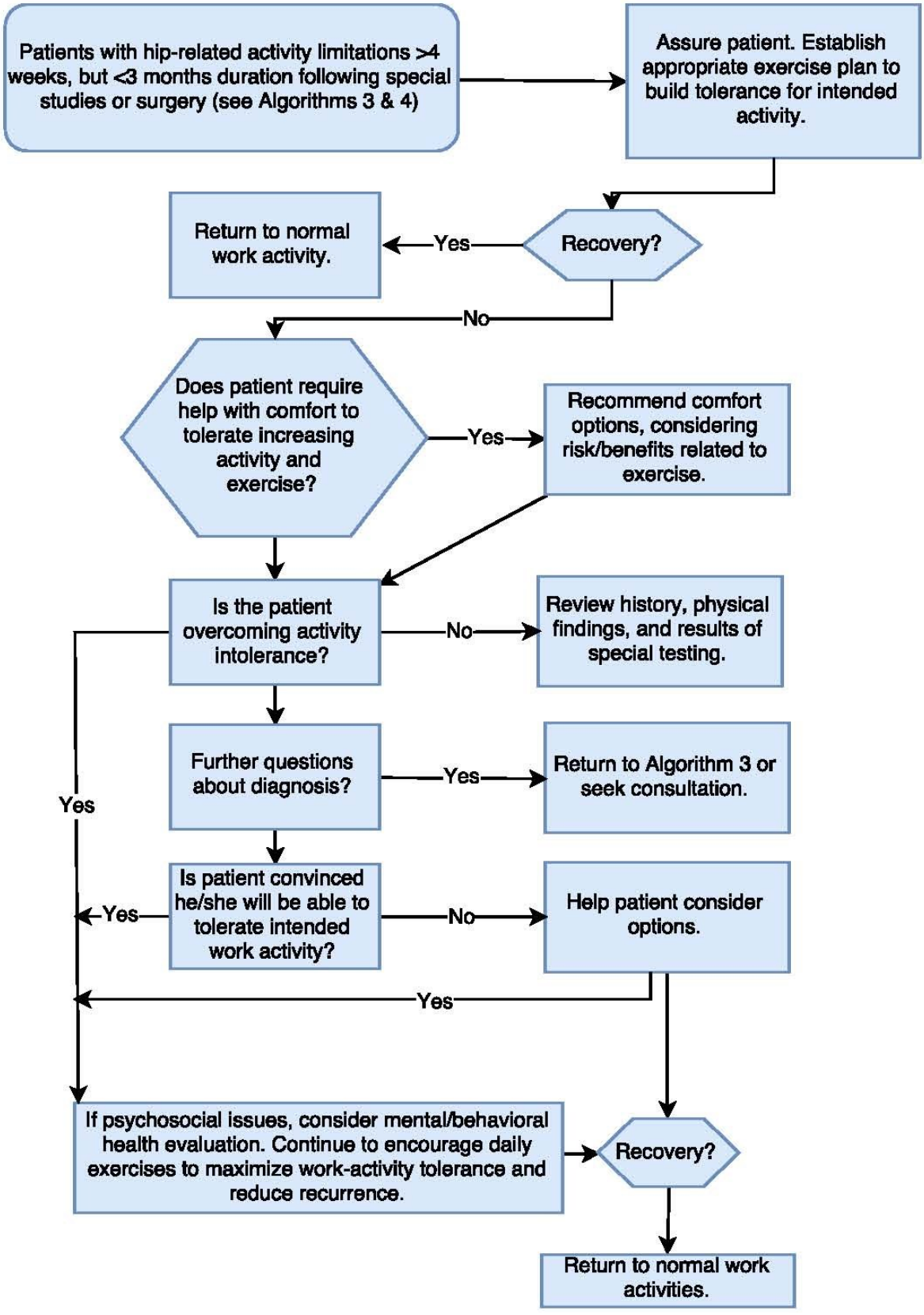
Algorithm 3. Hip and Groin Disorders subacute hip pain evaluation.



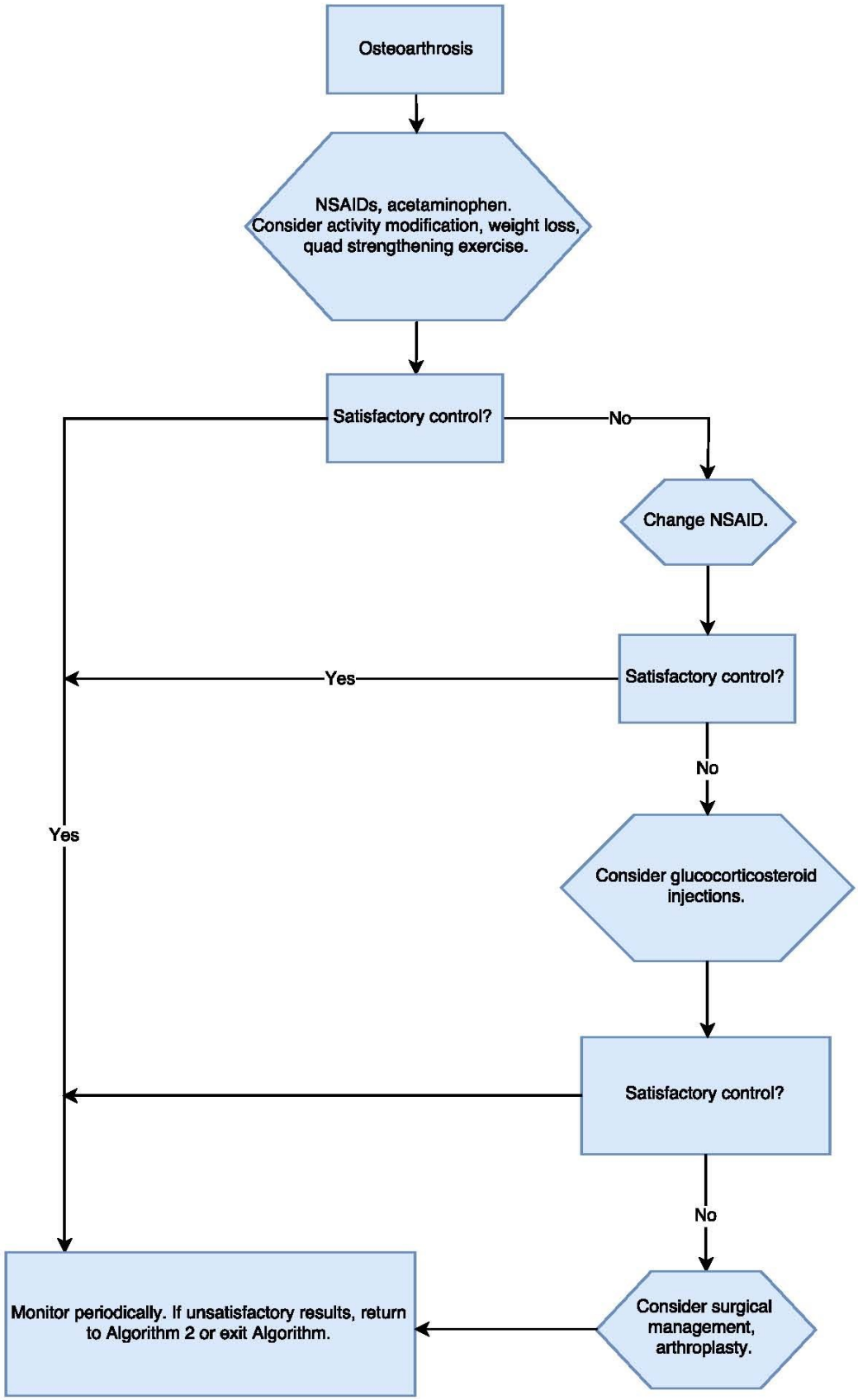
Algorithm 4. Hip and Groin Disorders subacute hip pain and pre-operative evaluation.



Algorithm 5. Hip and Groin Disorders subacute hip pain evaluation and treatment



Algorithm 6. Hip Osteoarthrosis treatment workflow



Hip Osteonecrosis

Summary of Recommendations

All *Guidelines* include analyses of numerous interventions, whether or not they are FDA-approved. For non-FDA-approved interventions, recommendations are based on the available evidence. This is not an endorsement of their use. Many of the medications recommended are utilized off-label.

The following summary table contains recommendations for evaluating and managing hip osteonecrosis from the Evidence-based Hip and Groin Disorders Panel. These recommendations are based on critically appraised higher quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

Bone Scanning with SPECT for Select Use in Patients with Acute, Subacute, or Chronic Osteonecrosis ..... Recommended, Evidence (C)
CT for Evaluating Patients with Osteonecrosis with Contraindications for MRI ..... Recommended, Insufficient Evidence (I)
Helical CT for Evaluating Osteonecrosis ..... Recommended, Insufficient Evidence (I)
MRI for Diagnosing Osteonecrosis ..... Moderately Recommended, Evidence (B)
X-rays for Diagnosing Osteonecrosis ..... Recommended, Insufficient Evidence (I)
Ultrasound for Osteonecrosis ..... No Recommendation, Insufficient Evidence (I)
Avoidance of Dysbaric Exposures or Other Symptom-provoking Activities or Other Risk Factors ..... Recommended, Insufficient Evidence (I)
Aggressive Targeting of Coronary Artery Disease Risk Factors ..... Recommended, Insufficient Evidence (I)
Non-weight-bearing Activities for Osteonecrosis ..... No Recommendation, Insufficient Evidence (I)
Hyperbaric Oxygen for Osteonecrosis ..... Recommended, Evidence (C)
Bisphosphonates for Mild to Moderate Cases of Osteonecrosis ..... No Recommendation, Insufficient Evidence (I)
NSAIDs for Osteonecrosis ..... Recommended, Insufficient Evidence (I)
Anti-Convulsant Agents (Including Topiramate) for Osteonecrosis ..... No Recommendation, Insufficient Evidence (I)
Gabapentin and Pregabalin for Osteonecrosis ..... No Recommendation, Insufficient Evidence (I)
Glucocorticosteroids for Osteonecrosis ..... Not Recommended, Insufficient Evidence (I)
Core Decompression Surgery for Osteonecrosis ..... Recommended, Insufficient Evidence (I)
Arthroplasty for Osteonecrosis ..... Strongly Recommended, Evidence (A)
Post-Operative Anticoagulant Therapy ..... See the Anti-coagulant section of the ACOEM Hip and Groin Disorders guideline.

Definitions and Related Terms

- Osteonecrosis
- Avascular Necrosis (AVN)
- Aseptic Necrosis

- Ischemic Bone Necrosis
- Ischemic Bone Death

Introduction

Osteonecrosis (aka, avascular necrosis) involves increased bone marrow pressure, loss of vascular supply, and subsequent bone death [1212]. Osteonecrosis tends to occur in bones with more tenuous blood supply, including the heads of the femur, humerus, or other ends of long bones, although it can occur in any bone. If the process advances, the bone collapses.

Some cases are considered occupational disorders, particularly in the setting of dysbarism (atmospheric compression/decompression) workers including divers and other workers in compressed air atmospheres who experience impaired blood supply to the femur due to nitrogen gas in the blood during excessively rapid decompression [1213, 1214]. Major trauma is another reported cause [1215]. It has been suggested that the root cause of osteonecrosis is frequently multifactorial with many different risk factors [1216]. Whether stereotypical, forceful use of the joint as a risk factor is unknown. Other risks appear to include diabetes mellitus, glucocorticosteroid use [331, 491, 1217-1220] or endogenous excess [1221], arteriovascular disease [331, 1215] hyperlipidemia sickle cell anemia [1219], coagulopathies [491], Gaucher's disease [1218, 1219] HIV [1220], post-irradiation [1219], alcoholism [1219, 1220], and smoking [1217-1220]. Many cases are idiopathic [1222]. In quality RCTs, alcoholism is often the predominant cause [1223, 1224].

Classification

The Steinberg/Ficat classification system is commonly used to classify osteonecrosis of the femoral head [1225-1228] (see Table 1. Steinberg Stages of Osteonecrosis for stages). This system, which uses an MRI, is broken into six stages. Stage 1 there are no radiographic signs of osteonecrosis; Stage 2 there is evidence of femoral head lucency/sclerosis; Stage 3 there is subchondral collapse but there is no femoral head flattening; Stage 4 has both subchondral collapse and femoral head flattening with normal joint spacing; Stage 5 has joint space narrowing, acetabular changes or both; and Stage 6 is when there are degenerative changes [1225-1228].

Table 1. Steinberg Stages of Osteonecrosis

Stage Descriptor	Clinical Features	X-ray Findings	Bone Scan
0	0	Normal	Normal
I	0	Normal	Abnormal
II	+	Sclerosis and/or cyst formation	Abnormal
III	++	Subchondral collapse (crescent sign) without flattening	Abnormal
IV	++	Flattening of femoral head without joint narrowing, or acetabular involvement	Abnormal
V	+++	Flattening of femoral head with joint narrowing and/or acetabular involvement	Abnormal
VI	+++	Advanced degenerative changes	Abnormal

Adapted from Ficat RP. Idiopathic bone necrosis of the femoral head. Early diagnosis and treatment. *J Bone Joint Surg [Br].* 1985;67(1):3-9 and Steinberg ME. Chapter 5: Management of Avascular Necrosis of the Femoral Head – An Overview. *Instr Course Lect*. 1988;37:41-50.

Impact

Patients are at highest risk of osteonecrosis in their third, fourth, or fifth decade of life and the US annual incidence rate is 10,000 to 20,000 cases a year [1216, 1219, 1229, 1230]. As of 2002, there have been an estimated 300,000 to 600,000 reported cases in the US of femoral head osteonecrosis [1231]. Osteonecrosis is more common in

males with a 7:3 male to female ratio [1216, 1230]. There is a high prevalence of hip osteonecrosis in adults with HIV [1232].
The proportion of osteonecrosis attributed to traumatic events, such as hip dislocation has been reported in 10-25% of cases [1231]. Osteonecrosis accounts for 5-12% of the 500,000 total joint replacement surgeries performed annually in the US [1216, 1218, 1219, 1233]. Total hip arthroplasty is commonly performed for osteonecrosis [1229].
There are limited cost estimates published regarding diagnosis and treatment for osteonecrosis. However, one estimate was $22,657 for a total hip arthroplasty and $16,724 for a free vascularized fibular graft [1234].

Risk and Causation

See the *Introduction* to the ACOEM Hip and Groin Disorders guideline.

Signs and Symptoms

There appears to be a clinically silent, pre-clinical state that is most frequently identified in an asymptomatic hip on x-ray [1215, 1235]. Patients with clinical presentations have either acute or insidious onset of persistent hip pain that may radiate to the thigh [1226, 1236-1240]. Pain is often worse at night and may be somewhat worse with activity. Hip range of motion is typically limited. Pain and range of motion worsen as the degree of impairment progresses [1229, 1240, 1241]. The stages are not inexorable, rather there appears to be potential for recovery at any of the early stages [1215, 1238, 1240].

Osteonecrosis

Avascular necrosis symptoms may include pain in the hip or thigh during standing or walking [400]. Signs can be indicated by radiographs. The signs include collapse of femoral head, band of sclerosis within head, subchondral crescent sign, narrowing of joint space, and cyst-like translucency and sclerosis within head.
For more information, see the *Introduction* to the ACOEM Hip and Groin Disorders guideline.

Red Flags

See the *Introduction* to the ACOEM Hip and Groin Disorders guideline.

Diagnosis

Initial Assessment

The history, physical, and radiographs effectively diagnose most hip disorders. Review of systems and examinations also should involve the knee, spine, abdomen, and genitourinary tract. Osteonecrosis is most commonly diagnosed on imaging studies. If the diagnosis of hip pain remains unclear are radiographs, magnetic resonance imaging (MRI with or without gadolinium etc.) is generally the imaging method for diagnosing most other intra-articular and extra-articular pathologies [402, 403].
Certain findings, “red flags,” raise suspicion of serious underlying medical conditions (see Table 2). Potentially serious disorders include infections, tumors, or systemic rheumatological disorders.

Diagnostic Criteria

Table 2. Diagnostic Criteria for Non-red-flag Conditions

Probable Diagnosis or Injury	Symptoms	Signs	Tests and Results
Osteonecrosis	Non-radiating hip pain. History of systemic factors (e.g., diabetes mellitus, alcohol)	Reduced ROM and pain with passive ROM usually present. May have pain with weight bearing. May be unable to bear weight if osseous collapse has occurred.	Radiographs required. MRI and CT may be ordered for further evaluation of the femoral head. Bone scans sometimes ordered particularly for evaluation of other joints.

Physical Exam

See the *Introduction* to the ACOEM Hip and Groin Disorders guideline.

Follow-up Visits

See the *Introduction* to the ACOEM Hip and Groin Disorders guideline.

Diagnostic Recommendations

Bone Scans (often with SPECT)

Bone scans identify areas of bony metabolic activity and there are many causes for abnormal radioactive uptake including metastases, infection, inflammatory arthropathies, fracture, or other significant bone trauma. Thus, positive bone scans are not highly specific [1242-1245]. Bone scans have been used to diagnose early osteonecrosis prior to findings on x-ray. [1246, 1247].

Bone Scanning with SPECT for Select Use in Patients with Acute, Subacute, or Chronic Osteonecrosis

Recommended.

Bone scanning, often with SPECT, is recommended for select use in patients with acute, subacute, or chronic pain to assist in the diagnosis of osteonecrosis and other conditions with increased polyosthotic bone metabolism, particularly when more than one joint needs to be evaluated.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Moderate**

Indications:	Patients with suspicion of osteonecrosis, or other increased bone metabolism, generally having already had MRI, but with concerns for other problems such as other joint involvement.
Benefits:	Identification of site of increased bone metabolism and screens for wider involvement in other joints.
Harms:	Negligible. Some radiation exposure
Frequency/Dose/Duration:	Generally one evaluation
Rationale:	Bone scanning with SPECT is helpful to identify areas of increased bone metabolism [1248]; thus, its primary use is for osteonecrosis cases (typically identified on radiographs) for which there are concerns for other joint involvement. Bone scanning is minimally invasive, has no adverse effects aside from radiation exposure, but is costly. It is selectively recommended for evaluation of patients with concerns of wider involvement. The threshold for use should generally be low, as

wider involvement of osteonecrosis may further emphasize a need for risk factor modification and imaging monitoring of other joints.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: bone scan; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 75 articles in PubMed, 301 in Scopus, 14 in CINAHL, 7 in Cochrane Library, 10600 in Google Scholar, and 1 from other sources. We considered for inclusion 12 from PubMed, 0 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 6 from Google Scholar, and 1 from other sources. Of the 21 articles considered for inclusion, 7 randomized trials and 14 systematic studies met the inclusion criteria.

Computerized Tomography (CT)

Computerized Tomography (CT) has been especially used to image the skeletal system and other body parts [1249, 1250] [1251, 1252], including to diagnose osteonecrosis [1253, 1254] [1253, 1254] [1254, 1255]

CT for Evaluating Patients with Osteonecrosis with Contraindications for MRI

Recommended.

CT is selectively recommended for evaluating patients with osteonecrosis, including for patients who need advanced imaging, but have contraindications for MRI or where helical CT is unavailable.

Strength of Evidence – Recommended, Insufficient Evidence (I)
Level of Confidence – **Moderate**

Indications: Hip pain thought to be from osteonecrosis, but with contraindications for MRI.

Benefits: Identification of extent and severity of osteonecrosis.

Harms: Negligible. Minor radiation exposure.

Frequency/Dose/Duration: Generally one evaluation. A second may be needed if there is a significant clinical change or to evaluate progress/resolution.

Rationale: Computerized tomography is considered superior to MRI for imaging of most hip abnormalities where advanced imaging of calcified structures is required. For osteonecrosis, there is no clear preference of CT over MRI. However, helical CT is generally thought to be preferable to CT for identification of fracturing and thus use of 'plain' CT is limited, including those settings without helical CT.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Computed Tomography, X-Ray Computed, Computerized Tomography, CT scan, CAT Scan, Angiography; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 63 articles in PubMed, 33 in Scopus, 0 in CINAHL, 0 in

Cochrane Library, 1,350 in Google Scholar, and 0 from other sources. We considered for inclusion 6 from PubMed, 4 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 12 articles considered for inclusion, 4 randomized trials and 8 systematic studies met the inclusion criteria.

Helical CT Scans

Helical CT scans are faster for scanning and have been used for evaluation of osteonecrosis [1256-1258].

Helical CT for Evaluating Osteonecrosis

Recommended.

Helical CT is recommended for evaluating patients with osteonecrosis who have contraindications for MRI.

Strength of Evidence – Recommended, Insufficient Evidence (I)
Level of Confidence – **Moderate**

Indications:	Hip pain from osteonecrosis, especially with concerns about fracturing and collapse. Also indicated for those needing evaluation of osteonecrosis but with contraindications for MRI.
Benefits:	Identification of extent and severity of osteonecrosis and fracturing.
Harms:	Negligible. Minor radiation exposure.
Frequency/Dose/Duration:	Generally, one evaluation. A second may be needed if there is a significant clinical change or for evaluating progress/resolution.
Rationale:	Helical CT is considered superior to MRI for imaging of most hip abnormalities where advanced imaging of calcified structures is required. For osteonecrosis, there is no clear preference of CT over MRI. Helical CT is thought to be better than CT at identifying fracturing and is therefore recommended for select use.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Helical CT Scans OR spiral computed tomography; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 3 articles in PubMed, 42 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 913 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging (MRI) is reportedly advantageous for evaluating osteonecrosis as it can also evaluate marrow edema [1259] [81, 489-495] [491-495]

MRI for Diagnosing Osteonecrosis

Recommended.

MRI is recommended for diagnosing osteonecrosis.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **High**

Indications:	Subacute or chronic hip pain thought to be due to osteonecrosis, particularly when the diagnosis is unclear or if additional diagnostic evaluation and/or staging is needed.
Benefits:	Identify severity, collapse and to stage.
Harms:	Negligible
Frequency/Dose/Duration:	Generally one evaluation. A second is often needed if there is a significant clinical change, or need to evaluate progress/resolution.
Rationale:	Multiple studies show utility of MRI for assessing ON [704, 1260]. Helical computerized tomography is considered superior to MRI for imaging bone collapse [481]. MRI is considered superior for imaging bone marrow edema, which is inversely correlated with prognosis. Thus, both tests have their advantages. MRI is not invasive (or minimally so with a contrast exam), has negligible adverse effects, is high cost, has utility for the diagnosis and staging of osteonecrosis and is thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: magnetic resonance imaging, mri, mri scan; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 159 articles in PubMed, 346 in Scopus, 83 in CINAHL, 19 in Cochrane Library, 5050 in Google Scholar (Went through first 100), and 0 from other sources. We considered for inclusion 24 from PubMed, 1 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 3 from Google Scholar, and 0 from other sources. Of the 29 articles considered for inclusion, 15 randomized trials and 14 systematic studies met the inclusion criteria.

X-Rays/Radiographs

Radiographs have long been used to assess osteonecrosis [1261-1269] [1215, 1265, 1270] [1215].

X-rays for Diagnosing Osteonecrosis

Recommended.

X-rays are recommended for diagnosing osteonecrosis.

Strength of Evidence – Recommended, Insufficient Evidence (I)
Level of Confidence – **High**

Indications:	All patients thought to have osteonecrosis.

Benefits:	Identify severity, collapse and for staging, although advanced imaging is better at staging.
Harms:	Negligible
Frequency/Dose/Duration:	Periodically obtaining x-rays to follow the course of the disease is customary.
Rationale:	Radiographs have long been used for diagnosing osteonecrosis, thus there are few quality studies to evaluate diagnostic efficacy. One study suggested MRI was modestly better than plain radiographs [1262], yet radiographs are much lower cost and more widely available. X-rays are helpful to evaluate most patients with hip pain, both to diagnose and to assist with the differential diagnostic possibilities. Early stage osteonecrosis x-rays may be normal, or show slight osteopenia. A high index of suspicion is necessary. X-rays are non-invasive, are low cost, have little risk of adverse effects, have clinical utility and thus are recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: X-rays or Radiographs; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 259 articles in PubMed, 526 in Scopus, 283 in CINAHL, 19 in Cochrane Library, 9710 in Google Scholar, and 1 from other sources. We considered for inclusion 6 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 7 articles considered for inclusion, 1 randomized trial and 5 systematic studies met the inclusion criteria.

Ultrasound

Diagnostic ultrasound has been used to evaluate the hip joint, especially the soft tissues, effusions, dysplasia and labral tears, as well as occult fractures [1271, 1272] [509] [508] [505] ,[506, 507] [1273].

Ultrasound for Osteonecrosis

No Recommendation.

There is no recommendation for or against the use of ultrasound to diagnose osteonecrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale:	There are no quality studies of ultrasound for diagnosing osteonecrosis and thus there is no recommendation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasound; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 25 articles in PubMed, 11 in Scopus, 4 in CINAHL, 2 in Cochrane Library, 4352 in

Google Scholar, and 2 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 2 from other sources. Of the 3 articles considered for inclusion, 0 randomized trials and 3 systematic studies met the inclusion criteria.

Treatment Overview

The early treatment focus for mild to moderate cases of osteonecrosis is to identify and treat reversible risk factors. Reduction or elimination of activities that significantly provoke symptoms including avoidance of dysbaric exposures is recommended. One trial has suggested hyperbaric oxygen may be effective. Evidence conflicts regarding whether disphosphonates are effective treatments. Moderately severe or severe cases generally receive prompt surgical treatment, especially if collapse has occurred. Multiple surgical procedures have been used to treat osteonecrosis including core decompression [1274-1277], rotational or simple varus osteotomy [1274, 1278, 1279], vascularized and devascularized bone grafting [1277, 1280], cementation [1055, 1281-1283], muscle pedicle grafting [1284], trabecular rod implementation, autologous bone marrow transplantation [1285], femoral head resurfacing [1286, 1287], hemiarthroplasty and arthroplasties [1055, 1222, 1274-1294]. Electrical stimulation is also used, although there are no quality studies of the efficacy of the procedure [1295].

Initial Care

Assessing disease severity if the first step for osteonecrosis. If collapse has not occurred and/or is not imminent, then osteonecrosis is unique among the hip/groin disorders, as assuring that there is not a remediable risk factor may be of critical importance. Elimination of decompression atmospheres, alcohol, glucocorticoids, and tightening diabetic control are prominent early interventions. Nonprescription analgesics may provide sufficient pain relief for most patients with hip pain from osteonecrosis. If either the condition is progressing and/or disease severity is more advanced, surgical intervention is indicated.

This guideline recommends interventions with quality evidence of proven efficacy. Known complication rates and safety profiles, if available, should always be utilized in decision making and were considered in developing this guideline. In addition to those treatments reviewed herein, there are many other theoretically potential treatments possible for management of hip and groin conditions. However, in the absence of moderate- to high-quality studies supporting their efficacy [511], these other interventions are not recommended and are indicated as **Not Recommended, Insufficient Evidence (I)**.

Activities and Activity Modification

The primary activity of concern for acute and subacute cases of osteonecrosis is de/compression. Patients with osteonecrosis should not generally undergo any de/compression atmospheres until the condition is resolved, whether occupational or non-occupational (e.g., diving). High force and/or high impact force (e.g., jumping) should generally be precluded in patients presenting with osteonecrosis (especially those with more severe disease at risk of collapse) until the condition is either substantially improved or resolved. Activities that result in a substantial increase in pain should also be examined for consideration of restrictions. Regardless of phase of the osteonecrosis (acute, subacute, chronic), adherence to decompression tables is highly advisable.

Work Activities

Work activity modifications are often necessary during the treatment course for patients with hip osteonecrosis. Avoidance of dysbarism is important in the recovery from osteonecrosis. Advice on how to avoid aggravating activities that at least temporarily increase pain includes a review of work duties to decide whether or not modifications can be accomplished without employer notification and to determine whether modified duty is appropriate and available.

An initial step in determining whether additional work activity modifications are required usually involves a discussion with the patient regarding whether he or she has control over his or her job tasks. In such cases where the worker can make modifications, e.g., receive assistance to lift a box or alternate sitting and standing as

needed, there may be no requirement to write any restrictions even if the pain is limiting. In some situations, it may be advisable to confirm this report with the patient's supervisor to signal to the supervisor that the person is under treatment. In some cases, specified limitations may be a better treatment strategy. Assessment of work activities and potential for modifications may also be facilitated by a worksite visit and analysis by a health care provider with appropriate training (e.g., typically a physician, occupational therapist, physical therapist, or some ergonomists).
Work limitations should be tailored by taking into account the following factors: 1) dysbaric conditions, 2) job physical requirements; 3) the safety of the tasks, in consideration of the diagnosed condition, age, and relevant biomechanical limitations; 4) severity of the problem; 5) work organizational issues (overtime, work allocation, wage incentives); and 6) the patient's understanding of his or her condition. Sometimes it is necessary to write limitations or to prescribe activity levels that are above what the patient feels he or she can do, particularly when the patient feels that sedentary activity is advisable. In such cases, the physician should be careful to not overly restrict the patient; education about the pain problem and the need to remain active should be provided.
Common limitations for osteonecrosis involve modifying the avoiding jumping, high impact activities, lowering weight of objects lifted, frequency of lifts, and posture – all while taking into account the patient's capabilities. For severe cases of osteonecrosis, frequent initial limitations for occupational and non-occupational activities include:

- No dysbaric exposures
- No jumping or high-impact activities
- No lifting of more than 10 pounds;
- No prolonged or repeated bending (flexion); and
- No prolonged or repeated crouching and squatting.

These work (and home) activity guidelines are generally reassessed every week in the acute phase with changes as the phase of the osteonecrosis allows.

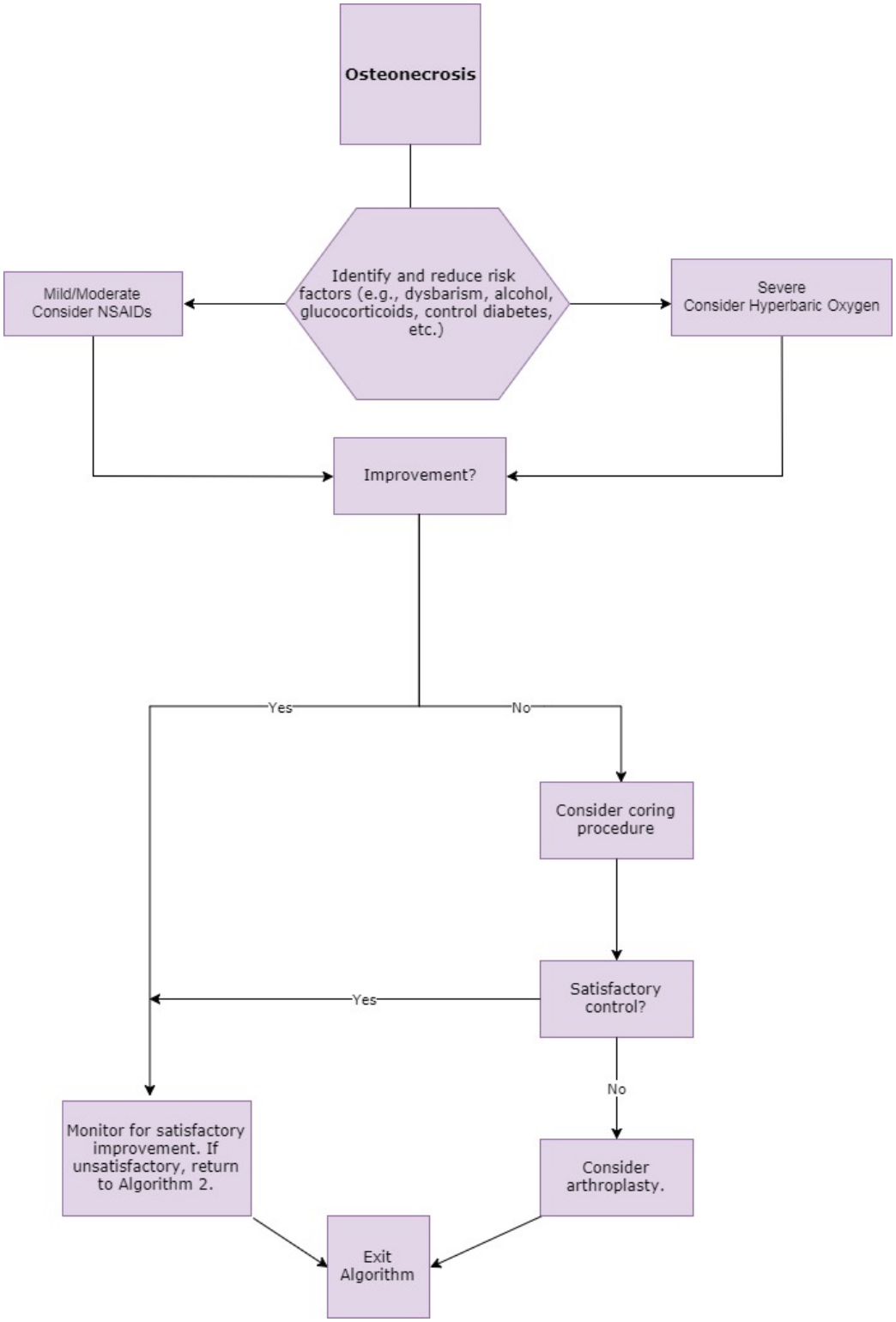
Ergonomic Interventions

The primary occupational concern for osteonecrosis is de/compression. Assessment of whether decompression tables were utilized and adhered to, both prior to presentation, as well as upon considering return to exposure, is important.

As falls result in considerable hip morbidity (including femoral head collapse and fractures) and fall protection equipment has resulted in far fewer fatalities in industry over the past few decades, fall protection is a priority for preventing acute injuries.

Algorithm

Hip Osteonecrosis Algorithm for Initial Assessment



Treatment Recommendations

Initial Care

Initial care may include avoidance of dysbaric exposures, other symptom-provoking activities, or other known risk factors for osteonecrosis, as well as control of diabetes mellitus, elimination or reductions in glucocorticosteroid use, and/or elimination of alcohol and tobacco products.

Avoidance of Dysbaric Exposures or Other Symptom-provoking Activities or Other Risk Factors

Recommended.

Activity Modification and Exercise

Reduction or elimination of activities that are significant risks for osteonecrosis, including avoidance of dysbaric exposures, control of diabetes mellitus, elimination or reductions in glucocorticosteroid use, and/or elimination of alcohol and tobacco products, is recommended.

Strength of Evidence – Recommended, Insufficient Evidence (I)
Level of Confidence – **Moderate**

Indications: All patients with osteonecrosis.

Benefits: Potential to modify the disease course and prevent need for surgery

Harms: Adverse effects of treatments rendered.

Rationale: There are few quality studies evaluating efficacy of risk factor modification for osteonecrosis. There is no quality evidence regarding non-weight-bearing status, which is sometimes instituted for months[1223, 1292, 1296]; thus, there is no recommendation for or against its use. As the following are known modifiable risk factors, elimination of decompression exposures, control of diabetes mellitus, elimination or reductions in glucocorticosteroid use, and elimination of alcohol and tobacco products are all recommended at the time the diagnosis is considered. As there is some evidence statins may reduce risk [1217] and tobacco is also a risk, the composite data suggest aggressive targeting of all coronary artery disease risk factors is needed and recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Risk Factors, Dysbaric exposure, symptom provoking, risk factor avoidance, avoidance learning, avoidance risk factors ; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 201 articles in PubMed, 2 in Scopus, 0 in CINAHL, 2 in Cochrane Library,

1060 in Google Scholar (Went through first 100), and 8 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 8 from other sources. Of the 8 articles considered for inclusion, 2 randomized trials and 0 systematic studies met the inclusion criteria.

Some of the same risk factors for coronary artery disease also are risk factors for osteonecrosis, including diabetes mellitus, smoking, and alcohol [1297, 1298]. Also, coronary artery disease and avascular necrosis are both complications of systemic lupus erythematosus [1299, 1300].

Aggressive Targeting of Coronary Artery Disease Risk Factors

Recommended.

Activity Modification and Exercise

Aggressive targeting of coronary artery disease risk factors is recommended for treatment of osteonecrosis.

Strength of Evidence – Recommended, Insufficient Evidence (I)

Level of Confidence – **Low**

Indications: All patients with osteonecrosis.

Benefits: Potential to modify the disease course and prevent need for surgery

Harms: Adverse effects of treatments rendered.

Rationale: There are no quality trials of aggressive treatments of cardiovascular disease risk factors. Yet, epidemiological evidence supports risks for osteonecrosis associated with diabetes mellitus, alcohol and smoking. Some evidence in limited patients (e.g., renal) also suggest statins are associated with lower risk [1217] [1301]). Anatomical evidence appears to support a disease mechanism based on tenuous blood supply. Thus, there is a rationale for targeting cardiovascular disease risk factors in patients with osteonecrosis. Cardiovascular disease risk factor modification is not invasive, has generally low adverse effects, is moderate cost depending on the intervention(s), has no quality evidence of efficacy, but has a strong theoretical construct; thus, it is recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: coronary artery disease, risk factors, smoking, hypertension; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 263 in Scopus, 1 in CINAHL, 0 in Cochrane Library, 1730 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Non-weight-bearing activity or therapy includes activities such as level-ground crutch walking [1302-1307].

Non-weight-bearing Activities for Osteonecrosis

No Recommendation.
Activity Modification and Exercise
There is no recommendation for or against the institution of non-weight-bearing activities for patients with osteonecrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	Although there is a longstanding theory that non-weight-bearing status may be helpful for osteonecrosis, there is no quality evidence that non-weight-bearing status is an effective treatment [1223, 1292, 1296] and non-weight bearing status has significant adverse effects that include venous thromboses, pulmonary emboli, and debility. Thus, there is no recommendation for or against a prescription of non-weight-bearing status.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: non-weight bearing activity; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 1 articles in PubMed, 497 in Scopus, 0 in CINAHL, 2 in Cochrane Library, 599 in Google Scholar, and 11 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 11 from other sources. Of the 12 articles considered for inclusion, 3 randomized trials and 8 systematic studies met the inclusion criteria.

Allied Health

Hyperbaric oxygen therapy uses high oxygen pressure to attempt to increase tissue oxygenation [1308-1310] and has been used to treat osteonecrosis [1309-1312].

Hyperbaric Oxygen for Osteonecrosis

Recommended.
Allied Health Interventions
Hyperbaric oxygen is recommended for treatment of osteonecrosis.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Low**

Indications:	Osteonecrosis Ficat Stage 2. It may be reasonable to attempt HBO in patients with more severe osteonecrosis.
Benefits:	
	Avoidance of need of surgery

Harms:	Barotrauma (especially of the ears), oxygen toxicity, claustrophobia/anxiety
Frequency/Dose/Duration:	2.5 ATA of hyperbaric oxygen for 82 minutes, comprising a period of 60 minutes for a total of 30 treatments [1309]
Indications for Discontinuation:	Completion of course, intolerance, clinical resolution, osteonecrosis collapse
Rationale:	There is one moderate quality study suggesting durable, reduced need of arthroplasty lasting 7 years among HBO-treated patients [1309], although the sample size is modest. Hyperbaric oxygen has been used to treat osteonecrosis of the jaw [1313], but a study following osteonecrosis of the hips of children from chemotherapeutics found no improvements with hyperbaric oxygen. HBO is not invasive, has low adverse effects, is high cost, has some evidence of efficacy for osteonecrosis, has a durable reduced need of surgery, and thus is recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, Hyperbaric Oxygen, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 8 articles in PubMed, 183 in Scopus, 15 in CINAHL, 7 in Cochrane Library, 456 in Google Scholar, and 1 from other sources. We considered for inclusion 1 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 5 articles considered for inclusion, 1 randomized trial and 4 systematic studies met the inclusion criteria.

Medications

Bisphosphonates are anti-resorptive agents that inhibit mature osteoclasts in the bone [1314, 1315]. Although they are primarily used to treat osteoporosis [1315, 1316], they have also been used to treat osteonecrosis [1314, 1316-1319].

Bisphosphonates for Mild to Moderate Cases of Osteonecrosis

No Recommendation.

There is no recommendation for bisphosphonates for treatment of osteonecrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Rationale:	Bisphosphonates have been evaluated in multiple moderate-quality studies; the results conflict, with some showing efficacy [1320, 1321] and some lacking efficacy [1237, 1318, 1322]. Bisphosphonates are not invasive, have some adverse effects, are moderate cost, and have substantially conflicting data on efficacy; thus, there is no recommendation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Bisphosphonates, Diphosphonates,

Alendronate, Etridonate, Didronel, Ibandronate, Boniva, Risedronate, Actonel, Atelvia, Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 40 articles in PubMed, 5619 in Scopus (Went through first 100), 203 in CINAHL, 40 in Cochrane Library, 2890 in Google Scholar (Went through first 100), and 28 from other sources. We considered for inclusion 8 from PubMed, 0 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 2 from other sources. Of the 12 articles considered for inclusion, 7 randomized trials and 4 systematic studies met the inclusion criteria.

NSAIDs for Osteonecrosis

NSAIDs are widely used among patients with hip osteoarthrosis, but less so among patients with hip osteonecrosis [1323-1326].

Recommended.

Medications (including topical creams)

NSAIDs are recommended for treatment of osteonecrosis.

Strength of Evidence – Recommended, Insufficient Evidence (I)
Level of Confidence – **Low**

Indications:	Osteonecrosis sufficiently severe to need analgesics. Generally if sufficiently severe to require opioids, NSAID should be prescribed upon which opioid is adjunctive. (See Hip Arthritis section on NSAIDs for details, including cytoprotective options; see ACOEM Opioids Guideline).
Benefits:	Modest reduction in pain.
Harms:	Gastrointestinal bleeding, other bleeding. Possible elevated cardiovascular risks including myocardial infarction, especially for high-dose COX-2 inhibitors. Renal failure may occur particularly in the elderly or those with otherwise compromised function.
Frequency/Dose/Duration:	In most osteonecrosis patients, scheduled dosage rather than as needed is generally preferable. As needed prescriptions may be reasonable for mild or moderate ON. The NSAID should generally be scheduled, rather than as-needed for treatment of more severe ON especially if there is consideration for adjunctive treatment with muscle relaxants, opioids, or other potentially impairing medications. Once the patient moves to a supportive long-term care plan and/or pain lessens, the patient may revert to selective use for "flare ups," with some patients also using NSAIDs to maintain work status and function.
Indications for Discontinuation:	Resolution of ON pain, lack of efficacy, or development of adverse effects that necessitate discontinuation.
Rationale:	There are no quality studies of NSAIDs for treatment of osteonecrosis. However, NSAIDs have plentiful evidence of efficacy compared with placebo for pain control (see Hip OA and LBP Guidelines). NSAIDs are

not invasive, have low adverse effects in working age populations, are low cost, have evidence of efficacy for treatment of other painful conditions and thus are recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: NSAIDs; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 3 articles in PubMed, 262 in Scopus, 0 in CINAHL, 11 in Cochrane Library, 1170 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Anti-Convulsant Agents (Including Topiramate) for Osteonecrosis

Anticonvulsants, also known as antiepileptic drugs, use mechanisms such as ion channels and neurotransmitter modulation to help control and suppress the symptoms of seizures [1327, 1328] [1329, 1330] [626]. Since the 1960s, anti-convulsant agents have been used off-label to treat certain chronic pain syndromes [623] (see ACOEM Chronic Pain Guideline for more details).

No Recommendation.

Medications (including topical creams)

There is no recommendation regarding anti-convulsant agents, including topiramate for osteonecrosis

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale: There are no quality studies of anti-convulsant medications for treatment of pain associated with osteonecrosis and thus there is no recommendation.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: **Anticonvulsants**; **Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head,** controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 26 in Google Scholar, and 4 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 4 from other sources. Zero articles met the inclusion criteria.

Gabapentin and Pregabalin for Osteonecrosis

Gabapentin is an antiepileptic and anticonvulsant medication that has also been used to treat neuropathic pain. Pregabalin is an anticonvulsant and neuropathic pain agent [1331, 1332] and has been used treat painful nerve diseases, and fibromyalgia (muscle pain and stiffness) [1333, 1334].

No Recommendation.

Medications (including topical creams)

There is no recommendation regarding gabapentin and pregabalin for the treatment of osteonecrosis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There are no quality studies of gabapentin or pregabalin for treatment of pain associated with osteonecrosis and thus there is no recommendation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Pregabalin; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 3 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 136 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Gabapentin; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 0 articles in PubMed, 0 in Scopus, 8 in CINAHL, 0 in Cochrane Library, 0 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Glucocorticosteroids for Osteonecrosis

Glucocorticosteroids [1335, 1336] [1335, 1337] have been used to treat arthritis, dermatitis, asthma, allergic reactions, and osteonecrosis [1337, 1338]

Not Recommended.

Medications (including topical creams)

Glucocorticosteroids, including by injection, are not recommended for treatment of osteonecrosis.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There are no quality studies assessing treatment of osteonecrosis with glucocorticosteroids. However, there is significant evidence that glucocorticosteroids are significant risk factors for the condition, thus, by inference, and in the absence of evidence of efficacy, glucocorticosteroids are not recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: glucocorticosteroids OR

glucocorticoids; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 25 articles in PubMed, 3 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 2960 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Surgical Considerations

CORE DECOMPRESSION SURGERY FOR OSTEONECROSIS

Core decompression is a surgical procedure commonly used to treat early stages of osteonecrosis [1339, 1340]. Core decompression involves drilling several smaller holes or one larger hole into the femoral head to decompress, and improve blood supply to nourish the affected bone. [424, 1341, 1342] [424, 1341, 1343].

Recommended.

Surgical Considerations

Core decompression surgery is recommended for treatment of osteonecrosis.

Strength of Evidence – Recommended, Insufficient Evidence (I)
Level of Confidence – **Low**

Indications:	Patients with generally moderate to severe osteonecrosis either (i) not responding to risk factor modification and/or (ii) felt to be at risk of collapse and further delay while treating risk factors or with hyperbaric oxygen is felt to be too risky.
Benefits:	Potential to heal without arthroplasty.
Harms:	Superficial and deep infection(s), osteomyelitis, failure to prevent collapse and need for arthroplasty.
Rationale:	Core decompression with or without bone grafts is the surgical procedure that has been most utilized to attempt to treat osteonecrosis [1215, 1275, 1344-1347]. However, the two moderate-quality studies of adults [492, 1347] conflict [1275]. The primary purpose of the procedure is to relieve the elevated intramedullary pressure that stagnates the microvascular circulation.[1215] In a case series, results were good in 94% of Stage I and 82% in Stage II. However, a case series cannot prove that earlier treatment results in superior outcomes as results may mislead through spectrum and other biases. While the coring decompression is not without risks and is costly, and although the two quality studies of a coring procedure conflict, core decompression is selectively recommended. Studies conflict regarding the utility of coring plus autologous bone marrow stem cell injections compared to coring alone. One study suggested superiority of vascularized fibular grafting to coring.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Core Decompression, core decompression surgery; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 123

articles in PubMed, 136 in Scopus, 43 in CINAHL, 1 in Cochrane Library, 1270 in Google Scholar, and 6 from other sources. We considered for inclusion 7 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 6 from other sources. Of the 15 articles considered for inclusion, 12 randomized trials and 1 systematic study met the inclusion criteria.

Arthroplasty for Osteonecrosis

Hip arthroplasty is the treatment for osteonecrosis with collapse [1348, 1349] [1350, 1351] [1352, 1353].
Strongly Recommended.

Surgical Considerations

Arthroplasty is strongly recommended for treatment of osteonecrosis with collapse or severe disease unresponsive to non-operative treatment.

Strength of Evidence – Strongly Recommended, Evidence (A)
Level of Confidence – **High**

Indications:	Patients with collapse of the femoral head are immediate candidates for arthroplasty. Additional candidates include those with severe osteonecrosis who are: (i) unresponsive to risk factor modification, and/or (ii) felt to be at significant risk of immediate collapse.
Benefits:	Potential for curative treatment.
Harms:	Superficial and deep infection(s), osteomyelitis, risk of requiring explantation. If young individual, increased risk of requiring revision surgery.
Rationale:	Once the head of the femur collapses, the treatment is usually arthroplasty, although early case series reported high revision rates of up to 37% that have more recently declined to approximately 2 to 9% [1055, 1354-1364] with improvements initially attributed to cementation techniques with subsequent reductions in revisions attributed to cementless techniques [1222]. A few of the quality studies regarding arthroplasty were performed for osteonecrosis, although none solely included those patients [1055, 1056, 1365]. See Hip Osteoarthrosis section on arthroplasty for additional details. The prognosis appears to be reasonably good in more recent studies of these patients and thus, arthroplasty is strongly but selectively recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: hip arthroplasty, hip replacement; Hip osteonecrosis, avascular necrosis, femur head necrosis, osteonecroses, bone necrosis, aseptic necrosis of bone, Kienboeck disease, necrosis of the femoral head, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 340 articles in PubMed, 2657 in Scopus, 310 in CINAHL, 10 in Cochrane Library, 3270 in Google Scholar, and 1 from other sources. We considered for inclusion 6 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 16 articles considered for inclusion, 11 randomized trials and 1 systematic studies met the inclusion criteria.

Post-Operative Anticoagulant Therapy

See the *Anti-coagulant* section of the ACOEM Hip and Groin Disorders guideline.

Hip Fractures

Summary of Recommendations

All *Guidelines* include analyses of numerous interventions, whether or not they are FDA-approved. For non-FDA-approved interventions, recommendations are based on the available evidence. This is not an endorsement of their use. Many of the medications recommended are utilized off-label.

The following summary table contains recommendations for evaluating and managing hip fractures from the Evidence-based Hip and Groin Disorders Panel. These recommendations are based on critically appraised higher quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

Bone Scanning for Select Use in Patients with Hip Pain ..... Recommended, Insufficient Evidence (I)
CT for Evaluating Patients with Possible Fractures, or Contraindications for MRI ..... Recommended, Evidence (C)
Helical CT for Evaluating Hip Fracture ..... Recommended, Insufficient Evidence (I)
MRI for Hip Joint Pathology ..... Recommended, Insufficient Evidence (I)
X-rays for Hip Fracture ..... Recommended, Insufficient Evidence (I)
Ultrasound for Evaluating Hip Fracture ..... Not Recommended, Insufficient Evidence (I)
Ergonomic Interventions ..... No Recommendation, Insufficient Evidence (I)
Fall Protection ..... Recommended, Insufficient Evidence (I)
Bed Rest for Unstable Fractures ..... Recommended, Insufficient Evidence (I)
Bisphosphonates for Hip Fracture Patients ..... Strongly Recommended, Evidence (A)
Calcitonin for Hip Fracture Patients ..... No Recommendation, Insufficient Evidence (I)
Non-steroidal Anti-inflammatory Drugs (NSAIDs) and Acetaminophen ..... See the Hip Osteoarthrosis section of the **ACOEM Hip and Groin Disorders guideline.**
Hot and Cold Therapies ..... See the Hip Osteoarthrosis section of the ACOEM Hip and Groin Disorders guideline.
TENS for Emergency Transport of Patients with Hip Fracture ..... Moderately Recommended, Evidence (B)
Acupressure for Transporting Hip Fracture Patients ..... Moderately Recommended, Evidence (B)
Fascia Iliaca Compartment Block (FICB) for Emergency Room Management of Hip Fractures ..... Moderately Recommended, Evidence (B)
Surgical Treatment for Hip Fractures ..... Recommended, Insufficient Evidence (I)
Arthroplasty for Hip Fractures ..... Strongly Recommended, Evidence (A)
Hemiarthroplasty for Hip Fractures ..... Strongly Recommended, Evidence (A)
One-Day Use of Systemic Antibiotics for Hip Surgery ..... Moderately Recommended, Evidence (B)
Acupuncture for Hip Arthroplasty Patients ..... Moderately Recommended, Evidence (B)

Infected Prostheses ..... See the Hip Osteoarthrosis section of the ACOEM Hip and Groin Disorders guideline.
Dislocations ..... See the Hip Osteoarthrosis section of the ACOEM Hip and Groin Disorders guideline.
Prosthetic Failure ..... See the Hip Osteoarthrosis section of the ACOEM Hip and Groin Disorders guideline.
Compression Stockings for Prevention of Venous Thromboembolic Disease ..... Moderately Recommended, Evidence (B)
Lower Extremity Pumps for Prevention of Venous Thromboembolic Disease ..... Moderately Recommended, Evidence (B)
Low-molecular Weight Heparin for Prevention of Venous Thromboembolic Disease ..... Strongly Recommended, Evidence (A)
Factor Xa Inhibitors for Prevention of Venous Thromboembolic Disease ..... Strongly Recommended, Evidence (A)
Warfarin and Heparin for Prevention of Venous Thromboembolic Disease ..... Moderately Recommended, Evidence (B)
Aspirin for the Prevention of Venous Thromboembolic Disease ..... Moderately Recommended, Evidence (B)
Post-operative Exercise and Rehabilitation Program for Hip Fracture Patients ..... Moderately Recommended, Evidence (B)
Geriatric Unit Treatment for Select Patients ..... Recommended, Evidence (C
Late Post-Operative Exercises ..... See the Hip Osteoarthrosis section of the ACOEM Hip and Groin Disorders guideline.
Late Post-Operative Exercise Program for Arthroplasty or Hip Fracture ..... See the Hip Osteoarthrosis section of the ACOEM Hip and Groin Disorders guideline.
Post-Operative Activities and Sports ..... See the Hip Osteoarthrosis section of the ACOEM Hip and Groin Disorders guideline.

Introduction

Hip fractures occur most commonly in US adults 65 or older (90% as the result of a fall). However, a sizable minority involve occupational incidents such as motor vehicle accidents and falls from height. These injuries may lead to severe health problems, reduced quality of life, and premature death. Hospital admissions for hip fractures average between 300,000 and 350,000 per year, and have been increasing; most of these admissions require approximately 1 week of hospitalization and 1 in 5 patients die within a year of their injury. Full recovery occurs in 25% of patients. Nursing home care is necessary for 40%. Cane or walker use is required longer term for 50% of hip fracture patients. The average cost of a hip fracture is $26,912 per patient. Women account for 76% of the fractures, with rates increasing exponentially with age for both sexes [131].

Overview

Hip fractures include both frank and stress fractures. All fractures involve an application of force that is beyond the bone strength. Occupational fractures most commonly result from falls or motor vehicle accidents. These almost invariably require surgical fixation or sometimes arthroplasty. Stress fractures most typically involve repeated applications of unaccustomed force over a relatively short interval of hours to days. These are usually treated with elimination of the offending exposure and observation; physical therapy to address movement system impairments, such as muscle performance and motor patterns, may assist in reducing forces on the affected site.

Related Terms

- Fracture
- Stress Fracture
- Hip Fracture

- Femoral Fracture
- Femoral Neck Fracture:
- Intracapsular fracture
- Intertrochanteric fracture
- Subtrochanteric fracture
- Acetabular fracture

Initial Assessment

The initial evaluation of a patient with potential occupational hip fracture is generally straightforward as the history, mechanism of injury and inability to use the hip provide strong diagnostic evidence. Nevertheless, a careful, thorough history is required. Review of systems that also involve the knee, spine, abdomen, and genitourinary tract is necessary. The examination of the patient needs to include relevant neighboring structures similar to the review of systems, as well as to seek other injured neighboring and distant structures. Medical history and physical examination findings can alert the physician to other pathology that presents with pain or other constitutional symptoms. Certain findings, "red flags," raise suspicion of serious underlying medical conditions which may also be present in the patient with a seemingly simple hip fracture (see Table 3. Red Flags for Potentially Serious Conditions Associated with Hip and Groin Pain*). Potentially serious disorders include infections, tumors, or systemic rheumatological disorders.

Red Flags

Table 3. Red Flags for Potentially Serious Conditions Associated with Hip and Groin Pain*

Disorder	Medical History	Physical Examination
Tumor/ Neoplasia	Severe localized pain, often deep seated, unrelenting bony pain History of cancer (at any point in a lifetime) Age >50 years Symptom consistent with disease in specific organ system (e.g., cough, change in bowel habit, epigastric pain, early satiety) Constitutional symptoms, such as recent unexplained weight loss, fatigue Pain that continues at night or at rest	Pallor, reduced blood pressure, diffuse weakness Tenderness over bony landmarks and percussion tenderness (other than greater trochanteric bursitis or groin strain) New mass or tenderness Abnormal pulmonary examination (crackles, wheezes, rhonchi, decreased breath sounds) New findings at a distant site to the original complaints
Infection	Constitutional symptoms, such as recent fever, chills, or unexplained weight loss Recent bacterial infection (e.g., urinary tract infection); I.V. drug abuse; diabetes mellitus; or immunosuppression (due to corticosteroids, transplant, or HIV) History of recurring infections treated with antibiotics (e.g., repeated urinary tract infections) Foreign travel with exposure potential Insect bites	Fever, tachycardia, tachypnea, hypotension Elevated white blood cell count (may be decreased in elderly or immunocompromised) Shift in the WBC differential towards immature cells ("left shift") Abnormal urinalysis Abnormal body part examination (e.g., pulmonary) Tenderness over bony landmarks

Disorder	Medical History	Physical Examination
Progressive Neurologic Deficit	Severe spine or extremity pain Progressive numbness or weakness Complaints of new clumsiness of gait	Significant and progressive dermatomal and/or myotomal (motor) involvement Evidence of cauda equina – urinary retention or bowel incontinence Hyper-reflexia or other evidence of myelopathy
Rheumatologic Disease	Diffuse arthralgias Prior arthropathies Skin changes, lesions, or ulcers Fatigue, malaise Subtle mental status changes	Polyarticular joint effusions (usually with warmth) X-ray abnormalities consistent with erosive or degenerative pathology Elevated sedimentation rate (ESR) or C-reactive protein (CRP) Hematuria, proteinuria Other specific abnormalities as appropriate (e.g., ANA, RF, anti-DNA, C3, anti-Ro, anti-La, oral ulcers, pulmonary abnormalities, ophthalmological involvement, dermal abnormalities)

*This list is not meant to be comprehensive, rather reviewing many common suggestive historical and examination findings.

Risk and Causation

See the *Introduction* to the ACOEM Hip and Groin Disorders guideline.

Signs and Symptoms

Hip fractures often have additional signs from general hip disorders such as bruising, swelling in and around hip area, shortened leg on side of injured hip, and external rotation (turning outward) of the lower extremity on the side of injured hip. Additional symptoms will include severe pain in the hip, groin, outer thigh pain, and/or outer groin pain and the inability to bear weight or move immediately after an accident or fall [395] [129].

Diagnosis

Diagnostic Criteria

The criteria presented in Table 4 follow the clinical thought process for evaluation of typical occupational hip fractures.

Table 4. Diagnostic Criteria for Non-red-flag Conditions

Probable Diagnosis or Injury	Symptoms	Signs	Tests and Results
Hip Fracture	Fall or motor vehicle accident. Severe pain. Unable to bear weight.	Unable to bear weight. Lower extremity shortened and externally rotated.	X-rays required. Other testing usually not necessary in acute treatment setting.

Adapted from Rondinelli RD (Ed.). *Guides to the Evaluation of Permanent Impairment, Sixth Edition*. Chicago, Ill: AMA Press; 2008; and Sanders SH, Harden RN, Vicente PJ. Evidence-based clinical practice guidelines for interdisciplinary rehabilitation of chronic nonmalignant pain syndrome patients. *Pain Prac*. 2005;5(4):303-15.

Classification

Hip Fractures are classified by radiographs into either an intracapsular or an extracapsular fracture. Hip fractures can be further categorized, depending on the level of fracture, displacement, and comminution [411, 412].

Physical Exam

See the *Introduction* to the ACOEM Hip and Groin Disorders guideline.

Follow-up Visits

See the *Introduction* to the ACOEM Hip and Groin Disorders guideline.

Diagnostic Recommendations

Bone Scans

Bone scans involve intravenous administration of a radioactive tracer medication that is preferentially concentrated in areas of metabolic activity in bone. There are many causes for abnormal radioactive uptake including metastases, infection, inflammatory arthropathies, fracture, or other significant bone trauma. Thus, positive bone scans are not highly specific [1366-1368] [1367, 1369, 1370].

BONE SCANNING FOR SELECT USE IN PATIENTS WITH HIP PAIN

Recommended.

Bone scanning is recommended for select use in patients with acute, subacute, or chronic hip pain to assist in the diagnosis of fractures, particularly when more than one joint needs to be evaluated for a systemic condition such as neoplasms and osteonecrosis.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Patients with hip fractures also with suspicion of osteonecrosis, Paget's disease, neoplasm, or other increased polyosthotic bone metabolism.
Benefits:	Secure a diagnosis that is potentially related to the fracture and thus also providing a potential avenue for secondary prevention.
Harms:	Negligible. Low level radiation exposure.
Frequency/Dose/Duration:	One scan. Rarely, a second scan may be indicated after passage of at least 3 months and a clinically meaningful change in symptoms and signs that beget a material change in the diagnosis.
Rationale:	Bone scanning may be a helpful diagnostic test to evaluate suspected metastases, primary bone tumors, infected bone (osteomyelitis), inflammatory arthropathies, or trauma (e.g., occult fractures). Bone scanning is generally not indicated for evaluation of hip OA. It may be helpful in patients with suspected early AVN, but without x-ray changes. In patients where the diagnosis is felt to be secure, there is not an indication for bone scanning as it does not alter treatment or management. Bone scanning is minimally invasive, has minimal potential for adverse effects (essentially equivalent to a blood test), but is high cost. It is also generally inferior to MRI.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: bone scans; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, subtrochanteric fractures, femoral neck fracture, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative

predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 81 articles in PubMed, 565 in Scopus, 5 in CINAHL, 16 in Cochrane Library, 9350 in Google Scholar, and 4 from other sources. We considered for inclusion 2 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 3 from Google Scholar, and 4 from other sources. Of the 10 articles considered for inclusion, 7 diagnostic studies and 3 systematic studies met the inclusion criteria.

Computerized Tomography (CT)

Computerized tomography (CT) remains an important imaging procedure, particularly for bony anatomy, whereas MRI is superior for soft tissue abnormalities. CT may be useful especially for boney imaging. CT also may be useful to evaluate the spine in patients with contraindications for MRI (most typically an implanted metallic-ferrous device) [1371-1377].

CT for Evaluating Patients with Possible Fractures, or Contraindications for MRI

Recommended.

CT is recommended for evaluating hip fracture patients with concerns for osteonecrosis or following traumatic dislocations or arthroplasty-associated recurrent dislocations. CT is also recommended for patients who need advanced imaging, but have contraindications for MRI.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Moderate**

Indications:	Hip fracture patients with pain from osteonecrosis with suspicion of subchondral fracture(s), increased polyosthotic bone metabolism, or traumatic hip dislocations, particularly when acetabular or femoral head fracture fragments are sought; arthroplasty-associated recurrent hip dislocations to evaluate the rotational alignment (anteversion) of the acetabular and femoral components; patients with contraindications for MRI.
Benefits:	Imaging to help explain dislocations and plan treatment. Secondary prevention. CT is generally superior to MRI for identification of most occult fractures.
Harms:	Negligible. Radiation exposure.
Frequency/Dose/Duration:	One evaluation. A second evaluation is rarely needed.
Rationale:	Computerized tomography is considered superior to MRI for imaging of most hip abnormalities where advanced imaging of calcified structures is required. A CT scan is minimally invasive, has few if any adverse effects, but is costly. CT is therefore recommended for select use. Contrasted CT studies are uncommonly needed for hip imaging as vascular structures are generally not involved.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: X-Ray Computed Tomography, Computerized Tomography, CT scan, CAT Scan; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, subtrochanteric fractures, femoral neck fracture, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 536 articles in PubMed (Went through first 100 of best match and all most recent), 358 in Scopus (Went through first 100), 48 in CINAHL, 22 in Cochrane Library, 23800 in Google Scholar (Went through first 100), and 5 from other sources. We considered for inclusion 15 from PubMed, 0 from Scopus, 4 from CINAHL, 1 from Cochrane Library, 1 from Google Scholar, and 5 from other sources. Of the 26 articles considered for

inclusion, 26 diagnostic studies and 0 systematic studies met the inclusion criteria.

Helical CT Scans

Helical CT scans are sometimes used for diagnosing osteonecrosis. There is quality evidence that they are superior to MRI or x-ray for identifying subchondral fractures in the femoral head [1378] [1379, 1380].

Helical CT for Evaluating Hip Fractures

Recommended.

Helical CT is selectively recommended for evaluating hip fracture patients thought to potentially have osteonecrosis or have need of advanced bone imaging, but who have contraindications for MRI.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Patients with hip fracture who are thought to have osteonecrosis, or have need of advanced bone imaging, but who have contraindications for MRI (e.g., implanted hardware), increased polyosthotic bone metabolism.
Benefits:	Imaging to help explain diagnose and plan treatment.
Harms:	Negligible. Radiation exposure.
Frequency/Dose/Duration:	One evaluation. A second evaluation is rarely needed.
Rationale:	Helical CT scanning has been largely replaced by MRI. However, it has been thought to be superior to MRI for evaluating subchondral fractures, although a definitive study has not been reported [1378]. In addition, there are patients who have contraindications for MRI (e.g., implanted ferrous metal), and in those patients who require evaluation of AVN, helical CT is recommended. Helical CT has few if any adverse effects, but is costly. It is recommended for use in select patients.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Helical CT Scans, Helical computed tomography, Tomography, Spiral Computed ; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, Iatrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, subtrochanteric fractures, femoral neck fracture, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 10 articles in PubMed, 27 in Scopus, 12 in CINAHL, 1 in Cochrane Library, 2380 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging (MRI) is not generally used as an initial or secondary test for most hip joint problems since it tends to be less helpful for imaging bones. It is considered the imaging test of choice for soft tissues. MRI is the gold standard for evaluating AVN after x-rays [81, 489, 490] and for evaluating osteonecrosis patients and is used to quantify the volume of affected tissue including marrow edema which is inversely correlated with prognosis [491-495] [1381-1384] [1381, 1385].

MRI FOR HIP JOINT PATHOLOGY WITH FRACTURE

Recommended.

MRI is recommended for select hip fracture patients who also have subacute or chronic hip pain with consideration of accompanying soft tissue pathology or other diagnostic concerns.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Level of Confidence – **Low**

Indications:	Patients with subacute or chronic hip pain who need imaging surrounding soft tissues, including evaluating periarticular structures or masses (generally not indicated for acute hip pain as radiographs usually suffice).
Benefits:	Diagnosing an alternative condition
Harms:	Negligible. Modest radiation exposure
Frequency/Dose/Duration:	Generally, only one examination should be required. A second evaluation is rarely needed.
Rationale:	There is low-quality evidence that MRI may be less sensitive for detection of subchondral fractures than helical CT or plain x-rays in patients with osteonecrosis [481]. MRI has been suggested for evaluations of patients with symptoms over 3 months [496, 1386-1388]. There are reports of negative MRIs, yet finding gluteus medius tendon tears at surgery, thus MRIs appear to potentially have similar limitations imaging tendons in hip joint as in the shoulder [500]. MRI is not invasive, has no adverse effects aside from issues of claustrophobia or complications of medication, but is costly. MRI is not recommended for routine hip imaging, but is recommended for select hip joint pathology particularly involving concerns regarding soft tissue pathology.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnetic Resonance Imaging (MRI); Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, subtrochanteric fractures, femoral neck fracture, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 220 articles in PubMed, 180 in Scopus, 48 in CINAHL, 42 in Cochrane Library, 18,400 in Google Scholar, and 0 from other sources. We considered for inclusion 10 from PubMed, 1 from Scopus, 6 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 18 articles considered for inclusion, 15 diagnostic studies and 1 systematic studies met the inclusion criteria.

Radiographs

X-rays are generally the initial test for evaluating most cases of hip pain [1266-1269] [1266-1269, 1389-1392].

X-RAYS FOR HIP FRACTURE

Recommended.

X-rays are recommended for evaluating hip fractures.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Level of Confidence – **High**

Indications:	All patients with potential hip fractures. Also in the absence of red flags, moderate to severe hip pain lasting at least a few weeks, and/or limited range of motion. The threshold for additional x-rays of the lumbar spine and/or knee should be low if the hip x-rays do not readiliy explain the symptoms and signs.

Benefits:	Diagnose fracture. Also may diagnose signs of potential metastases and polyostotic bone growth.
Harms:	Negligible.
Frequency/Dose/Duration:	Obtaining x-rays once is generally sufficient. For patients with chronic or progressive hip pain, it may be reasonable to obtain a second set of x-rays, particularly if symptoms change.
Rationale:	Radiographs are not invasive, have no adverse effects, are low cost, and highly effective at diagnosing fracture and are thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: X-ray, Radiography; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, subtrochanteric fractures, femoral neck fracture, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 512 articles in PubMed (Most Recent), 510 in PubMed (Best Match, went through first 100), 862 in Scopus (Went through first 100), 328 in CINAHL (Went through first 100), 265 in Cochrane Library (Went through fist 100), 18300 in Google Scholar (Went through first 100), and 8 from other sources. We considered for inclusion 6 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 8 from other sources. Of the 14 articles considered for inclusion, 14 diagnostic studies and 0 systematic studies met the inclusion criteria.

Ultrasound

Diagnostic ultrasound has been used to evaluate the hip joint, especially the soft tissues, effusions [505], dysplasia [506, 507], and labral tears [508], as well as occult fractures [509]. Quantitative ultrasound has been sued for the non-invasive assessment of osteoporosis and bone status [1393-1396].

Ultrasound for Evaluating Hip Fracture

Not Recommended.

Ultrasound is not recommended for evaluating hip fracture patients. It may be helpful for many other soft tissue hip problems.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	Ultrasound is not invasive, has no adverse effects, is low cost, has no defined use for the routine evaluation of hip fracture patients and is thus not recommended. Quantitatis ultrasound may be useful for evaluating osteoporosis. Ultrasound also has uses for evaluation of soft tissues**.**
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasound; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, subtrochanteric fractures, femoral neck fracture, diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative

predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 782 articles in PubMed, 213 in Scopus, 20 in CINAHL, 7 in Cochrane Library, 282,200 in Google Scholar, and 0 from other sources. We considered for inclusion 22 from PubMed, 5 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 27 articles considered for inclusion, 24 diagnostic studies and 1 systematic studies met the inclusion criteria.

Treatment Overview

Initial Care

Initial care of hip fracture patients is focused on immobilization while obtaining a rapid diagnosis, and providing pain relief generally as soon as the diagnosis is made.

This guideline recommends interventions with quality evidence of proven efficacy. Known complication rates and safety profiles, if available, should always be utilized in decision making and were considered in developing this guideline. In addition to those treatments reviewed herein, there are many other theoretically potential treatments possible for management of hip fracture patients. However, in the absence of moderate- to high-quality studies supporting their efficacy [511], these other interventions are not recommended and are indicated as **Not Recommended, Insufficient Evidence (I)**.

Activities and Activity Modification

The acute hip fracture patient is immobilized until the diagnosis is made and surgical treatment is provided. However, after definitive care, the vast majority of patients begin the rehabilitation process ideally immediately post-operatively. Early post-operative ambulation, exercises and activities results in faster recovery, lower costs, and fewer complications (e.g., less pneumonia, venous thromboembolisms). Post-operative recovery involves the resumption of activities at the earliest possible dates.

Work Activities

Time off work is generally required during the acute treatment phase of most hip factures. Subsequently, work activity modifications are usually necessary during the recovery phase from hip fractures. Return to work on a gradual basis is often helpful, with subsequent progressive increases in work activities provided until full release is achieved.

When early return to work is not possible, a gradual increase in physical therapy exercises that simulate work tasks is highly advisable to accelerate the return to work process. When early return to work is not possible, it is often necessary to communicate with the employer to facilitate return to work in hip fracture patients.

The first step in determining whether work activity modifications are required usually involves a discussion with the patient regarding whether he or she has control over his or her job tasks. In such cases where the worker can make modifications, e.g., receive assistance to lift a box or alternate sitting and standing as needed, there may be no requirement to write any restrictions after the acute treatment phase even if the pain is limiting. In some situations, it may be advisable to confirm this report with the patient's supervisor to signal to the supervisor that the person is under treatment. In some cases, specified limitations may be a better treatment strategy. Assessment of work activities and potential for modifications may also be facilitated by a worksite visit and analysis by a health care provider with appropriate training (e.g., typically a physician, occupational therapist, physical therapist, or some ergonomists).

Work limitations should be tailored by taking into account the following factors: 1) job physical requirements; 2) the safety of the tasks, in consideration of the diagnosed condition, age, and relevant biomechanical limitations; 3) severity of the problem; 4) work organizational issues (overtime, work allocation, wage incentives); and 5) the

patient's understanding of his or her condition. Sometimes it is necessary to write limitations or to prescribe activity levels that are above what the patient feels he or she can do, particularly when the patient feels that sedentary activity is advisable. In such cases, the physician should be careful to not overly restrict the patient; education about the pain problem and the need to remain active should be provided.

hese work (and home) activity guidelines are generally reassessed every week in the acute phase with gradual increases in activity recommended so that patients evolve off modified duty in no more than 6 to 12 weeks. The amount of weight handled can be progressively increased. An alternative is to return the patient at first to 1 to 2 hours a day on his or her prior full duty job, with the remainder of the day spent at modified duty. The number of hours of full duty work can be increased every 1 to 2 weeks.

Ergonomic Interventions

The primary intervention for most occupational hip fracture patients is safety-related rather than ergonomics (see other guidance such as Fall Protection).

Treatment Recommendations

Activity Modification

Fall Protection

Fall protection to decrease risk of falls may involve any combination of administrative controls, education, personal protective equipment and strengthening/balance exercises [513, 516-519] [515, 1397, 1398] [513-515, 1399-1401] [514, 1398, 1402-1409]. Hip protectors are used in those with high risk of falls, particularly in the elderly.
Recommended.

Measures to prevent falls are recommended.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Those who sustained hip fractures from a fall; those at risk of falls; those who have either fallen or nearly fallen, irrespective of incurring an injury
Benefits:	Potential to reduce frequency and severity of falls. Secondary and tertiary prevention.
Harms:	Negligible
Frequency/Dose/Duration:	Depends on intervention. Some interventions such as education and PPE involve one appointment, but may involve a second to ascertain success, barriers and adherence. Exercise programs may involve course(s) of therapy and transitioning to independent home exercise programs.
Rationale:	Falls are high cost, associated with high morbidity and mortality, both in the occupational, non-occupational and elderly populations. While there are no quality studies demonstrating efficacy of fall protection for hip problems in workers, fall protection measures are likey successful but not yet demonstrated. Exercise programs targeting strength and balance also should reduce risk of falls and severity. Fall protection is not invasive, has low adverse effects, is low to moderate cost, and is thought to be effective and thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Fall protection, fall prevention; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic

femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 42 articles in PubMed, 3011 in Scopus (Went through first 100), 105 in CINAHL, 68 in Cochrane Library, 17,600 in Google Scholar (Went through first 100), and 20 from other sources. We considered for inclusion 9 from PubMed, 2 from Scopus, 3 from CINAHL, 0 from Cochrane Library, 5 from Google Scholar, and 2 from other sources. Of the 19 articles considered for inclusion, 14 randomized trials and 0 systematic studies met the inclusion criteria.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ergonomic Interventions; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 5 articles in PubMed, 13 in Scopus, 1 in CINAHL, 3 in Cochrane Library, 88700 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Bed Rest for Unstable Fractures

Patients with hip fractures have been successfully treated non-operatively in limited randomized control trials, with no significant outcomes differences compared with other treatment methods [1410-1412]. Bed rest is also applied among patients with limited activity due to back pain, femoral neck fracture, but days of bed rest should be limited due to increased mortality [1413-1415].

Recommended.

Activity Modification and Exercise

Bed rest is recommended for patients with clear contraindication to weight-bearing status such as an unstable fracture.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **High**

Indications:	Hip fracture patients and others with unstable fractures
Benefits:	Avoid further displacement of fracture and other trauma
Harms:	Venous thromboembolism, debility
Indications for Discontinuation:	Definitive surgical care
Rationale:	Bed rest is required for hip fracture patients and those with clear contraindication to weight-bearing status due to an unstable fracture.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: bed rest; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures,

femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 11 articles in PubMed, 68 in Scopus, 5 in CINAHL, 3 in Cochrane Library, 5850 in Google Scholar, and 0 from other sources. We considered for inclusion 3 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 1 randomized trials and 2 systematic studies met the inclusion criteria.

Medications

Bisphosphonate inhibit bone reabsorption [1416-1418] that are generally prescribed to prevent or to treat a variety of skeletal conditions such as low bone density, Paget disease of bone, malignancies metastatic to bone, multiple myeloma, hypercalcemia of malignancy, and osteogenesis imperfecta [1416, 1418] [1419, 1420] Bisphosphate reportedly help reduce the risk of hip fractures [1421-1426] and osteoporosis [1419, 1422, 1427-1429].

Bisphosphonates for Hip Fracture

Strongly Recommended.

Medications (including topical creams)

Bisphosphonates are strongly recommended for select patients with osteopenia-related hip fractures.

Strength of Evidence – **Strongly Recommended, Evidence (A)**
Level of Confidence – **High**

Indications:	Patients with hip fractures thought to be due to osteoporosis or osteopenia to prevent additional fractures. Patients should have cause of the osteopenia established and osteomalacia ruled out. Adequate Vitamin D and calcium must be present to initiate restoration therapy.
Benefits:	Increased bone mineral density. Reduced risk of secondary fractures.
Harms:	Gastritis, esophagitis, stricture, osteonecrosis of the jaw, suppression of bone turnover, musculoskeletal pain, hypocalcemia, ocular inflammation, subtrochanteric fracture.
Frequency/Dose/Duration:	Taken in oral or parenteral formulations as per manufacturer recommendations.
Indications for Discontinuation:	Resolution of bone mass decrements, adverse effects, intolerance.
Rationale:	There are numerous quality studies of bisphosphonates for primary and secondary prevention of fractures with a uniform conclusion that they prevent hip fractures [1430-1454]. By definition, patients with hip fractures had insufficient bone mass resulting in failure. Some occupational patients might not require these medications if they suffered a high-energy impact. However, the vast majority of patients with hip fracture are candidates for treatment if for no reason other than tertiary prevention. There is quality evidence that hip fracture patients develop more bone mass; thus, bisphosphonates are strongly recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Diphosphonates, bisphosphonate ; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures,

femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 77 articles in PubMed, 100 in Scopus, 345 in CINAHL, 36 in Cochrane Library, 97,000 in Google Scholar, and 3 from other sources. We considered for inclusion 10 from PubMed, 3 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 4 from Google Scholar, and 2 from other sources. Of the 21 articles considered for inclusion, 10 randomized trials and 4 systematic studies met the inclusion criteria.

Calcitonin for Hip Fracture

No Recommendation.

Medications (including topical creams)

There is no recommendation for or against calcitonin for the treatment of patients with hip fracture.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There is one high-quality study suggesting modest benefits from calcitonin in hip fracture patients [1459], yet the largest trial was negative [1458], suggesting there is at best very weak efficacy. Calcitonin is minimally invasive, has relatively few adverse effects, and is moderately costly, but absent clear evidence of efficacy, there is no recommendation. Calcitonin has been used for patients who have adverse effects or contraindications for a bisphosphonate, which may provide a small, highly select population for a trial of calcitonin treatment.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: calcitonin; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 97 articles in PubMed, 233 in Scopus, 30 in CINAHL, 8 in Cochrane Library, 6360 in Google Scholar, and 1 from other sources. We considered for inclusion 3 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 4 articles considered for inclusion, 4 randomized trials and 0 systematic studies met the inclusion criteria.

Non-steroidal Anti-inflammatory Drugs (NSAIDs) and Acetaminophen

NSAIDs and acetaminophen have been used for treatment of pain [1460, 1461] [1460, 1462-1466] [1465, 1467-1469] There are conflicting data on whether NSAID may help treat hip fracture, or delay boney union [720-723, 1470-1472].

See the recommendations for NSAIDs and Acetaminophen in the Hip Osteoarthrosis section of the ACOEM Hip and Groin Disorders guideline.

Hot and Cold Therapies

Cold and heat have been proposed to either modify disease processes (e.g., cold to allegedly reduce acute inflammation and swelling and heat to speed healing through increased blood supply) [1473, 1474] and/or work as distractants [1475, 1476].

See the recommendations for Hot and Cold Therapies in the Hip Osteoarthrosis section of the ACOEM Hip and Groin Disorders guideline.

Electrical Therapies

There are multiple forms of electrical therapies used to treat musculoskeletal pain. These include high-voltage galvanic, H-wave stimulation, interferential therapy (IFT or IT), iontophoresis, microcurrent, percutaneous electrical nerve stimulation (PENS), sympathetic electrotherapy, and transcutaneous electrical stimulation (TENS). These have been used in the treatment of hip fractures or even promoting bone growth.

TENS is used to control pain through electrical stimulation through the skin for the treatment of many painful conditions, although it has most typically been used for spine disorders (see Chronic Pain and Low Back Disorders Guidelines) [916-922, 1477-1479].

TENS for Emergency Transport of Patients with Hip Fracture

Moderately Recommended.

Electrical Therapies

TENS is moderately recommended for emergency transport of patients with hip fracture.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Hip fracture patients in transport. TENS may have limited applicability to patients awaiting surgery for hip fracture.
Benefits:	Improved pain control
Harms:	Negligible
Frequency/Dose/Duration:	During emergency transport. May have limited applicability to patients awaiting surgery for hip fracture.
Indications for Discontinuation:	Provision of definitive treatment
Rationale:	One high-quality study suggests TENS reduces pain during emergency transport reduces pain compared to sham [928]. TENS is not invasive, has low adverse effects, is moderately costly, has evidence of efficacy during emergency transport and is thus recommended for that application.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar from January 1st, 2008 to January 1st, 2018 using the following terms: Transcutaneous Electircal Nerve Stimulation, TENS; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck

fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 4 articles in PubMed, 200 in Scopus, 459 in CINAHL (Went through first 100), 2 in Cochrane Library, 3680 in Google Scholar (Went through first 100), and 1 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 2 randomized trials and 0 systematic studies met the inclusion criteria.

Acupressure for Transporting Hip Fracture Patients

Acupressure is the application of pressure points to reduce anxiety and manage pain in patients being transported in emergency vehicles [1480, 1481].

Moderately Recommended.

Allied Health Interventions

Acupressure is moderately recommended for transporting patients with hip fracture to the hospital.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Hip fracture patients in transport. Acupressure may have limited applicability to patients awaiting surgery for hip fracture.
Benefits:	Improved pain control
Harms:	Negligible
Frequency/Dose/Duration:	During emergency transport. May have limited applicability to patients awaiting surgery for hip fracture.
Indications for Discontinuation:	Provision of definitive treatment
Rationale:	Quality evidence suggests acupressure reduced pain for hip fracture patients during transportation [1480]. It is not invasive, has essentially no adverse effects, is low cost and is recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar from January 1st, 2008 to January 1st, 2018 using the following terms: Acupressure; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 1 articles in PubMed, 87 in Scopus, 3 in CINAHL, 2 in Cochrane Library, 2700 in Google Scholar (Went through first 100), and 1 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic studies met the inclusion criteria.

Surgical Considerations

Fascia Iliaca Compartment Block (FICB) for Emergency Room Management of Hip Fractures

The fascia iliaca compartment block (FICB) is a regional nerve block used for hip and femoral fractures to anesthetize the femoral nerve, obturator nerve, and lateral cutaneous femoral nerve [1482-1484]. The FICB is commonly used in emergencies to temporarily control hip fracture pain sufficiently to allow a medical team to manipulate the patient before performing a hip surgery [942, 1485-1490].

Moderately Recommended.

Injection Therapy

Fascia iliaca compartment block (FICB) is moderately recommended for emergency room management of hip fractures.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Hip fracture patients with sufficient pain to potentially need nerve block
Benefits:	Improved pain management without risks of opioids, reduced consumption of opioids.
Harms:	Negligible
Frequency/Dose/Duration:	One block
Rationale:	Mutiple moderate quality studies demonstrate superiority of FICB to other controls (e.g., [1485-1487, 1491-1493], although one reported superiority of the femoral nerve block to FICB [1494]. One study demonstrated that a fascia iliaca compartment block with bupivacaine provided superior pain relief compared with I.M. morphine injection in the emergency room for patients with suspected hip fracture [1490]. FICB is minimally invasive, has adverse effects, is moderate cost, has many studies demonstrating efficacy and is thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Fascia Iliaca Compartment Block, FICB; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 16 articles in PubMed, 31 in Scopus, 11 in CINAHL, 1 in Cochrane Library, 856 in Google Scholar, and 0 from other sources. We considered for inclusion 7 from PubMed, 4 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 13 articles considered for inclusion, 10 randomized trials and 2 systematic studies met the inclusion criteria.

SURGICAL TREATMENT FOR HIP FRACTURES

Recommended.

Surgical Considerations

Surgical intervention for hip fractures is recommended as soon as the patient is medically stable.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Level of Confidence – **High**

Indications:	Hip fractures
Benefits:	Faster recovery and lower mortality risks than with non-operative management
Harms:	Perioperative infections, venous thromboembolisms, pneumonia
Rationale:	There are many different surgical approaches and products used for fixation. There also are numerous biomechanical studies on these various approaches [1520-1525]; however, while yielding sometimes useful information, they are unable to definitively test efficacy or superiority in humans. Pins are sometimes hydroxyapatite-coated [1526], although quality evidence of efficacy or superiority of these products in these patients is lacking. Fixation failures have been thought to be particularly due to either inadequate reduction or suboptimal fixation [1500, 1527, 1528]. In the elderly, additional factors influencing adverse outcomes include comorbid medical conditions and ability to bear weight [1500, 1529-1531]. These reports suggest technical issues as well as post-operative management are necessary to achieve optimal outcomes. Two authors have published multiple Cochrane reviews [1532-1534]. One of these reviews concluded the sliding hip screw was superior to nails for extracapsular hip fractures, but that there is insufficient evidence to ascertain meaningful differences between different intramedullary nails [1533]. A sliding hip screw was also thought to be superior to fixed nail plates for extracapsular hip fractures [1534]. The sliding hip screw is thought to have a lower complication rate than intramedullary nails for treatment of trochanteric fractures [1532]. Another literature review concluded there was a preference for surgical fixation among intertrochanteric hip fracture patients if the patient was medically stable. Stable fractures were felt to be better treated with plate and screw implants and intramedullary devices. Unstable fractures were thought to be better treated with load-sharing intramedullary implants; however, the literature was not felt to have demonstrated this belief [1529]. There are two studies using minimally invasive techniques, but no clear conclusions in favor of these approaches [1535, 1536]. Osteonecrosis and nonunion rates are high in post-hip fracture patients, and with inadequacy of reduction reportedly a significant factor [1500], successful reduction becomes an important consideration. External fixation devices have been studied in one quality study and suggested external fixation was superior for

operative time, blood loss and pain for treatment of pertrochanteric fractures [1526]. This study needs replication.

There are many quality RCTs evaluating various products, particularly including dynamic hip screws, dynamic condylar screws, compression hip screws, intramedullary hip screws, gamma nails, gliding nails, proximal femoral nails, Pugh nails, percutaneous compression plates, nail plates, and Medoff sliding plates (see hip fracture evidence table). A majority of the studies failed to find one approach superior to another [1502, 1503, 1512, 1517, 1537-1542] and some provide conflicting results. Additionally, the variability of the types of fractures provides additional uncertainty regarding optimal intervention(s). Thus, there is no recommendation for or against the use of a specific product.

It is also noteworthy that quality studies document fracture healing conservatively with traction [1501, 1507-1509], yet death rates are also reportedly higher for that method of treatment [1508]. A Cochrane review concluded that quality trials comparing conservative and surgical treatment for hip fractures are needed [1543]. However, as one quality study found longer hospital stays and deaths particularly in the elderly [1501], the current quality evidence suggests that surgical results are superior to traction for treatment of these fractures, thus surgery is recommended particularly in the elderly.

The speed with which treatment is considered early or delayed varies with estimates of 6 to 12 hours [1544-1548]. There are no quality studies, but a retrospective review of cases and a large case series suggest better outcomes for earlier intervention [1548] or shorter hospitalizations and fewer complications [1549]. Generally, early intervention is recommended once the patient is medically stable. Skin sterilization issues have been studied and are important considerations [1082, 1550-1553].

The type of surgical treatment (e.g., pin, screw, nail) or non-operative management is deferred to the treating surgeon.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Surgery, surgical treatment, internal fixation, sliding hip screw, fixed nail plates, dynamic screws, compression hip screws, intramedullary hip screws, gamma nails, proximal femoral nails, pugh nails, percutaneous compression plate, nail plates, medoff sliding plates; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 870 articles in PubMed (Went through first 200), 16405 in Scopus (Went through first 200), 2247 in CINAHL (Went through first 200), 1092 in Cochrane Library (Went through first 200), 17000 in Google Scholar (Went through first 200), and 145 from other sources. We considered for inclusion 71 from PubMed, 9 from Scopus, 19 from CINAHL, 0 from Cochrane Library, 4 from Google Scholar, and 27 from other sources. Of the 130

articles considered for inclusion, 108 randomized trials and 22 systematic studies met the inclusion criteria.

Arthroplasty for Hip Fractures

Arthroplasty is performed on some patients with hip fractures, including femoral neck fractures [1554-1557] [1558-1561].

Strongly Recommended.

Surgical Considerations

Arthroplasty is strongly recommended for older patients especially with displaced femoral neck and subcapital fractures.

Strength of Evidence – **Strongly Recommended, Evidence (A)**

Level of Confidence – **High**

Indications:	Hip fractures, especially displaced femoral neck and subcapital fractures.
Benefits:	Faster recovery and lower complication rates for select fractures
Harms:	Perioperative infections, venous thromboembolisms, pneumonia
Rationale:	There are several quality studies evaluating arthroplasty and hemiarthroplasty results compared with internal fixation for treatment of displaced fractures. Three evaluated displaced intracapsular fractures [1506, 1562, 1563], one evaluated unstable intertrochanteric fractures [1564], two were of displaced femoral neck fractures [1565, 1566], and another two were of displaced subcapital fractures [1562] [1567, 1568]. Nearly all of these studies suggest arthroplasty or hemiarthroplasty result in superior outcomes including lower complication rates, lower reoperation rates, lower pain ratings, and/or superior ambulatory function at 6 to 24 months. One of the studies concerned younger patients with displaced intracapsular fractures and found total hip arthroplasty resulted in better outcomes [1563]. In contrast, a Cochrane review of arthroplasty for hip fractures concluded there was insufficient evidence of superiority of arthroplasty to internal fixation [1569]. Regardless, the quality evidence is in favor of arthroplasty or hemiarthroplasty for treatment of displaced femoral neck, displaced intracapsular and displaced subcapital fractures in the older patient is strongly recommended (see arthroplasties) as a preferred treatment option. In the young patient, it is desirable to save the femoral head, so internal fixation should be strongly considered.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Arthroplasty, Replacement, Hip; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 546 articles in PubMed, 3047 in Scopus, 1079 in CINAHL, 163 in Cochrane Library, 39500 in Google Scholar, and 7 from other sources. We considered for inclusion 34 from PubMed, 1 from Scopus, 3 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 7 from other sources. Of

the 45 articles considered for inclusion, 26 randomized trials and 19 systematic studies met the inclusion criteria.

HEMIARTHROPLASTY FOR HIP FRACTURES

Strongly Recommended.

Surgical Considerations

Hemiarthroplasty is strongly recommended for older patients with displaced femoral neck and subcapital fractures.

Strength of Evidence – **Strongly Recommended, Evidence (A)**
Level of Confidence – **High**

Indications:	Hip fractures, especially displaced femoral neck and subcapital fractures.
Benefits:	Faster recovery and lower complication rates for select fractures
Harms:	Perioperative infections, venous thromboembolisms, pneumonia
Rationale:	There are reports, including quality studies, of fractures healing conservatively with traction [1501, 1507-1509], yet death rates are also reportedly higher for that method of treatment [1508]. A Cochrane review concluded that quality trials comparing conservative and surgical treatment for hip fractures are needed [1543]. However, as one quality study found longer hospital stays and deaths particularly in the elderly [1501], the current quality evidence suggests that surgical results are superior to traction for treatment of these fractures, thus surgery is recommended particularly in the elderly. The speed with which treatment is considered early or delayed is somewhat controversial with estimates of 6 to 12 hours [1544-1548]. There are no quality studies, but a retrospective review of cases and a large case series suggest better outcomes for earlier intervention [1548] or shorter hospitalizations and fewer complications [1549]. Generally, early intervention is recommended once the patient is medically stable. Skin sterilization issues have been studied and are important considerations [1082, 1550-1553]. There are several quality studies evaluating arthroplasty and hemiarthroplasty results compared with internal fixation for treatment of displaced fractures. Three evaluated displaced intracapsular fractures [1506, 1562, 1563], one evaluated unstable intertrochanteric fractures [1564], two were of displaced femoral neck fractures [1565, 1566], and another two were of displaced subcapital fractures [1562] [1567, 1568]. Nearly all of these studies suggest arthroplasty or hemiarthroplasty result in superior outcomes including lower complication rates, lower reoperation rates, lower pain ratings, and/or superior ambulatory function at 6 to 24 months. One of the studies concerned younger patients with displaced intracapsular fractures and found total hip arthroplasty resulted in better outcomes [1563]. In contrast, a Cochrane review of arthroplasty for hip fractures concluded there was insufficient evidence of superiority of

arthroplasty to internal fixation [1569]. Regardless, the quality evidence is in favor of arthroplasty or hemiarthroplasty for treatment of displaced femoral neck, displaced intracapsular and displaced subcapital fractures in the older patient is strongly recommended (see arthroplasties) as a preferred treatment option. In the young patient, it is desirable to save the femoral head, so internal fixation should be strongly considered.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hemiarthroplasty; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 130 articles in PubMed, 1290 in Scopus, 110 in CINAHL, 28 in Cochrane Library, 3180 in Google Scholar, and 2 from other sources. We considered for inclusion 25 from PubMed, 18 from Scopus, 9 from CINAHL, 0 from Cochrane Library, 6 from Google Scholar, and 2 from other sources. Of the 60 articles considered for inclusion, 29 randomized trials and 9 systematic studies met the inclusion criteria.

One-Day Use of Systemic Antibiotics for Hip Surgery

Moderately Recommended.

Medications (including topical creams)

One-day use of systemic antibiotics is moderately recommended for patients undergoing surgical hip procedures.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **High**

Indications: All hip surgical patients

Benefits: Reduced surgical infections and reduced need for re-operations, including removals of infected prostheses.

Harms: Negligible aside from rare allergic reactions

Frequency/Dose/Duration: One administration

Rationale: Evidence from a non-randomized registry data of 10,905 hip prostheses showed that the risk of revision due to infection was reduced 75 to 78% with a systemic antibiotic combined with an antibiotic-impregnated cement compared with either systemic antibiotic administration or antibiotic-impregnated cement alone. The risk, if there was only antibiotic in the cement, was 6.3-fold higher, and, if the antibiotic was only systemic risk, was 4.3-fold greater [615]. There is a belief that some cases of aseptic loosening are undiagnosed infections [1581] as there were lower rates of aseptic loosening among those with both routes of antibiotic administration compared

with either alone [615] and those with gentamicin cement appear to have lower rates of aseptic loosening compare with systemic antibiotics [1587, 1588]. In the largest comparative trial of more than 1,600 hip arthroplasties, cement with gentamicin was found to produce fewer deep infections, but more superficial infections compared with an uncontrolled arm of systemic antibiotics alone [1582, 1587, 1588]. There is one low-quality study suggesting no difference in infection rates between cement-antibiotic and systemic antibiotic arms [618]. Thus, there is quality evidence that a combination of systemic and antibiotic-impregnated cement is important to prevent infections. There was no prosthesis survival benefit if systemic antibiotics were administered for greater than one day [1589]. Numerous antibiotics have been utilized, including gentamicin, cloxacillin, dicloxacillin, probenecid, cephalexin, and phenoxymethylpenicillin [1582], but there are no large-scale, head-to-head comparative trials available.

Evidence:

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Antibiotics for surgery; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 56 articles in PubMed, 282 in Scopus, 6 in CINAHL, 8 in Cochrane Library, 18,000 in Google Scholar, and 6 from other sources. We considered for inclusion 15 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 6 from other sources. Of the 21 articles considered for inclusion, 18 randomized trials and 3 systematic studies met the inclusion criteria.

Acupuncture for Hip Arthroplasty Patients

Acupuncture has been used to treat pain in multiple settings, including post-operative [1108, 1590-1593].

Moderately Recommended.

Allied Health Interventions

Acupuncture is moderately recommended for hip arthroplasty procedures.

Strength of Evidence – **Moderately Recommended, Evidence (B)**

Level of Confidence – **Moderate**

Indications:	Hip arthroplasty patients.
Frequency/Dose/Duration:	Up to 3 post-operative days [1108, 1594]
Rationale:	Two quality trials demonstrated efficacy of acupuncture for hip arthroplasty patients, including reducing opioid needs [1108, 1594]. Acupuncture is minimally invasive, has essentially no adverse effects, is low cost, and thus is recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acupuncture; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 1 article in PubMed, 1 in Scopus, 1 in CINAHL, 0 in Cochrane Library, 0 in Google Scholar, and 2 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 2 articles considered for inclusion, 2 randomized trials and 0 systematic studies met the inclusion criteria.

Infected Prostheses

See Hip OA Guideline

Dislocations

See Hip OA Guideline

Prosthetic Failure

See Hip OA Guideline

Prevention of Venous Thromboembolic Disease

Venous thromboembolic disease (VTED) is a high-risk complication among post-operative hip or knee arthroplasty patients resulting in morbidity and mortality [1595, 1596] The literature has been noted to largely address deep venous thrombosis and not pulmonary embolism [1596]. Reported risk factors in these post-operative patients include prior venous thromboembolism, age, general anesthesia, obesity, cancer, clotting disorder, and restricted mobility [1597, 1598] [1596]. Treatments have included early ambulation (discussed elsewhere), compression boots, and medications. There are currently four classes of medications commonly used to prevent VTED: warfarin/coumadin, low molecular weight heparin, Factor Xa inhibitors, and direct thrombin inhibitors [1599]. Of these options, all are currently available in the U.S. with the exception of an oral direct thrombin inhibitor. While initially believed to be a complication of hospitalization, post-hospital discharge surveillance data suggest high risk of thromboembolism continues well after discharge [1600] with many studies thus treating patients for 30 days for longer.

Duration of prophylaxis is one of the areas of controversy [1601]. One quality study suggested a reduction if the treatment period after arthroplasty is extended to 30 to 42 days with an OR = 0.38 and NNT = 50 [1600]. Another study suggested no benefits from extending treatment from 4 to 10 days out to 12 weeks [1602]. Individualization of treatment likely is required to include factors such as activity level, other joint involvement, cancer status, prior venous thromboembolism history, and bleeding risks. Onset of treatment is another area of controversy, as European surgeons tend to initiate prophylaxis preoperatively and North American surgeons post-operatively [1603].
Compression stockings have been used to help prevent VTD [1604-1608].

Compression Stockings for Prevention of Venous Thromboembolic Disease

Moderately Recommended.

Devices

Post-operative graded compression stockings are moderately recommended for the prevention of venous thromboembolic disease [1609, 1610].

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	All post-operative major hip surgical patients (e.g., hip fractures, hip arthroplasties, or any other patients thought at increased risk of VTED in the post-operative period). Usually used as adjunctive treatment and often used for all patients. Especially indicated among those having had a prior VTE, have contraindication(s) for anticoagulant therapy(ies) and/or are at particularly increased risk of VTE.
Benefits:	Reduced risk of VTED
Harms:	Negligible
Frequency/Dose/Duration:	Duration of treatment is unclear and longer use does not add expense. As risk of VTED is high, particularly for these major procedures, threshold for use of 2 weeks or longer should be generally low.
Indications for Discontinuation:	One month post-operative and/or resumption of all normal activities and activity levels. Use beyond 4 weeks is indicated for those who have not resumed normal activities.
Rationale:	There are many quality studies of various means to reduce risk of venous thromboembolic disease (see venous thromboembolic disease evidence table), although various methodological issues in the available trials have been raised [1600, 1603, 1611-1615]. Graded compression stockings have been compared with no compression stockings and found to reduce risk in one moderate quality study [1610]. They also have been included in quality studies as adjunctive therapy in a trial comparing enoxaparin plus stockings vs. enoxaparin alone and found to reduce risk [1609]. Stockings are not invasive, have few adverse effects and are low cost, thus, they are moderately recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Compression Stockings; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation,

random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 5 articles in PubMed, 43 in Scopus, 3 in CINAHL, 1 in Cochrane Library, 1040 in Google Scholar, and 4 from other sources. We considered for inclusion 3 from PubMed, 1 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 6 from other sources. Of the 13 articles considered for inclusion, 13 randomized trials and 0 systematic studies met the inclusion criteria.

Lower Extremity Pumps for Prevention of Venous Thromboembolic Disease

Lower extremity pumps provide compression to the legs to reduce clotting [411, 1616] [1616, 1617].

Moderately Recommended.

Devices

Lower extremity pump devices are moderately recommended for the prevention of venous thromboembolic disease [1618-1620].

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Post-operative major hip surgical patients (e.g., hip fractures, hip arthroplasties, or any other patients thought at increased risk of VTED in the post-operative period). Usually used as adjunctive treatment and often used for all patients. Especially indicated among those having had a prior VTE, have contraindication(s) for anticoagulant therapy(ies) and/or are at particularly increased risk of VTE.
Benefits:	Reduced risk of VTED
Harms:	Negligible
Frequency/Dose/Duration:	Devices include foot pumps, foot plus calf pumps, entire lower extremity intermittent compression devices and various other combinations. Duration of treatment is unclear. Most have utilized devices for the duration of hospitalization. As risk of VTED is high particularly for these major procedures, threshold for use of 2 weeks or longer should be generally low including while at home.
Indications for Discontinuation:	Discontinuation is generally recommended by 14 days unless there are continuing ongoing issues, such as delayed rehabilitation and ambulation that result in a judgment of increased risk. Some patients are also unable to tolerate devices [1621].
Rationale:	Pumps have been evaluated in quality trials that have included comparisons with no pump devices, as well as in therapeutic combinations [1618-1620]. One quality study suggested superiority of pump devices to a low molecular weight heparin [1621], while another found superiority to unfractionated heparin [1622]. Devices include foot pumps, foot plus calf pumps, entire lower extremity intermittent compression devices and various other combinations. As there are no quality comparative trials, there is no recommendation for a particular device. Pump devices are not invasive, have few adverse effects and are low cost, thus, they are moderately recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Lower extremity pumps, Intermittent Pneumatic Compression Device, Lymphedema, Lymphedema Pump, Compression devices, foot pump, Leg Compression Machine, Bio Compression Systems, Sequential Compression Device, arteriovenous impulse system, mechanical prophylaxis; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 1 articles in PubMed, 8 in Scopus, 0 in CINAHL, 0 in Cochrane Library,

8440 in Google Scholar, and 7 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 4 from other sources. Of the 7 articles considered for inclusion, 4 randomized trials and 0 systematic studies met the inclusion criteria.

Low-molecular Weight Heparin for Prevention of Venous Thromboembolic Disease

Low molecular weight heparin (LMWH) helps reduce the formation of clots [1623-1625] [1623, 1626] [1623, 1627].

Strongly Recommended.

Medications (including topical creams)

Low-molecular weight heparin is strongly recommended for prevention of venous thromboembolic disease.

Strength of Evidence – **Strongly Recommended, Evidence (A)**

Level of Confidence – **High**

Indications:	Post-operative arthroplasty patients, hip fracture patients and other major hip surgery patients, particularly those with either prolonged inactivity or prolonged reduced or sedentary activity levels [1602, 1609, 1628-1638]. Particularly indicated for those with a prior VTE. Those with contraindication(s) for anticoagulant therapy(ies) and/or are at particularly increased risk of VTE may be better candidates for compressive devices. There is some evidence LMWH is generally preferable to warfarin for VTED prophylaxis, however, there is no clear superiority or inferiority of LMWHs, Factor Xa inhibitors, and/or traditional warfarin-based regimens. Patients with prior reactions to LMWH should generally receive other treatments first.
Benefits:	Reduced risk of VTED
Harms:	Increased risk of bleeding. Risk of intracranial and gastrointestinal bleeds are of particular concern, especially as the treatment is not readily reversible.
Frequency/Dose/Duration:	Subcutaneous injections of enoxaparin (Lovenox) 4,000 IU or 40mg SC Q.D. [1609, 1628, 1629, 1631, 1635, 1639-1644] for variable durations ranging from 5 to 9 postoperative days [1642-1644] to 8 to 14 days [1641] to 10 to 14 days [1639], 21 days [1628, 1629], 30 days [1635], to 12 weeks [1631]. There is no consensus on duration of treatment, and individualization based on activity level appears indicated. Duration unclear. Available quality studies utilized treatment courses ranging from 4 days [1634] to 12 weeks [1631]. A plurality of the studies utilized a course of 30 to 35 days [1632, 1633, 1635, 1636]. There is quality evidence that treatment is generally required beyond hospitalization; there is evidence of deep venous thromboses many months later (reviewed above). One quality trial suggested no benefits from extending 4 to 10 days treatment out to 12 weeks [1602]. In the absence of substantive quality data comparing various durations of treatment, it is suggested that approximately 30 days of treatment after surgery may be required for average patients (a single trial suggested 30 to 42 days after arthroplasty) [1600]. Patients with prior histories of venous thrombi, prolonged inactivity, delayed recovery or recurrences of thromboses, or family histories of venous thrombi likely require longer courses. Those with major risk of bleeding may warrant individualized shorter courses. Patients who regain activity rapidly may be appropriate candidates for shorter courses of treatment.
Indications for Discontinuation:	Completion of course of treatment, development of major complication (e.g., major bleeding) or other adverse effect.

Rationale: Generally, major bleeding is the most significant adverse effect of most of the medications used to prevent VTED. The high or moderate quality trials are mostly underpowered to detect these events. The general trend across the medications and studies is for more bleeding in the more effective agents. This suggests individualization is needed, and among patients with a greater risk for bleeding, consideration of the agents with apparently lower risk (e.g., enoxaparin or warfarin) is suggested.
There are many quality studies of low-molecular weight heparin with the quality studies comparing treatment with placebo all suggesting benefits [1602, 1628-1630, 1632-1638]. These have shown approximately 1/3 reductions in deep venous thrombosis compared with warfarin [1645] and result in lower incidence of heparin-associated thrombocytopenia [1646-1648]. While mildly invasive and with some adverse effects, these medications are effective in reducing risk of VTED and thus are strongly recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Low-Molecular-Weight Heparin; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 45 articles in PubMed, 168 in Scopus, 18 in CINAHL, 24 in Cochrane Library, 6400 in Google Scholar, and 48 from other sources. We considered for inclusion 5 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 46 from other sources. Of the 52 articles considered for inclusion, 48 randomized trials and 5 systematic studies met the inclusion criteria.

Factor Xa Inhibitors for Prevention of Venous Thromboembolic Disease

Strongly Recommended.
Medications (including topical creams)
Factor Xa inhibitors are strongly recommended for the prevention of venous thromboembolic disease.
Strength of Evidence – **Strongly Recommended, Evidence (A)**
Level of Confidence – **High**

Indications: Post-operative arthroplasty patients, hip fracture patients, or other major hip surgery patients, particularly those with prolonged inactivity or prolonged reduced or sedentary activity levels [1598, 1649-1651]. Particularly indicated for those with a prior VTE. There is no clear superiority or inferiority of LMWHs, Factor Xa inhibitors, and/or traditional warfarin-based regimens Those with contraindication(s) for anticoagulant therapy(ies) and/or are at particularly increased risk of VTE may be better candidates for compressive devices. Patients with prior reactions should generally receive other treatments first. Patients with renal failure or renal insufficiency should generally receive a different medication due to renal excretion of this compound.

Benefits:	Reduced risk of VTED
Harms:	Increased risk of bleeding. Risk of intracranial and gastrointestinal bleeds of particular concern, especially as the treatment is not readily reversible.
Frequency/Dose/Duration:	Medications include subcutaneous injections of Fondaparinux (Arixtra) 2.5mg SC Q.D.; Rivaroxaban (Xarelto) and Apixaban (Eliquis). The recommended duration of a course of treatment is unclear. The literature suggests duration be individualized based largely on factors such as prolonged inactivity, delayed recovery or thrombotic recurrences, prior history and risks of bleeding.
Indications for Discontinuation:	Completion of course of treatment, development of major complication (e.g., major bleeding) or other adverse effect.
Rationale:	There are a few studies of Factor Xa inhibitors, with quality studies having shown Fondaparinux superiority to placebo [1650]. One study found efficacy of Rivaroxaban among femoral neck fracture patients [1652]. Additionally, these agents have been shown to be superior to enoxaparin in two quality studies [1598, 1649], although equivalent in another [1651]. Major bleeding appears more common with Fondparinux than enoxaparin [1614]. While mildly invasive and with some adverse effects, these medications are effective in reducing risk of VTED and thus are strongly recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Factor Xa Inhibitors, Anticoagulants; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 59 articles in PubMed, 16 in Scopus, 28 in CINAHL, 2 in Cochrane Library, 2830 in Google Scholar, and 5 from other sources. We considered for inclusion 8 from PubMed, 2 from Scopus, 4 from CINAHL, 0 from Cochrane Library, 4 from Google Scholar, and 5 from other sources. Of the 23 articles considered for inclusion, 10 randomized trials and 8 systematic studies met the inclusion criteria.

WARFARIN AND HEPARIN FOR PREVENTION OF VENOUS THROMBOEMBOLIC DISEASE

Moderately Recommended.

Medications (including topical creams)

Warfarin and heparin are moderately recommended for prevention of venous thromboembolic disease.

Strength of Evidence – **Moderately Recommended, Evidence (B)**

Level of Confidence – **Moderate**

Indications:	Post-operative arthroplasty patients, hip fracture patients and other major hip surgery patients [1659, 1660]. Warfarin particularly indicated for those with a prior VTE. There is no clear superiority or inferiority of LMWHs, Factor Xa inhibitors, and/or traditional warfarin-based regimens. Those with contraindication(s) for anticoagulant therapy(ies) and/or are at particularly increased risk of VTE may be better candidates for compressive devices. Patients with adverse reactions to warfarin may be maintained on heparin throughout the treatment course, however, evidence of efficacy of monotherapy with heparin is quite limited (Barber 77; Bergqvist 79; Hull 79). Patients with reactions to heparin, but at increased risk of thrombosis may be begun on the other agents and switched to warfarin.
Benefits:	Reduced risk of VTED
Harms:	Increased risk of bleeding. Risk of intracranial and gastrointestinal bleeds of particular concern, however, somewhat less concerning than some other treatment options as the treatment is more readily reversible than with low molecular weight heparins or Factor Xa inhibitors.
Frequency/Dose/Duration:	Subcutaneous injections of Heparin, which can be titrated to the activated partial thromboplastin time (aPTT). Warfarin dose titrated to International Normalized Ratio (INR). Magnitude of anticoagulation is recommended to be individualized, and include risks of thrombi versus risks of bleeding and it is notable that the quality studies utilized a range of INRs. The recommended duration of a course of treatment is unclear. The literature suggests duration be individualized based largely on factors such as prolonged inactivity, delayed recovery or thrombotic recurrences, prior history and risks of bleeding.
Indications for Discontinuation:	Completion of course of treatment, development of major complication (e.g., major bleeding) or other adverse effect.
Rationale:	There is quality evidence that heparin is effective compared with placebo [1659]. However, a moderate quality study found dextran superior to subcutaneous heparin administration [1661]. Heparin is an option in select patients who have contraindications for using other more effective medications for VTED prevention. While mildly invasive and with some adverse effects, these medications are effective in reducing risk of VTED and thus are recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Warfarin, Heparin; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found

and reviewed 71 articles in PubMed, 160 in Scopus, 15 in CINAHL, 1281 in Cochrane Library, 3380 in Google Scholar, and 19 from other sources. We considered for inclusion 7 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 4 from Google Scholar, and 19 from other sources. Of the 30 articles considered for inclusion, 25 randomized trials and 1 systematic studies met the inclusion criteria.

Aspirin for the Prevention of Venous Thromboembolic Disease

Moderately Recommended.

Aspirin is moderately recommended for the prevention of deep venous thrombosis.

Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Indications:	Limited use. Data suggest Aspirin inferior to Heparin (Powers 89), yet it is superior to placebo (Powers 89; Lancet 00). Post-operative arthroplasty patients, hip fracture patients and other major hip surgery patients, generally after cessation of other treatments such as LMWH, heparin, or other anticoagulants [1666]. May be indicated for treatment along with compressive devices among the few patients with contraindications for the other anticoagulant therapies.
Benefits:	Reduced risk of VTED
Harms:	Increased risk of bleeding. Risk of intracranial and gastrointestinal bleeds
Frequency/Dose/Duration:	Aspirin 160mg per day was used in the PEP trial. Other studies have found 85mg/day sufficient for heart attack prevention. Duration of a course of treatment is unclear. One month is suggested, however due to other risk factors, prolonged or indefinite treatment may be recommended.
Indications for Discontinuation:	Completion of course of treatment, development of major complication (e.g., major bleeding) or other adverse effect.
Rationale:	There is quality evidence from the large scale PEP trial that aspirin reduces risk of VTED [1666]. However, other agents reviewed above are likely superior for DVT prevention and ASA may be best used for treatment after cessation of other anti-thrombotic therapy(ies).
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Aspirin, Acetylsalicylic Acid; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 9 articles in PubMed, 111 in Scopus, 22 in CINAHL, 17 in Cochrane Library, 6590 in Google Scholar, and 2 from other sources. We considered for inclusion 2 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 2 from other sources. Of the 8 articles considered for

inclusion, 2 randomized trials and 3 systematic studies met the inclusion criteria.

Pre- and Post-Operative Rehabilitation, Including Hip Arthroplasty and Hip Fractures

Numerous studies have evaluated post-operative rehabilitation and activity levels that appear important for recovery from hip procedures, especially for arthroplasty and hip fracture patients [1159, 1160] (see Post-Operative Rehabilitation evidence table). Considerations have included post-operative activity limitations, post-operative rehabilitation programs and late rehabilitation programs several months after surgery [1160]. Although there is probably overlap with characteristics and needs of arthroplasty patients, mobilization, exercises and activities after hip fracture may differ somewhat and are considered separately below.

Post-Operative Activity Limitations and Rehabilitation Programs: Hip Fracture

The above considerations among arthroplasty patients are likely important in hip fracture patients, and vice versa, particularly as the bodies of evidence appear to support similar conclusions (see post-operative rehabilitation evidence table). There are many quality trials and other studies that involve largely or solely hip fracture patients [1186, 1667-1672] and many of these patients are often debilitated, potentially producing a few unique indications. Others have reviewed this literature and drawn disparate conclusions. A Cochrane review concluded that the available trials were insufficient to draw conclusions [1667]. Another Cochrane review concluded there was no evidence of reductions in mortality among those treated in an interdisciplinary setting versus an orthopedic unit [1670]. A third review recommended physical therapy, occupational therapy and assessments of the home environment particularly to prevent falls in the elderly [1151]. Cost effectiveness of accelerated rehabilitation has been suggested [1673].

Variability between patients is large; the general literature does not substantially discuss more complex patients. It is advised that the rehabilitation components be coordinated with the treating orthopedist who will be better able to address critical questions of bone strength, quality and immediate post-operative results.

There are no quality studies directly evaluating immediate weight-bearing among hip fracture patients. Accelerated rehabilitation has been shown to reduce hospital stays [1673-1675] while remote trials found no adverse effects from earlier weight bearing [1676, 1677]. There is a belief that similar to arthroplasty patients, lack of weight bearing is harmful. Thus, early weight bearing is recommended for those patients with good immediate surgical results and without contraindications to early weight bearing.

There are multiple studies that have attempted to identify whether treatment in a geriatric unit is superior to an orthopedic ward [1678-1682]. There also are quality studies reported of inpatient and outpatient interdisciplinary rehabilitation, which failed to find superiority to usual care [1669, 1683]. It appears that the location of the care, as well as the field of study of the attending is immaterial. Instead, the quality and components of the care required for a given patient appear important. There is quality evidence that those patients with multiple health care issues, particularly including moderate dementia, benefit from treatment in a geriatric unit [1684].

Throughout the exercise literature, a pattern exists that active, functional exercises (e.g., walking, stairs) are more effective and patients are more compliant with those prescriptions. This pattern appears to continue in the quality studies of rehabilitation of hip patients.

There is relatively little quality evidence that directly addresses the importance of a walking program (see post-operative rehabilitation evidence table). However, ambulation and walking programs are components of nearly all rehabilitation programs, particularly including accelerated or intensive rehabilitation programs. Those programs are nearly all reportedly beneficial in the quality studies [1185, 1673-1675, 1685]. Quality studies that appear to have particularly included an ambulatory program as an important component also document benefits [1201, 1686, 1687]. One quality study found aerobic exercises to be comparable to a resistance training program [1201], which as noted below suggests efficacy. Available evidence suggests the primary exercise program elements should entail activities patients require for daily living, especially focusing on walking [1180, 1183]. Thus, a progressive walking program is recommended.

Perhaps the most studied exercise program among hip fracture patients is strengthening or resistance exercise (see post-operative rehabilitation evidence table). These exercises may include steps, stairs, and weight machines. Strengthening exercises have been evaluated in many quality trials [1188, 1189, 1201, 1686, 1688-1692] with all but one of those trials [1692] documenting benefits of the strengthening or resistance exercises. Thus, strengthening and resistance exercises are recommended. Exercises included sit to stand, unilateral heel raises, partial knee bends, 1-legged standing balance, knee raises with alternating arms, marching, side and back leg raises in standing, and unilateral pelvic raising and lowering in standing. These data suggest an evaluation at 4 months post-op and consideration of additional strengthening program components and postural stability through controlled weight bearing is recommended [1198].

Flexibility exercises have traditionally been emphasized in rehabilitation programs; however, there are few quality trials. One quality trial that emphasized flexibility in one treatment arm was negative [1688, 1689]. Thus, some caution is warranted regarding how much, or whether to include flexibility exercises. These are recommended for those patients with significant reductions in functional range of motion, but not generally recommended for other patients.

Evidence is not consistent on whether the program should be home-based or supervised, although home-based programs are generally preferable for reasons of better approximation of long-term environmental factors for purposes of sustenance and cost. The number of appointments and intensity has varied widely in the quality trials (see Post-Operative Rehabilitation evidence table). This suggests individualization is often required, particularly utilizing factors including immediate surgical results, bone quality, patient motivation, caregiver support, degree of deficits, confounding medical conditions, mental health (especially dementia and depression), and mismatches between current functional status and occupational or avocational functional status to be factored into the decision on numbers of appointments and intensity of treatments. An initial instructional appointment is recommended for all patients. Variability is large. Some patients require daily inpatients appointments, whereas others may require thrice-weekly or weekly appointments.

The following program components are recommended and are similar to post-arthroplasty components, although individualization is similarly required that incorporates the surgical results and patient characteristics as noted above. The following are specific components of a progressive physical or occupational therapy program that are recommended based on the quality treatment literature. They assume good surgical results, good bone quality, and reasonable pre-injury medical and physical condition.

Post-operative Exercise and Rehabilitation Program for Hip Fracture Patients

Moderately Recommended.

Rehabilitation Programs

A post-operative exercise and rehabilitation program is moderately recommended for hip fracture patients.

Strength of Evidence – **Moderately Recommended, Evidence (B)**

Level of Confidence – **Moderate**

Indications:	All hip fracture patients. Programs and protocols should be closely coordinated with the treating orthopedist, particularly as patient variability is wide, although workers' compensation patients tend to be younger, in better condition, and able to advance conditioning exercises more rapidly than the elderly. Programs need to be individualized, based on factors such as preoperative condition, bone quality, immediate surgical results, contraindications, and other medical conditions. Workers' compensation patients may benefit from immediate post-operative weight bearing [1673-1677, 1685], progressive walking [1201, 1686], progressive stair climbing [1691], marching-in-place exercises, flexibility [1688, 1689], and strengthening [1188, 1201, 1686, 1688-1691]. Program advancement must be individualized based on progress.
Benefits:	Accelerated functional recovery including walking distance, strength
Harms:	Negligible

Frequency/Dose/Duration:	Duration based primarily on progress. Program may typically be daily in hospital settings and rehabilitation inpatient settings, 2 or 3 times weekly in outpatient settings gradually tapered as home exercises are instituted and the patient's recovery advances. Courses of up to 3 months in more severe cases may be required.
Indications for Discontinuation:	Functional recovery; independent in home-based progressive rehabilitation program
Rationale:	There are multiple quality studies of post-operative rehabilitation programs for hip fracture patients (see post-operative rehabilitation evidence table). Most of these patients appear to require formal physical or occupational therapy, usually in the form of a progressive treatment program. The available evidence suggests functional exercises are helpful, and these include activities patients must successfully perform upon return to home, such as walking, stair climbing and other activities required to perform activities of daily living. These programs generally require many visits for success in these patients, so they are costly. However, these programs are not invasive, have few adverse effects, and help the patient return to normal or improved functional abilities. Thus, they are recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Activities of daily living, rehabilitation, home physical therapy;Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 149 articles in PubMed, 178 in Scopus, 8 in CINAHL, 109 in Cochrane Library, 22900 in Google Scholar, and 21 from other sources. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 4 from Google Scholar, and 21 from other sources. Of the 26 articles considered for inclusion, 14 randomized trials and 4 systematic studies met the inclusion criteria.

Geriatric Unit Treatment for Select Patients

Recommended.

Rehabilitation Programs

Geriatric unit treatment is selectively recommended for patients with multiple health care issues, particularly for those with moderate dementia.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Moderate**

Indications:	Hip fracture patients with at leaste moderate dementia.
Benefits:	Accelerated functional recovery including walking distance, strength. Improved mental functions.
Harms:	Negligible
Frequency/Dose/Duration:	Duration based primarily on progress, with demonstration of progressive functional gains over time. Courses of up to 3 months in more severe cases may be required.
Indications for Discontinuation:	Functional recovery; independent in home-based progressive rehabilitation program
Rationale:	There are multiple studies that have attempted to identify whether treatment in a geriatric unit is superior to an orthopedic ward [1678-1682]; however, the studies do not agree and have significant heterogeneity. There also are two quality studies reported of interdisciplinary rehabilitation, one inpatient and one outpatient, which both failed to find superiority to usual care [1669, 1683]. It appears that the location of the care, as well as the field of study of the attending is immaterial. Instead, the quality and components of the care required for a given patient are believed to be important. There is no recommendation for or against treatment in a geriatric unit or given as an interdisciplinary intervention for most patients. There is quality evidence that those selective patients with multiple health care issues, particularly including moderate dementia, benefit from treatment in a geriatric unit [1684].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Health Services for the Aged, Geriatric Assessment, Geriatrics, Rehabilitation Centers, Rehabilitation Programs; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 24 articles in PubMed, 151 in Scopus, 29 in CINAHL, 3 in Cochrane Library, 9660 in Google Scholar, and 21 from other sources. We considered for inclusion 11 from PubMed, 7 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 15 from Google Scholar, and 21 from other sources. Of the 54 articles considered for inclusion, 36 randomized trials and 14 systematic studies met the inclusion criteria.

Femoroacetabular Impingement, "Hip Impingement," and Labral Tears

Summary of Recommendations

MR Arthrogram for Diagnosing Femoroacetabular Impingementor Labral Tears in Patients with Subacute or Chronic Hip Pain ..... Recommended, Evidence (C)
Ultrasound for Evaluating Femoroacetabular Impingement or Labral Tears ..... Recommended, Insufficient Evidence (I)
Local Glucocorticosteroid Injections for Hip Impingement or Labral Tears ..... Recommended, Insufficient Evidence (I)
Hip Arthroscopy for Diagnosing and Treating Hip Pain with Suspicion of Labral Tear, Intraarticular Body, Femoroacetabular Impingement, or Other Subacute or Chronic Mechanical Symptoms ..... Recommended, Insufficient Evidence (I)
Surgical Repair for Hip Impingement or Labral Tears ..... Recommended, Insufficient Evidence (I)
Therapy for Treatment of Hip Impingement or Labral Tears ..... Recommended, Insufficient Evidence (I)

Introduction

Impingement involves abnormalities of either the femoral head ("cam impingement") or acetabulum ("pincer impingement"), depending on the hip joint appearance [35, 44] [35]. Developmental abnormalities are thought to result in the condition, including e.g., a mild slipped capital femoral epiphysis [153, 1706, 1707]. The condition causes hip pain in athletes, e.g., hockey players and catchers [1708] and those involved in kicking activities such as martial arts [45, 1709] Slipped capital femoral epiphysis, fractures and osteonecrosis are thought to be causes due to altered anatomical orientation [44, 1707, 1710]. A second group of patients have this condition after arthroplasty [1706, 1711].

Femoroacetabular impingement is believed to increase risk for hip osteoarthrosis [34, 36-45]. A corollary is that early identification could lead to successful surgically intervention, e.g., clearing hip motion and alleviating femoral abutment [1712-1714]. Thus the process of osteoarthrosis could theoretically delay or abort [34, 499] arthroplasty by as much as 20 years [83]. However, there is no quality epidemiological evidence to support this theory or corollary [42]. More data are being collected to attempt to support these theories beginning with large case series [34]. Meanwhile, one RCT has suggested no differences between physical therapy and arthroscopic surgery at 2 years of followup [1715].

Patients with hip impingement typically present with activity-related anterior groin pain exacerbated by hip flexion [45, 1714] [35]. Pain usually increases with prolonged sitting, difficulty getting in and out of an automobile or chair, and walking up slopes [45, 496, 1714] [35]. An antalgic gait may be present, along with severe trochanteric tenderness, reduced range of motion and weak abduction for acute significant tendon tears [1716]. Lateral hip pain with radiation to the thigh may occur, as well as buttock or groin pain [496, 1717, 1718]. Passive hip range of motion is normal, but internal rotation of a 90° flexed hip is painful and the lateral trochanter is tender [496, 1719]. Pain may also be reproduced with figure-four or flexed-abducted externally rotated (FABER) position. The distance between the lateral genicular line and the examination table is usually increased [1714]. There may be limited internal rotation in the affected hip [45]. Resisted abduction provokes pain as does pain when standing on the affected leg for at least 30 seconds [496]. A minority of patients may be mistakenly diagnosed with "low back pain" [496] as that clinical "diagnostic" categorization has frequently aggregated lumbar, lumbosacral and gluteal pain.

Labral tears may be considered as distinct entities. Some authors believe these are the most common cause of mechanical hip joint symptoms including popping, catching and locking [471, 1720, 1721]. Yet, labral tears are present in over 58-90% of middle-aged to older hips studied [1722-1724], most often in conjunction with other degenerative phenomenon [471, 1722, 1725, 1726], including degenerative joint disease and tendinosis/ impingement [41, 45, 83, 1727-1729]. Most tears are reportedly in the anterosuperior part of the labrum [1386, 1723, 1730, 1731]. The pathophysiology of labral tears is controversial, particularly as these appear to be more

analogous to a disease where precipitating events are either seemingly minor or absent [45, 471]. Theories for potential causes include age-related degeneration similar to other cartilaginous structures, degenerative articular surfaces, acute trauma, and stereotypical use [45, 1732].
There are no quality studies comparing diagnostic testing and thus diagnostic strategies are somewhat unclear. Diagnostic tests for chronic hip pain thought to be femoroacetabular impingement or labral tears usually include x-rays and MR arthrography [1387, 1733-1736] [1737].

Diagnostic Recommendations

MR Arthrogram for Diagnosing Femoroacetabular Impingement or Labral Tears in Patients with Subacute or Chronic Hip Pain

Recommended.

MR arthrogram is recommended to diagnose femoroacetabular impingement and labral tears in patients with subacute or chronic hip pain.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Moderate**

Indications:	Patients with subacute or chronic hip pain and symptoms or clinical suspicion of femoroacetabular impingement, labral tears, or other hip joint concerns. Plain x-ray is generally the initial radiological study [35].
Benefits:	Secure a diagnosis.
Harms:	Generally rare, but includes infection
Frequency/Dose/Duration:	Generally only one arthrogram is needed.
Rationale:	The use of MR arthrograms has been evaluated in quality studies and there is some evidence of efficacy. MRA is helpful in evaluating and confirming femoroacetabular impingement, and labral tears [499]. Enhanced MR arthrogram allows better labral evaluation and is recommended for diagnosing femoroacetabular impingement compared to other imaging procedures [38, 39, 44, 83, 90, 499, 1386-1388, 1736, 1738-1746]. MR arthrography is minimally invasive, has no adverse effects aside from issues of claustrophobia or complications of medication, but is costly. However, it is likely the best imaging procedure available for these patients and is recommended for select use.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Labral Tears, Femoroacetabular Impingement (FAI), treatment; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 102 articles in PubMed, 128 in Scopus, 154 in CINAHL, 2 in Cochrane Library, 4070 in Google Scholar, and 0 from other sources. We considered for inclusion 9 from PubMed, 4 from Scopus, 5 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 20 articles considered for inclusion, 10 diagnostic studies and 6 systematic studies met the inclusion criteria.

Ultrasound for Evaluating Femoroacetabular Impingement or Labral Tears

Recommended.

Ultrasound is recommended for evaluating patients with femoroacetabular impingement and labral tears.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Patients with hip pain thought to be from impingement or labral tears. Generally, arthrogram and MRI is/are the preferred diagnostic tests, yet selective use of ultrasound may be helpful.
Benefits:	Secure a diagnosis
Harms:	Negligible
Frequency/Dose/Duration:	Generally, only once.
Rationale:	Ultrasound has not been evaluated in quality studies. However, ultrasound appears helpful in evaluating and confirming femoroacetabular impingement, and labral tears and is thus recommended [499].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Labral Tears, Femoroacetabular Impingement (FAI), treatment; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 102 articles in PubMed, 128 in Scopus, 154 in CINAHL, 2 in Cochrane Library, 4070 in Google Scholar, and 0 from other sources. We considered for inclusion 9 from PubMed, 4 from Scopus, 5 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 20 articles considered for inclusion, 10 diagnostic studies and 6 systematic studies met the inclusion criteria.

Treatment Recommendations

- Work and Activity Modifications -See Hip OA Guideline
- Exercise -See Hip OA Guideline
- Medications -See Hip OA Guideline
- NSAIDs, -See Hip OA Guideline
- Devices -See Hip OA Guideline
- Hot and Cold Therapies -See Hip OA Guideline
- Electrical Therapies -See Hip OA Guideline

Injections

LOCAL GLUCOCORTICOSTEROID INJECTIONS FOR HIP IMPINGEMENT OR LABRAL TEARS

Recommended.

Medications (including topical creams)

Local glucocorticosteroid injections are recommended for treatment of "hip impingement" or labral tears [33, 34, 42, 1747, 1748]. (See NSAID frequency, dose discontinuation information, as well as exercise frequencies and information inferred from treatment of osteoarthrosis.)

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Hip impingement and/or labral tears generally not resolving over a period of a few weeks of treatment with activity modification and NSAIDs. This is generally a greater consideration among the elderly with a chronic or relapsing course [496] and/or those who are thought to have a significant inflammatory component.
Benefits:	Improved symptoms
Harms:	Rare infection
Frequency/Dose/Duration:	Generally, only one injection is performed. A second injection may be considered if there is improvement that is incomplete.
Rationale:	There are no quality studies that address glucocorticosteroid injection treatment for femoroacetabular/hip impingement. A trial of conservative therapy has been recommended [43, 1710, 1712, 1720, 1731, 1749]. Reduction, modification, or elimination of activities that significantly provoke symptoms is also recommended [42, 43, 45, 1710, 1712, 1747]. Glucocorticosteroid injection is invasive, has low adverse effects, is moderately costly, has no quality evidence of efficacy, and thus is selectively recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Labral Tears, Femoroacetabular Impingement (FAI), treatment; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 653 articles in PubMed, 694 in Scopus, 112 in CINAHL, 2 in Cochrane Library, 2590 in Google Scholar, and 0 from other sources. We considered for inclusion 9 from PubMed, 4 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 16 articles considered for

inclusion, 8 randomized trials and 7 systematic studies met the inclusion criteria.

Surgical Considerations

Hip Arthroscopy for Diagnosing and Treating Hip Pain with Suspicion of Labral Tear, Intraarticular Body, Femoroacetabular Impingement, or Other Subacute or Chronic Mechanical Symptoms

Recommended.

Arthroscopy is recommended to diagnose and treat patients with hip pain if there is a suspicion of labral tear, intraarticular body, femoroacetabular impingement, or there are other subacute or chronic mechanical symptoms.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Patients with hip pain with suspicion of labral tear, intraarticular body, femoroacetabular impingement, or other subacute or chronic mechanical symptoms.
Benefits:	Secure a diagnosis and potentially intervene at the same time.
Harms:	Complication rates from hip arthroscopic procedures range from 1.3 to 1.6% [467-469] with more serious injuries tending to be related to nerve retraction, neuropraxias, infection, or complex regional pain syndrome [467-473]. Labral resections may increase instability [1750, 1751].
Frequency/Dose/Duration:	Generally, only one procedure is needed.
Rationale:	Arthroscopy of the hip is increasingly utilized to treat several hip disorders, especially ones with mechanical symptoms. Symptomatic labral tears and removal of foreign bodies have been reported as successfully treated in uncontrolled case series [93, 1731, 1752-1758]. Labral repair has been reported as successful in case series [94, 1759]. Femoroacetabular impingement is also a potential indication [1714, 1758]. A microfracture procedure has been utilized to treat both knee [1760] and hip chondral lesions [37, 1761]. By analogy with the knee joint, where quality evidence has demonstrated a lack of efficacy of chondroplasty [474], chondroplasty of the hip joint is not recommended [475, 476]. Surgical repairs have been attempted with reportedly successful results in case series [496, 1744, 1762, 1763]. Arthroscopic surgery [83, 1714, 1720, 1727, 1731, 1747, 1752, 1755, 1758, 1764-1769] or open repair [1712, 1713, 1727, 1770, 1771] are recommended for cases that fail conservative management [42, 1747, 1772]. Arthroplasty is invasive, has some adverse effects, and is costly. However, it is indicated for patients with persistent mechanical symptoms.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Labral Tears, Femoroacetabular Impingement (FAI), treatment; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 102 articles in PubMed, 128 in Scopus, 154 in CINAHL, 2 in Cochrane Library, 4070 in Google Scholar, and 0 from other sources. We considered for inclusion 9 from PubMed, 4 from Scopus, 5 from

CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 20 articles considered for inclusion, 10 diagnostic studies and 6 systematic studies met the inclusion criteria.

Surgical Repair for Hip Impingement or Labral Tears

Recommended.

Open surgical repair is recommended for hip impingement or labral tear cases that fail conservative management and either fail arthroscopic repair and/or are thought to be best treated with an open approach.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Patients with hip pain with suspicion of labral tear, intraarticular body, femoroacetabular impingement, or other subacute or chronic mechanical symptoms. Generally, should either have failed arthroscopic repair and/or thought to be best treated with an open approach.
Benefits:	Definitively address the diagnosis.
Harms:	Somewhat higher complication rates with open procedures compared with arthroscopic procedures, including infection, nerve injuries, venous thrombosis, CRPS. Labral resections may increase instability [1750, 1751].
Frequency/Dose/Duration:	Generally, only one procedure is needed.
Rationale:	Surgical repairs have been attempted with reportedly successful results in case series [496, 1744, 1762, 1763]. Arthroscopic surgery [83, 1714, 1720, 1727, 1731, 1747, 1752, 1755, 1758, 1764-1769] or open repair [1712, 1713, 1727, 1770, 1771] are recommended for cases that fail conservative management [42, 1747, 1772]. There are many different surgical procedures that have been utilized to attempt to address the hip pathology that is thought to be producing symptoms [1712], including debridement [1713, 1747] and/or osteoplasty of the femoral head [1712], acetabular osteoplasty [1712], resection or repair of labral tears [1707, 1714, 1727, 1749, 1759], labral debridement [1710], limbectomy [1757], trochanteric flip osteotomy, peri-acetabular osteotomy [1773], or triple osteotomy [1707, 1710, 1712-1714, 1727, 1747, 1749, 1757, 1759, 1773]. Surgical procedures for hip dysplasia have included shelf osteoplasty, femoral varus osteotomy, and acetabular osteotomy [43, 83, 1773, 1774]. There are no quality studies to address efficacy of either open or arthroscopic repairs, or comparative studies between these approaches [42]. There is controversy regarding which approach is preferred [42, 43, 1712]. A case series reported better results from arthroscopy among patients with mechanical symptoms and without osteoarthrosis [1755]. Arthroscopy has been used to diagnose and potentially plan subsequent mini or open surgical repair [43, 45, 1775].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Labral Tears, Femoroacetabular Impingement (FAI), treatment; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies.

We found and reviewed 653 articles in PubMed, 694 in Scopus, 112 in CINAHL, 2 in Cochrane Library, 2590 in Google Scholar, and 0 from other sources. We considered for inclusion 9 from PubMed, 4 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 16 articles considered for inclusion, 8 randomized trials and 7 systematic studies met the inclusion criteria.

Rehabilitation Programs

THERAPY FOR TREATMENT OF HIP IMPINGEMENT OR LABRAL TEARS

Recommended.

Rehabilitation Programs

Therapy is recommended for treatment of hip impingement or labral tears [33, 34, 42, 1747, 1748].

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Level of Confidence – **Moderate**

Indications:	Most patients may benefit from a course of therapy after arthroscopic (or open) surgical repairs
Benefits:	Improve rate of recovery and address functional deficits.
Harms:	Negligible
Frequency/Dose/Duration:	Generally, 1-2 appointments/week, with sets of 6-8 appointments ordered. Another set of appointments is a consideration if there is lack of complete objective recovery or failure to reach a plateau. Another set of 6-8 appointments would rarely be indicated if there was ongoing objective evidence of improvement after 12-16 appointments.
Indications for Discontinuation:	Full recovery, completion of a course of therapy and reaching a plateau in healing, non-compliance
Rationale:	Post-operative rehabilitation for arthroscopic procedures is thought to differ from other surgical hip procedures [1758] and prolonged partial weight-bearing protocols lasting from 10 days (e.g., labral resection, labral repair, capsular modification) to 4 weeks (e.g., osteoplasty, microfracture) have been developed [1714, 1758]. Some physicians believe that range-of-motion exercises should begin within 4 hours of an arthroscopic impingement procedure [1714]. However, quality evidence suggesting that the rehabilitation solely related to this procedure is different is lacking. In fact, quality evidence for other procedures suggests more rapid rehabilitation protocols result in superior outcomes (see Post-Operative Rehabilitation). There is evidence that younger healthier patients who undergo arthroscopy do not require different rehabilitation protocols [1758] than older healthier patients. Thus, the primary issues are pre-operative functional status and projected post-rehabilitation status. In general, following usual hip rehabilitation protocols is indicated, although the rate of progress is often accelerated compared with more extensive surgical procedures and is particularly accelerated for younger healthier patients who may not require retraining in gait or weight bearing.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Labral Tears, Femoroacetabular Impingement (FAI), treatment; controlled clinical trial, controlled

trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 653 articles in PubMed, 694 in Scopus, 112 in CINAHL, 2 in Cochrane Library, 2590 in Google Scholar, and 0 from other sources. We considered for inclusion 9 from PubMed, 4 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 16 articles considered for inclusion, 8 randomized trials and 7 systematic studies met the inclusion criteria.

Gluteus Medius Tendinosis and Tears ("Rotator Cuff of the Hip"), Greater Trochanteric Pain Syndrome, and Trochanteric Bursitis

Summary of Recommendations

MR Arthrogram for Diagnosing Gluteus Medius Tendinosis or Tears, or Trochanteric Bursitis in Patients with Subacute or Chronic Hip Pain ..... Recommended, Evidence (C)
Ultrasound for Evaluating Gluteus Medius Tendinopathies, Greater Trochanteric Bursitis, and Greater Trochanteric Pain Syndrome/Lateral Hip Pain ..... Recommended, Insufficient Evidence (I)
Limitations for Greater Trochanteric Bursitis/Greater Trochanteric Pain Syndrome Trochanteric Bursitis, and Gluteus Medius Tendon Tears..... Recommended, Insufficient Evidence (I)
Progressive Exercise for Acute, Subacute, Chronic Trochanteric Bursitis, Greater Trochanteric Pain Syndrome, Trochanteric Bursitis, and Gluteus Medius Tears with Accompanying Clinical Bursitis.... Recommended, Insufficient Evidence (I)
Glucocorticosteroid Injections for Acute, Subacute, or Chronic Trochanteric Bursitis, Greater Trochanteric Pain Syndrome and Gluteus Medius Tears with Accompanying Clinical Bursitis..... Recommended, Evidence (C)
Surgical Repair for Gluteus Medius Tears ..... Recommended, Insufficient Evidence (I)

Introduction

Gluteus medius tendinosis or tears, trochanteric bursitis, and greater trochanteric pain syndrome are a constellation of symptoms and signs that overlap. They parallel shoulder tendinoses and subacromial bursitis, although they have not been shown to have a direct mechanistic parallel between the hip and shoulder. Similar to the shoulder, many cases of bursitis may actually be manifestations of gluteus medius tendinosis [496]. As with the shoulder, it appears that bursitis does not generally occur without some tendinosis also present [496]. The gluteus medius tendon is the structural analog of the supraspinatus tendon; the degenerative pathophysiology is comparable. Thus, the entity has been considered analogous to "rotator cuff" of the hip [496, 1745, 1763, 1776, 1777]. These entities are increasingly recognized as significant causes of hip pain and morbidity [54, 496, 1716, 1743, 1744, 1778-1780].

Trochanteric bursitis (TB) and greater trochanteric pain syndrome (GTPS) are terms used to describe chronic pain or tenderness of the lateral part of the hip [1781, 1782]. Although TB and GTPS are often used synonymously, GTPS may also include gluteus tendinopathy and tears as well as external coxa saltans [1783, 1784]. There are several studied methods on the diagnosis of TB/GTPS including a questionnaire, physical examination, MRI, ultrasound

scans, bone scintigraphy and plain radiography [1781, 1785-1789]. In general, clinical signs are used for initial diagnosis followed by one or more form of imaging to verify the diagnosis [56, 1790, 1791]. Conservative treatment of TB/GTPS has included exercise, physical therapy, foot orthotics, analgesics, corticosteroid injections, menopausal hormone therapy, or low energy shock-wave therapy [1792-1797]. Other treatments have included open surgery, open gluteal repair, arthroscopy, and endoscopic gluteal repair [1798-1801].
Risk factors are not defined. Reported associated factors have generally included age, trauma, fractures, diabetes mellitus, obesity, anabolic steroid use, renal failure, hyperparathyroidism, dystrophic calcification, rheumatoid arthritis, systemic lupus erythematosus, and gout [37, 1716]. Also, comparable with the shoulder, most cases appear to be partial tears and not related to acute specific trauma [496, 1717, 1718].

Diagnostic Recommendations

MR Arthrogram for Diagnosing Gluteus Medius Tendinosis, Gluteus Medius Tears, or Trochanteric Bursitis in Patients with Subacute or Chronic Hip Pain

Recommended.

MR arthrogram is recommended to diagnose gluteus medius tendinosis or tears, and for greater trochanteric pain syndrome in patients with subacute or chronic hip pain.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Moderate**

Indications:	Patients with subacute or chronic hip pain and symptoms or clinical suspicion of gluteus medius tendinosis or tears, and for greater trochanteric pain syndrome patients. It is a consideration as well in those with trochanteric bursitis, especially if it does not resolve readily, as bursitis often accompanies gluteus medius tendinopathies.
Benefits:	Secure a diagnosis.
Harms:	Generally rare, but includes infection
Frequency/Dose/Duration:	Generally, only one arthrogram is needed.
Rationale:	MR arthrograms has been evaluated in some quality studies. It appears helpful in evaluating and confirming gluteus medius tendinosis or tears, or greater trochanteric pain syndrome [499]. Enhanced MR arthrogram allows better labral evaluation and is recommended for diagnosing gluteus medius tendinosis or tears, or trochanteric bursitis compared to other imaging procedures [38, 39, 44, 83, 90, 499, 1386-1388, 1736, 1738-1746]. MR arthrography is minimally invasive, has rare adverse effects, but is costly. However, it is likely the best imaging procedure available for these patients and is recommended for select use.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Gluteus Medius Tendinopathy, Gluteus Medius Tears; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 55 articles in PubMed, 2 in Scopus, 3 in CINAHL, 1 in Cochrane Library, 6580 in Google Scholar, and 0 from other sources. We considered for inclusion 5 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 7 articles considered for inclusion, 5 diagnostic studies and 2 systematic studies met the inclusion criteria.

Ultrasound for Evaluating Gluteus Medius Tendinopathies, Greater Trochanteric Bursitis, and Greater Trochanteric Pain Syndrome/Lateral Hip Pain

Recommended.

Ultrasound is recommended for evaluating patients with gluteus medius tendinopathies, greater trochanteric bursitis, and greater trochanteric pain syndrome/lateral hip pain.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Patients with hip pain thought to be from these disorders. Generally, arthrogram and MRI is/are the preferred diagnostic tests, yet selective use of ultrasound may be helpful.
Benefits:	Secure a diagnosis
Harms:	Negligible
Frequency/Dose/Duration:	Generally, only once.
Rationale:	Ultrasound has not been evaluated in quality studies. However, ultrasound appears helpful in evaluating and confirming gluteus medius tendinopathies and is thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Gluteus Medius Tendinopathy, Gluteus Medius Tears; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 55 articles in PubMed, 2 in Scopus, 3 in CINAHL, 1 in Cochrane Library, 6580 in Google Scholar, and 0 from other sources. We considered for inclusion 5 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 7 articles considered for inclusion, 5 diagnostic studies and 2 systematic studies met the inclusion criteria. A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Trochanteric bursitis, greater trochanteric pain syndrome, GTPS**;** diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 63 articles in PubMed using the most recent sorting function. We conducted a secondary review in PubMed using the best match sorting function and found and reviewed 852 articles (Went through first 100). We also found and reviewed 122 in Scopus, 88 in CINAHL, 56 in Cochrane Library, 17400 in Google Scholar (Went through first 100), and 16 from other sources. We considered for inclusion 7 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 4 from Google Scholar, and 0 from other sources. Of the 13 articles considered for inclusion, 6 diagnostic studies and 5 systematic studies met the inclusion criteria.

Treatment Recommendations

Work and Activity Modifications

Limitations for Greater Trochanteric Pain Syndrome, Trochanteric Bursitis, and Gluteus Medius Tendon Tears

Recommended.

Activity Modification and Exercise

Limitations may be helpful in the acute phase of greater trochanteric pain syndrome, trochanteric bursitis, and gluteus medius tendon tears.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Greater trochanteric pain syndrome, trochanteric bursitis, and/or gluteus medius tendinopathies with moderate and severe pain, especially with functional deficits and/or significant worsening of symptoms from performing essential job functions. Those with mild pain but high job physical demands are also candidates for limitations.
Benefits:	Facilitate functional recovery through graded increases over the course of treatment.
Harms:	Excessive debility due to excessively restrictive limitations
Frequency/Dose/Duration:	Until sufficiently resolved. If severe limitations are required, step-wise reduction in the limitations is advised over the course of treatment.
Indications for Discontinuation:	Sufficient functional and pain recovery. There is a consideration for a trial of stepwise elimination of restrictions in those without significant functional recovery to help ascertain surgical case status and document pre-operative abilities.
Rationale:	There are no quality trials of limitations, however limitations are necessary for allowing the ability to perform job tasks which are not significantly aggravating and thus they are recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Gluteus Medius Tendinopathy, Gluteus Medius Tears, treatments, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 34 articles in PubMed, 118 in Scopus, 4 in CINAHL, 0 in Cochrane Library, 1280 in Google Scholar, and 2 from other sources. We considered for inclusion 3 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 11 articles considered for inclusion, 3 randomized trials and 8 systematic studies met the inclusion criteria.

Exercise

Progressive Exercise for Acute, Subacute, Chronic Greater Trochanteric Pain Syndrome, Trochanteric Bursitis, and Gluteus Medius Tears with Accompanying Clinical Bursitis

Recommended.

Activity Modification and Exercise

Progressive, eccentric exercise is recommended for greater trochanteric pain syndrome, trochanteric bursitis, and gluteus medius tendinosis and tears, particularly to address any strength deficits in the lateral hip musculature.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Most patients may benefit from a course of therapy, but particularly those with strength deficits and/or significant functional impairments.
Benefits:	Improve rate of recovery and address functional deficits.
Harms:	Negligible
Frequency/Dose/Duration:	Generally, 1-2 appointments/week, with sets of 6-8 appointments ordered. Another set of appointments is a consideration if there is lack of complete objective recovery or failure to reach an acceptable plateau. Another set of 6-8 appointments would rarely be indicated if there was ongoing objective evidence of improvement after 12-16 appointments.
Indications for Discontinuation:	Full recovery, completion of a course of therapy and reaching a plateau in healing, non-compliance
Rationale:	There are no quality studies of exercise. Exercise has low adverse effects, is generally low to moderate cost depending on the numbers of appointments, is able to address functional deficits, and is thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Gluteus Medius Tendinopathy, Gluteus Medius Tears, treatments, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 34 articles in PubMed, 118 in Scopus, 4 in CINAHL, 0 in Cochrane Library, 1280 in Google Scholar, and 2 from other sources. We considered for inclusion 3 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 11 articles considered for inclusion, 3 randomized trials and 8 systematic studies met the inclusion criteria.

Medications

NSAIDs or Acetaminophen for Acute, Subacute, or Chronic Trochanteric Bursitis, Greater Trochanteric Pain Syndrome and Gluteus Medius Tears with Accompanying Clinical Bursitis

See Hip OA *Guideline*

Devices

See Hip OA *Guideline*

Hot and Cold Therapies

See Hip OA Guideline

Electrical Therapies

See Hip OA Guideline

Injections

Glucocorticosteroid Injections for Acute, Subacute, or Chronic Trochanteric Bursitis, Greater Trochanteric Pain Syndrome, and Gluteus Medius Tears with Accompanying Clinical Bursitis

Recommended.

Injection Therapy

Trochanteric glucocorticosteroid injections are recommended as a treatment option for acute, subacute, or chronic trochanteric bursitis, greater trochanteric pain syndrome, and gluteus medius tears with accompanying clinical bursitis.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Moderate**

Indications:	Symptoms of trochanteric bursitis of at least a couple weeks with prior treatment that has included NSAIDs or acetaminophen and avoidance of aggravating activities.
Benefits:	Improved pain and function.
Harms:	Infection rarely occurs
Frequency/Dose/Duration:	Two quality studies used either: 1) methylprednisolone 60mg plus 2.5mL 0.5% bupivacaine [1802] or 2) betamethasone plus lidocaine and suggested better outcomes with higher doses [1803]. The higher quality study had no placebo control. Each injection should be scheduled separately and the effects of each evaluated before additional injections are scheduled rather than scheduling a series of 3 injections. The most tender location is recommended be targeted [1802] and fluoroscopic guidance is not necessary for an initial injection [1802], although it is a more reasonable option for a second injection, especially if the first injection is unsatisfactory.
Indications for Discontinuation:	Resolution of symptoms, decrease in symptoms to a tolerable level, or failure to gain significant benefits.
Rationale:	Quality trials have evaluated glucocorticosteroid injections [1802-1808]. One study had no placebo control; however, it provided quality evidence that fluoroscopic guidance was not necessary for an initial injection of trochanteric bursitis. The moderate-quality trial compared 3 different doses of betamethasone, however, without a placebo control. As the probability of clinical response was higher in the higher dose group [1803], there is some evidence these injections are likely effective compared with placebo and are recommended. However, there are multiple glucocorticosteroid medications and no head-to-head comparisons between different medications. These injections are invasive, have a low risk of adverse effects, are moderate cost, and are an option for treatment of hip patients, particularly after inadequate results from NSAID trials, exercise, or other conservative interventions.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Trochanteric bursitis, greater

trochanteric pain syndrome, GTPS; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 335 articles in PubMed (Went through first 100), 992 in Scopus (Went through first 100), 81 in CINAHL, 56 in Cochrane Library, 17400 in Google Scholar (Went through first 100), and 48 from other sources. We considered for inclusion 9 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 11 articles considered for inclusion, 2 randomized trials and 5 systematic studies met the inclusion criteria.

Surgical Considerations

See also Hip OA Guideline

Surgical Repair for Gluteus Medius Tears

Recommended.

Surgical Considerations

Surgical repair is recommended for gluteus medius tears that are non-responsive to medical management.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Level of Confidence – **Moderate**

Indications:	Tears of the gluteus medius tendon with accompanying pain and/or functional deficits felt amenable to surgical treatment. Generally at least 3 weeks of non-operative treatment is advisable to ascertain whether the pain and/or function will sufficiently recover without need for surgery.
Benefits:	Improved function and reduced pain.
Harms:	Lack of resolution, infection, nerve injury, CRPS
Rationale:	Gluteus medius tendon tears have been treated with surgical repair, although there are no quality studies to ascertain efficacy. Surgical repair has adverse effects and is costly, but when there are functional deficits and/or unresolvable pain related to gluteus medius tendon tears, it is a recommended treatment.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Gluteus Medius Tendinopathy, Gluteus Medius Tears, treatments, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 34 articles in PubMed, 118 in Scopus, 4 in CINAHL, 0 in Cochrane Library, 1280 in Google Scholar, and 2 from other sources. We considered for inclusion 3 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 11 articles considered for inclusion, 3 randomized trials and 8 systematic studies met the inclusion criteria.

Rehabilitation Programs

See Hip OA Guideline

Hamstring and Hip Flexor Strains

Summary of Recommendations

X-rays or MRI to Diagnose Hamstring Strains and Tears and Hip Flexor Strains ..... Recommended, Insufficient Evidence (I)
Ultrasound for Diagnosing Hamstring Strains and Tears and Hip Flexor Strains ..... Recommended, Insufficient Evidence (I)
Work Limitations for Treatment of Hamstring or Hip Flexor Strains ..... Recommended, Insufficient Evidence (I)
Bed Rest for Treatment of Hamstring or Hip Flexor Strains ..... Not Recommended, Insufficient Evidence (I)
NSAIDS for Treatment of Hamstring or Hip Flexor Strains ..... Recommended, Insufficient Evidence (I)
Ice or Heat or Wraps for Treatment of Hamstring or Hip Flexor Strains ..... Recommended, Insufficient Evidence (I)
Therapy for Treatment of Hamstring or Hip Flexor Strains ..... Recommended, Evidence (C)
Surgical Repair of Hamstring or Hip Flexor Strains ..... Recommended, Insufficient Evidence (I)

Introduction

Hamstring and hip flexor strains are thought to be true muscular strains (i.e., disrupted myotendinous junctions) [101, 1809-1811]. These problems are usually precipitated by a high-force maneuver, including sports injuries in sprinting, football, or soccer [1812-1814], with near-maximum or maximum voluntary contraction use. Prior injury is likely the greatest predictor of future risk. Patients have pain exacerbated by use, stiffness and weakness. The examination findings are tenderness usually at either the muscle origin or insertion (e.g., high versus low hamstring strains) with swelling or large ecchymoses in more severe cases. Some cases involve complete ruptures and require surgical repair. Clinical tests are generally not necessary, although in the more severe cases, evaluation with x-rays and/or MRI are used to evaluate the underlying bony structure as well as the degree of muscle tear as severe, rare cases may require surgery. Treatments may include NSAIDs, heat or cold, ace wraps, work limitations, therapy, and progressive agility, trunk stabilization and icing (PATS).

Diagnostic Recommendations

X-rays or MRI to Diagnose Hamstring Strains and Tears and Hip Flexor Strains

Recommended.

MRI is recommended to diagnose hamstring or hip flexor strains in more severe cases.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Severe and select cases of moderately-severe strains in which there is consideration for surgical repair.
Benefits:	Identification of need for surgery
Rationale:	There are no quality studies of MRI for the assessment of these stains. MRI is not invasive, has low adverse effects, is high cost, but helps to assess degree of severity in more severe cases which helps define surgical eligibility. Thus, MRI is selectively recommended to evaluate more severe strains that are potential surgical cases.

Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hamstring muscles, hip flexor strains; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 171 articles in PubMed, 3 in Scopus, 2434 in CINAHL, 30 in Cochrane Library, 17400 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 4 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Ultrasound for Diagnosing Hamstring Strains and Tears and Hip Flexor Strains

Recommended.

Ultrasound is recommended for evaluating patients with hamstring strains, tears, and hip flexor strains.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Patients with hamstring strains, tears and hip flexor strains that are generally at least moderate in severity. Mild strains generally resolve with appropriate treatment and without need for diagnostic testing.
Benefits:	Secure a diagnosis
Harms:	Negligible
Frequency/Dose/Duration:	Generally, only once.
Rationale:	Ultrasound has not been evaluated in quality studies. However, ultrasound appears helpful in evaluating and confirming these diagnoses and is thus recommended.

Treatment Recommendations

Work and Activity Modifications

Work Limitations for Treatment of Hamstring or Hip Flexor Strains

Recommended.

Activity Modification and Exercise

Work limitations are recommended for patients with hamstring or hip flexor strains, especially in the acute phase for those with significant functional deficits and/or who perform high-physical jobs or cannot avoid job tasks thought to have resulted in the strain.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Hamstring or hip flexor strains with moderate and severe pain, especially with functional deficits and/or significant worsening of symptoms from performing essential job functions. Those with mild pain but high job physical demands are also candidates for limitations.
Benefits:	Facilitate functional recovery through graded increases over the course of treatment.
Harms:	

Excessive debility due to excessively restrictive limitations

Frequency/Dose/Duration: Until sufficiently resolved. If severe limitations are required, step-wise reduction in the limitations is advised over the course of treatment.

Indications for Discontinuation: Sufficient functional and pain recovery. There is a consideration for a trial of stepwise elimination of restrictions in those without significant functional recovery to help ascertain surgical case status and document pre-operative abilities.

Rationale: There are no quality trials of limitations, however limitations are necessary for allowing the ability to perform job tasks which are not significantly aggravating and thus they are recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hamstring muscles, hamstring injury, hip flexor strains; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 107 articles in PubMed, 1179 in Scopus, 690 in CINAHL, 30 in Cochrane Library, 17900 in Google Scholar, and 4 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 9 from Cochrane Library, 1 from Google Scholar, and 4 from other sources. Of the 14 articles considered for inclusion, 12 randomized trials and 2 systematic studies met the inclusion criteria.

Bed Rest for Treatment of Hamstring or Hip Flexor Strains

Not Recommended.

Activity Modification and Exercise

Bed rest is not recommended for treatment of hamstring or hip flexor strains.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **High**

Indications:

All patients

Benefits:

Maintains

Rationale: Bed rest increases debility and risks of DVT, thus is not recommended. Limitations may be required especially for more severe strains and tears (see Work Limitations).

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hamstring muscles, hamstring injury, hip flexor strains; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 107 articles in PubMed, 1179 in Scopus, 690 in CINAHL, 30 in Cochrane Library, 17900 in Google Scholar, and 4 from other

sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 9 from Cochrane Library, 1 from Google Scholar, and 4 from other sources. Of the 14 articles considered for inclusion, 12 randomized trials and 2 systematic studies met the inclusion criteria.

Exercise

See Hip OA *Guideline*

Medications

NSAIDS FOR TREATMENT OF HAMSTRING OR HIP FLEXOR STRAINS

Recommended.

Medications (including topical creams)

NSAIDS are recommended for treatment of hamstring or hip flexor strains.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Most patients with sufficient pain from hamstring or hip flexor strains needing medication.
Benefits:	Reduced pain without functional impairments in a working-age population.
Harms:	See also Hip OA for detailed discussion of cardiovasdcular risks, GI and other adverse effects, and counter measures. Negligible in working age population. Risks for GI bleeding especially if there are combinations of age, diabetes and/or inflammatory arthritis.
Frequency/Dose/Duration:	Per manufacturer's recommendations. Generally scheduled use is advised for acute and moderate to severe-cases until recovery begins to occur at which point PRN use is more commonly used.
Indications for Discontinuation:	recovery, adverse effects, intolerance, non-compliance
Rationale:	There is one quality study of treatment options for hamstring or hip flexor strains; however, it only addresses exercise; thus, nearly all treatment recommendations are empiric [101, 1809]. Nonsteroidal anti-inflammatory medications are recommended (see NSAIDs for dose, frequency, discontinuation information).
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hamstring muscles, hamstring injury, hip flexor strains; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 107 articles in PubMed, 1179 in Scopus, 690 in CINAHL, 30 in Cochrane Library, 17900 in Google Scholar, and 4 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0

from CINAHL, 9 from Cochrane Library, 1 from Google Scholar, and 4 from other sources. Of the 14 articles considered for inclusion, 12 randomized trials and 2 systematic studies met the inclusion criteria.

Devices

See Hip OA Guideline

Hot and Cold Therapies

ICE OR HEAT OR WRAPS FOR TREATMENT OF HAMSTRING OR HIP FLEXOR STRAINS

Recommended.

Hot and Cold Therapies

Ice or heat or ace wraps are recommended for treatment of hamstring or hip flexor strains.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Most patients with sufficient pain from hamstring or hip flexor strains needing treatment and medication, especially in the acute and peri-operative stages.
Benefits:	Ability to self-treat to reduce pain without functional impairments
Harms:	Negligible
Frequency/Dose/Duration:	Generally tailored according to severity and patient preferences. Use is generally greatest in the acute and peri-/post-operative stages and then tapered off as recovery occurs.
Indications for Discontinuation:	Recovery, adverse effects, intolerance, non-compliance
Rationale:	There are no quality trials of heat or cold treatments or ace wraps. These treatments are non-invasive, have negligible adverse effects, are low cost when self-applied, and are thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hamstring muscles, hamstring injury, hip flexor strains; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 107 articles in PubMed, 1179 in Scopus, 690 in CINAHL, 30 in Cochrane Library, 17900 in Google Scholar, and 4 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 9 from Cochrane Library, 1 from Google Scholar, and 4 from other sources. Of the 14 articles considered for inclusion, 12 randomized trials and 2 systematic studies met the inclusion criteria.

Electrical Therapies

See Hip OA Guideline

Injections

See Hip OA Guideline

Rehabilitation Programs

Therapy for Treatment of Hamstring or Hip Flexor Strains

Recommended.

Therapy is recommended for treatment of hamstring or hip flexor strains.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Moderate**

Indications:	Most patients may benefit from a course of therapy, but particularly those with strength deficits and/or significant functional impairments.
Benefits:	Improve rate of recovery and address functional deficits. One specific type of treatment is PATS (progressive agility, trunk stability and icing) [1815].
Harms:	Negligible
Frequency/Dose/Duration:	Generally, 1-2 appointments/week, with sets of 6-8 appointments ordered. Another set of appointments is a consideration if there is lack of complete objective recovery or failure to reach an acceptable plateau. Another set of 6-8 appointments would rarely be indicated if there was ongoing objective evidence of improvement after 12-16 appointments.
Indications for Discontinuation:	Full recovery, completion of a course of therapy and reaching a plateau in healing, non-compliance
Rationale:	There are a few quality studies of exercise [1815]. Eccentric exercises were reportedly effective in another trial [1816]. Another trial emphasized an individualized program for football players [1817]. Exercise has low adverse effects, is generally low to moderate cost depending on the numbers of appointments, is able to address functional deficits, and is thus recommended. The quality of the available data does not allow for a clear preference of one exercise regimen over another.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hamstring muscles, hamstring injury, hip flexor strains; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 107 articles in PubMed, 1179 in Scopus, 690 in CINAHL, 30 in Cochrane Library, 17900 in Google Scholar, and 4 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 9 from Cochrane Library, 1 from Google Scholar, and 4 from other sources. Of the 14 articles considered for inclusion, 12 randomized trials and 2 systematic studies met the inclusion criteria.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hamstring muscles, hamstring injury, hip flexor strains; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 107 articles in PubMed, 1179 in Scopus, 690 in CINAHL, 30 in Cochrane Library, 17900 in Google Scholar, and 4 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0

from CINAHL, 9 from Cochrane Library, 1 from Google Scholar, and 4 from other sources. Of the 14 articles considered for inclusion, 12 randomized trials and 2 systematic studies met the inclusion criteria.

Surgical Considerations

SURGICAL REPAIR OF HAMSTRING OR HIP FLEXOR STRAINS

Recommended.

Surgical repair is recommended for treatment of large or complete hamstring or hip flexor strains.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **High**

Indications:	Large or complete tears of the hamstrings or hip flexor strains with functional deficits felt amenable to surgical treatment. Generally, large or complete hamstrings tears require surgical repair to facilitate recovery.
Benefits:	Improved functional recovery and reduced pain.
Harms:	Lack of resolution, infection, nerve injury, CRPS
Rationale:	Hamstring tears and hip flexor tears that are large or complete have generally been treated with surgical repair, although there are no quality studies to ascertain efficacy. Surgical repair has adverse effects and is costly, but as these muscles are important for physical function, surgical repair is recommended.

Groin Strains, Sports Hernias, and Adductor-Related Groin Pain

Summary of Recommendations

X-rays or MRI to Diagnose Groin Strains, Sports Hernias, or Adductor-related Groin Pain ..... Recommended, Insufficient Evidence (I)
Ultrasound for Evaluating Groin Strains, Sports Hernias, or Adductor-related Groin Pain ..... Recommended, Insufficient Evidence (I)
Work Limitations for Treatment of Groin Strains, Sports Hernias, or Adductor-related Groin Pain ..... Recommended, Insufficient Evidence (I)
Bed Rest for Treatment of Groin Strains, Sports Hernias, or Adductor-related Groin Pain ..... Not Recommended, Insufficient Evidence (I)
NSAIDS for Treatment of Groin Strains, Sports Hernias, or Adductor-related Groin Pain ..... Recommended, Insufficient Evidence (I)
Ice or Heat or Wraps for Treatment of Groin Strains, Sports Hernias, or Adductor-related Groin Pain ..... Recommended, Insufficient Evidence (I)
Therapy for Treatment of Groin Strains, Sports Hernias, or Adductor-related Groin Pain ..... Recommended, Evidence (C)

Introduction

Groin strains are generally thought to be true strains with disrupted myotendinous junction(s) that involve the adductor muscles in the upper thigh [101, 1809]. Sports hernias are comparable strains, but involve the lower abdominal musculature, especially the obliques. These problems are precipitated by a high-force maneuver, including sports injuries, that is usually at or near maximum voluntary contraction capabilities. As with other true strains, prior injury is thought to be predictive of future risk. Patients have pain exacerbated by use, stiffness, and

weakness. The examination findings are tenderness at the muscular origin, and there may be swelling and ecchymoses in more severe cases. Clinical tests are generally not necessary, although in the more severe cases, evaluation with x-rays and/or MRI are recommended for evaluation of the underlying bony structure as well as the degree of muscle tear as rare cases may require surgery.

Diagnostic Recommendations

X-rays or MRI to Diagnose Groin Strains, Sports Hernias, or Adductor-related Groin Pain

Recommended.

X-rays or MRI are selectively recommended to diagnose groin strains, sports hernias, or adductor-related groin pain in more severe cases.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Severe and select cases of moderately-severe strains in which there is consideration for surgical repair.
Benefits:	Identification of need for surgery
Rationale:	There are no quality studies of MRI and x-rays for the assessment of these stains. X-rays aid avulsion fracture diagnosis and MRI aids the diagnosis of strain/tear severity. MRI and x-rays are not invasive, have low adverse effects, MRI is high cost, but these tests help assess degree of severity in more severe cases which helps define surgical eligibility.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: groin strain, groin pain, adductor related groin pain; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 395 articles in PubMed, 73 in Scopus, 70 in CINAHL, 6 in Cochrane Library, 41000 in Google Scholar, and 2 from other sources. We considered for inclusion 12 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 2 from other sources. Of the 17 articles considered for inclusion, 7 diagnostic studies and10 systematic studies met the inclusion criteria.

Ultrasound for Evaluating Groin Strains, Sports Hernias, or Adductor-related Groin Pain

Recommended.

Ultrasound is recommended for evaluating groin strains, sports hernias, or adductor-related groin pain.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Patients with groin strains, sports hernias, or adductor-related groin pain that are generally at least moderate in severity. Mild strains generally resolve with appropriate treatment and without need for diagnostic testing.
Benefits:	Secure a diagnosis

Harms:	Negligible
Frequency/Dose/Duration:	Generally, only once.
Rationale:	Ultrasound has not been evaluated in quality studies. However, ultrasound appears helpful in evaluating and confirming these diagnoses and is thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: groin strain, groin pain, adductor related groin pain; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 395 articles in PubMed, 73 in Scopus, 70 in CINAHL, 6 in Cochrane Library, 41000 in Google Scholar, and 2 from other sources. We considered for inclusion 12 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 2 from other sources. Of the 17 articles considered for inclusion, 7 diagnostic studies and10 systematic studies met the inclusion criteria.

Treatment Recommendations

Work and Activity Modifications

Work Limitations for Treatment of Groin Strains, Sports Hernias, or Adductor-related Groin Pain

Recommended.

Work limitations are recommended for patients with groin strains, sports hernias, or adductor-related groin pain, especially in the acute phase for those with significant functional deficits and/or who perform high-physical jobs or cannot avoid job tasks thought to have resulted in the strain.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Groin strains, sports hernias, or adductor-related groin moderate and severe pain, especially with functional deficits and/or significant worsening of symptoms from performing essential job functions. Those with mild pain but high job physical demands are also candidates for limitations.
Benefits:	Facilitate functional recovery through graded increases over the course of treatment.
Harms:	Excessive debility due to excessively restrictive limitations
Frequency/Dose/Duration:	Until sufficiently resolved. If severe limitations are required, step-wise reduction in the limitations is advised over the course of treatment.
Indications for Discontinuation:	Sufficient functional and pain recovery. There is a consideration for a trial of stepwise elimination of restrictions in those without significant functional recovery to help ascertain surgical case status and document pre-operative abilities.
Rationale:	There are no quality trials of limitations. However, limitations are necessary for allowing the ability to perform job tasks that are not significantly aggravating; thus, they are recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: groin strain, groin pain, adductor related groin pain; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 847 articles in PubMed, 2524 in Scopus, 74 in CINAHL, 6 in Cochrane Library, 27000 in Google Scholar, and 6 from other sources. We considered for inclusion 16 from PubMed, 4 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 6 from other sources. Of the 27 articles considered for inclusion, 19 randomized trials and 8 systematic studies met the inclusion criteria.

Bed Rest for Treatment of Groin Strains, Sports Hernias, or Adductor-related Groin Pain

Not Recommended.

Bed rest is not recommended for treatment of groin strains, sports hernias, or adductor-related groin pain.

Strength of Evidence –**Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **High**

Rationale: Bed rest increases debility and risks of DVT and thus is not recommended. Limitations may be required, especially for more severe strains and tears (see Work Limitations).

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: groin strain, groin pain, adductor related groin pain; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 847 articles in PubMed, 2524 in Scopus, 74 in CINAHL, 6 in Cochrane Library, 27000 in Google Scholar, and 6 from other sources. We considered for inclusion 16 from PubMed, 4 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 6 from other sources. Of the 27 articles considered for inclusion, 19 randomized trials and 8 systematic studies met the inclusion criteria.

Exercise

See Hip OA *Guideline*

Medications

NSAIDS for Treatment of Groin Strains, Sports Hernias, or Adductor-related Groin Pain

Recommended.

NSAIDS are recommended for treatment of groin strains, sports hernias, or adductor-related groin pain.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications: Most patients with sufficient pain from groin strains, sports hernias, or adductor-related groin pain needing medication.

Benefits:	Reduced pain without functional impairments in a working-age population.
Harms:	See also Hip OA for detailed discussion of cardiovasdcular risks, GI and other adverse effects, and counter measures. Negligible in working-age population. Risks for GI bleeding, especially if there are combinations of age, diabetes, and/or inflammatory arthritis.
Frequency/Dose/Duration:	Per manufacturer's recommendations. Generally scheduled use is advised for acute and moderate to severe cases until recovery begins to occur, at which point PRN use is more commonly used.
Indications for Discontinuation:	Recovery, adverse effects, intolerance, non-compliance
Rationale:	There are no quality study of treatment options for groin strains other than for exercise and surgery. Thus, nearly all treatments are empiric. Nonsteroidal anti-inflammatory medications are recommended for pain management (see NSAIDs for dose, frequency, discontinuation information).
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: groin strain, groin pain, adductor related groin pain; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 847 articles in PubMed, 2524 in Scopus, 74 in CINAHL, 6 in Cochrane Library, 27000 in Google Scholar, and 6 from other sources. We considered for inclusion 16 from PubMed, 4 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 6 from other sources. Of the 27 articles considered for inclusion, 19 randomized trials and 8 systematic studies met the inclusion criteria.

Devices

See Hip OA *Guideline*

Hot and Cold Therapies

Ice or Heat or Wraps for Treatment of Groin Strains, Sports Hernias, or Adductor-related Groin Pain

Recommended.

Ice or heat or ace wraps are recommended for treatment of groin strains, sports hernias, or adductor-related groin pain.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Most patients with sufficient pain from groin strains, sports hernias, or adductor-related groin pain needing treatment and medication, especially in the acute and peri-operative stages.
Benefits:	Ability to self-treat to reduce pain without functional impairments

Harms:	Negligible
Frequency/Dose/Duration:	Generally tailored according to severity and patient preferences. Use is generally greatest in the acute and peri-/post-operative stages and then tapered off as recovery occurs.
Indications for Discontinuation:	Recovery, adverse effects, intolerance, non-compliance
Rationale:	There are no quality trials of heat or cold treatments or ace wraps. These treatments are non-invasive, have negligible adverse effects, are low cost when self-applied, and are thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: groin strain, groin pain, adductor related groin pain; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 847 articles in PubMed, 2524 in Scopus, 74 in CINAHL, 6 in Cochrane Library, 27000 in Google Scholar, and 6 from other sources. We considered for inclusion 16 from PubMed, 4 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 6 from other sources. Of the 27 articles considered for inclusion, 19 randomized trials and 8 systematic studies met the inclusion criteria.

Electrical Therapies

See Hip OA *Guideline*

Injections

See Hip OA *Guideline*

Surgical Considerations

See Hip OA *Guideline*

Rehabilitation Programs

Therapy for Treatment of Groin Strains, Sports Hernias, or Adductor-related Groin Pain

Recommended.

Rehabilitation Programs

Therapy is recommended for treatment of groin strains, sports hernias, or adductor-related groin pain.

Strength of Evidence – **Recommended, Evidence (C)**

Level of Confidence – **Moderate**

Indications:	Most patients may benefit from a course of therapy, but particularly those with strength deficits and/or significant functional impairments. Thus, groin strains, sports hernias, and/or adductor-related groin pain generally at least moderate in severity. Mild cases usually resolve with elimination of exposure(s), NSAIDs, and time.
Benefits:	Facilitate earlier recovery, address functional deficits, and facilitate graded increase in activity as recovery occurs.

Harms:	Negligible; rarely significant worsening with therapy.
Frequency/Dose/Duration:	Generally 1-2 appointments/week, with sets of 6-8 appointments ordered. Another set of appointments is a consideration if there is lack of complete objective recovery or failure to reach an acceptable plateau. Another set of 6-8 appointments would rarely be indicated if there was ongoing objective evidence of improvement after 12-16 appointments.
Indications for Discontinuation:	Full recovery, completion of a course of therapy and reaching a plateau in healing, non-compliance
Rationale:	There are few studies of exercise. Two trials found various aggregates of interventions in a training program to be effective [1809, 1818]; however, neither of these trials allows a clear evidence-based prescription due to the heterogeneity and lack of control of the interventions. Exercise has low adverse effects, is generally low to moderate cost depending on the numbers of appointments, is able to address functional deficits, and is thus recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: groin strain, groin pain, adductor related groin pain; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 847 articles in PubMed, 2524 in Scopus, 74 in CINAHL, 6 in Cochrane Library, 27000 in Google Scholar, and 6 from other sources. We considered for inclusion 16 from PubMed, 4 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 6 from other sources. Of the 27 articles considered for inclusion, 19 randomized trials and 8 systematic studies met the inclusion criteria.

Meralgia Paresthetica

Summary of Recommendations

Magnetic Resonance Neurography for the Diagnosis of Meralgia Paresthetica ..... Recommended, Evidence (C)
Nerve Conduction Study to Confirm Diagnosis of Meralgia Paresthetica and Localize Entrapment ..... Recommended, Insufficient Evidence (I)
Weight Loss/Avoidance of Aggravating Exposures/Loose Clothing for Treatment of Meralgia Paresthetica ..... Recommended, Insufficient Evidence (I)
NSAIDS for Treatment of Meralgia Paresthetica ..... No Recommendation, Insufficient Evidence (I)
Topical Lidocaine Patches for Treatment of Meralgia Paresthetica ..... No Recommendation, Insufficient Evidence (I)
Glucocorticosteroid Injections for Treatment of Meralgia Paresthetica ..... Recommended, Insufficient Evidence (I)
Surgical Release for Treatment of Meralgia Paresthetica ..... Recommended, Insufficient Evidence (I)
Spinal Cord Stimulator for Treatment of Meralgia Paresthetica ... No Recommendation, Insufficient Evidence (I)

Introduction

Meralgia paresthetica is a peripheral entrapment neuropathy of the lateral femoral cutaneous nerve that is a purely sensory nerve supplying the upper lateral aspects of the thigh. Meralgia paresthetica (MP) is a condition that is typically caused by the lateral femoral cutaneous nerve being entrapped or damaged [1819-1822]. While a nerve entrapment may occur at any point along any nerve, the condition in this nerve is most commonly from a localized pressure in the area of the inguinal ligament, generally in obese, middle aged adults in whom the obesity is presumed to produce the pressure on the nerve either directly or through tight clothing. The disorder has also occurred among athletes including gymnasts. Onset may be relatively acute, e.g., after one night's sleep or insidious. A tight, heavy tool belt may produce an occupational cause. Other causes include trauma, scarring from prior trauma, and insults from systemic rheumatological disorders. Symptoms involve tingling and numbness in the distribution of the nerve. Pain may be absent, mild or rarely, severe. There is no muscle weakness. Symptoms of MP are usually characterized by a patient complaining of pain, numbness, or burning in the lateral or anterolateral thigh [1819, 1820, 1823]. While the diagnosis is primarily clinical, one study suggested successful diagnostic evaluation of MP using magnetic resonance neurography [1820]. More studies suggest the usefulness of somatosensory evoked potentials for the diagnosis of MP [108, 1821, 1822]. Multiple observational studies show reduction of MP symptoms [1819, 1823, 1824]. However, no randomized controlled trials for treatments were found; a retrospective analysis suggested success with pulsed radiofrequency neuromodulation of the lateral femoral cutaneous nerve for the treatment of MP [1825].

Diagnostic Recommendations

Magnetic Resonance Neurography for the Diagnosis of Meralgia Paresthetica

Recommended.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Low**

Indications:	Most cases are diagnosed clinically and successfully treated empirically, thus requiring no testing. Testing is advised, however, before surgery both to secure the diagnosis and more precisely identify the location of entrapment for the operative approach.
Benefits:	Assess with diagnosis and localize entrapment.
Harms:	Negligible
Frequency/Dose/Duration:	Once
Rationale:	The diagnosis is usually made on clinical grounds and imaging is generally not indicated. For patients in whom there is either a considerable question about the accuracy of the diagnosis, or for whom surgery is contemplated, a nerve conduction study is recommended to confirm the diagnosis and localize the entrapment.[1826] There is one study suggesting MR neurography is effective and thus is an alternative test [1820]. There is preliminary evidence suggesting that ultrasound may be an option [1827].
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Meralgia Paresthetica; diagnostic,

diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency, systematic, systematic review, retrospective, and prospective studies. We found and reviewed 7 articles in PubMed, 12 in Scopus, 14 in CINAHL, 15 in Cochrane Library, 2080 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 5 from Google Scholar, and 0 from other sources. Of the 11 articles considered for inclusion, 6 diagnostic studies and 5 systematic studies met the inclusion criteria.

Nerve Conduction Study to Confirm Diagnosis of Meralgia Paresthetica and Localize Entrapment

Recommended.

A nerve conduction study is recommended to confirm the diagnosis of meralgia paresthetica and localize the entrapment.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications: Most cases are diagnosed clinically and successfully treated empirically, thus requiring no testing. Testing is advised however before surgery both to secure the diagnosis and more precisely identify the location of entrapment for the operative approach.

Benefits: Assess with diagnosis and localize entrapment.

Harms: Negligible

Frequency/Dose/Duration: Once. Should generally not be ordered until symptoms have persisted for at least 3 weeks to allow sufficient time for electrical findings to develop.

Rationale: The diagnosis is usually made on clinical grounds and imaging is generally not indicated. For patients in whom there is either a considerable question about the accuracy of the diagnosis, or for whom surgery is contemplated, a nerve conduction study is recommended to confirm the diagnosis and localize the entrapment [1826].

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Meralgia Paresthetica; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency, systematic, systematic review, retrospective, and prospective studies. We found and reviewed 7 articles in PubMed, 12 in Scopus, 14 in CINAHL, 15 in Cochrane Library, 2080 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 3 from

Scopus, 0 from CINAHL, 0 from Cochrane Library, 5 from Google Scholar, and 0 from other sources. Of the 11 articles considered for inclusion, 6 diagnostic studies and 5 systematic studies met the inclusion criteria.

Treatment Recommendations

Work and Activity Modifications

WEIGHT LOSS/AVOIDANCE OF AGGRAVATING EXPOSURES/LOOSE CLOTHING FOR TREATMENT OF MERALGIA PARESTHETICA

Recommended.

Behavioral and Psychological Interventions

Weight loss for patients who are overweight or obese, avoidance of aggravating exposures, and the wearing of loose clothing and tool belts is recommended for treatment of meralgia paresthetica.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications: All patients with meralgia paresthetica

Benefits: Generally this is the most effective treatment strategy.

Harms: Negligible

Frequency/Dose/Duration: Duration is generally until recovered.

Rationale: There are no quality studies to evaluate, diagnose, or treat the condition, thus treatments are empiric. The diagnosis is usually made on clinical grounds and imaging is generally not indicated. Weight loss is recommended for those who are overweight or obese. Patients should also avoid aggravating exposures, toolbelts, and wear loose clothing.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Meralgia Paresthetica; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 27 articles in PubMed, 214 in Scopus, 10 in CINAHL, 15 in Cochrane Library, 1520 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 5 systematic studies met the inclusion criteria.

Exercise

See Hip OA *Guideline*

Medications

NSAIDS for Treatment of Meralgia Paresthetica

No Recommendation.

Medications (including topical creams)

There is no recommendation for or against the use of NSAIDS to treat meralgia paresthetica.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There are no quality studies to evaluate, diagnose, or treat the condition; thus, treatments are empiric. Because this is a peripheral entrapment neuropathy and NSAIDs appear ineffective for other entrapment neuropathies in quality studies, such as for treatment of carpal tunnel syndrome, there is no recommendation for or against the use of NSAIDs for meralgia paresthetica. A trial of an NSAID for a severe case may be a reasonable option.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Meralgia Paresthetica; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 27 articles in PubMed, 214 in Scopus, 10 in CINAHL, 15 in Cochrane Library, 1520 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 5 systematic studies met the inclusion criteria.

Topical Lidocaine Patches for Treatment of Meralgia Paresthetica

No Recommendation.

Medications (including topical creams)

There is no recommendation for or against the use of topical lidocaine patches to treat meralgia paresthetica.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There are no quality studies to evaluate, diagnose, or treat the condition; thus, treatments are empiric. Topical lidocaine patches have been used [1828]. However, for most patients, the pain is insufficient to warrant treatment. Thus, there is no recommendation for or against the use of lidocaine patches.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar wthout date limits using the following terms: Meralgia Paresthetica; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 27

articles in PubMed, 214 in Scopus, 10 in CINAHL, 15 in Cochrane Library, 1520 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 5 systematic studies met the inclusion criteria.

Devices

See Hip OA *Guideline*

Hot and Cold Therapies

See Hip OA *Guideline*

Electrical Therapies

See Hip OA *Guideline*

Injections

Glucocorticosteroid Injections for Treatment of Meralgia Paresthetica

Recommended.

Injection Therapy

Glucocorticosteroid injections are recommended for treatment of meralgia paresthetica if more conservative treatments are not efficacious.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Meralgia paresthetica sufficiently severe and not responding to other non-invasive treatments.
Benefits:	Improvement in symptoms
Harms:	Rare infection or nerve damage
Frequency/Dose/Duration:	One injection. Generally only perform a second injection if there is incomplete improvement with the first injection. Need of a third injection should be fairly rare.
Indications for Discontinuation:	There should be no second injection if there was sufficient recovery after the first.
Rationale:	There are no quality studies to evaluate, diagnose, or treat the condition; thus, treatments are empiric. Glucocorticosteroid injections have been tried and are recommended if the above-mentioned more conservative treatments do not resolve the condition.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Meralgia Paresthetica; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 27

articles in PubMed, 214 in Scopus, 10 in CINAHL, 15 in Cochrane Library, 1520 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 5 systematic studies met the inclusion criteria.

Surgical Considerations

Surgical Release for Treatment of Meralgia Paresthetica

Recommended.

Surgical release is recommended for treatment of select patients with meralgia paresthetica.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Patients who both have continued symptoms unresponsive to the above treatments and in whom symptoms are sufficiently severe to warrant invasive treatment. Should have diagnosis and site of entrapment confirmed by either nerve conduction study or MR neurography.
Benefits:	Resolution of a nerve entrapment
Harms:	Rare infection, nerve damage, CRPS
Rationale:	There are no quality surgical studies. For patients in whom there is either a considerable question about the accuracy of the diagnosis, or for whom surgery is contemplated, a nerve conduction study or MR neurography is recommended to confirm the diagnosis and localize the entrapment [1826]. Surgical release is rarely needed. However, for those who both have continued symptoms unresponsive to the above and in whom the symptoms are sufficiently severe to warrant invasive treatment, surgical release is recommended.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Meralgia Paresthetica; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 27 articles in PubMed, 214 in Scopus, 10 in CINAHL, 15 in Cochrane Library, 1520 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 5 systematic studies met the inclusion criteria.

Spinal Cord Stimulator for Treatment of Meralgia Paresthetica

No Recommendation.

Devices

There is no recommendation for or against the use of spinal cord stimulators for treatment of select patients with meralgia paresthetica.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There are no quality studies to evaluate, diagnose, or treat the condition, thus treatments are empiric. A spinal cord stimulator has been implanted in one case with reported good short- to intermediate-term results [1829]. However, the intervention is highly invasive compared with a peripheral sensory nerve entrapment neuropathy. There are no quality studies of efficacy. SCS has caused fatalities. Therefore, there is no recommendation for or against the use of spinal cord stimulators.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Meralgia Paresthetica; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 27 articles in PubMed, 214 in Scopus, 10 in CINAHL, 15 in Cochrane Library, 1520 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 5 systematic studies met the inclusion criteria.

Rehabilitation Programs

See Hip OA *Guideline*

Lower Abdominal Strains

Summary of Recommendations

Culturing Urine to Diagnose Lower Abdominal Strains ..... No Recommendation, Insufficient Evidence (I)
Bed Rest for Treatment of Lower Abdominal Strains ..... Not Recommended, Insufficient Evidence (I)
Work Limitations for Treatment of Lower Abdominal Strains ..... Recommended, Insufficient Evidence (I)
NSAIDS for Treatment of Lower Abdominal Strains ..... Recommended, Insufficient Evidence (I)
Ice or Heat for Treatment of Lower Abdominal Strains ..... Recommended, Insufficient Evidence (I)
Therapy for Treatment of Lower Abdominal Strains ..... Recommended, Insufficient Evidence (I)

Introduction

Lower abdominal strains are frequent occurrences in sports and occupational populations, particularly in those that involve heavy lifting [101]. The pathophysiological abnormality is unclear. Pain onset is usually acute and in the context of a heavy lift or sports-related forceful exertion. Pain occurs most typically in the lower abdominal muscles, often along the inguinal canal; however, there is no hernia. Whether abdominal strain is either a risk or a precursor to an indirect inguinal hernia is also unknown. Some have thought the disorder represented urine reflux into the vas deferens during heavy lifting or strain (see Epididymo-Orchitis). There are no quality studies to evaluate, diagnose, or treat the condition; thus, treatments are empiric. Patients should be evaluated for hernias and referred for consideration of surgical repair if found [26].

Diagnostic Recommendations

Culturing Urine to Diagnose Lower Abdominal Strains

No Recommendation.

There is no recommendation for or against culturing urine to diagnose lower abdominal strain unless other symptoms are present.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: Unless other symptoms are present, there is no recommendation for or against culturing of urine (evaluation and treatment of epididymo-orchitis follows).

Treatment Recommendations

Work and Activity Modifications

Bed Rest for Treatment of Lower Abdominal Strains

Not Recommended.

Bed rest is not recommended for treatment of lower abdominal strains.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **High**

Rationale: Bed rest is not recommended due to concern regarding deep venous thrombosis and other adverse effects.

Work Limitations for Treatment of Lower Abdominal Strains

Sometimes Recommended.

Work limitations are recommended for patients with lower abdominal strains, particularly if performing high-physical jobs or if the worker cannot avoid job tasks thought to have resulted in the strain.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications: Lower abdominal strains with moderate and severe pain, especially with functional deficits and/or significant worsening of symptoms from performing essential job functions. Those with mild pain but high job physical demands are also candidates for limitations.

Benefits: Facilitate functional recovery through graded increases over the course of treatment.

Harms: Excessive debility due to excessively restrictive limitations

Frequency/Dose/Duration: Until sufficiently resolved. If severe limitations are required, step-wise reduction in the limitations is advised over the course of treatment.

Indications for Discontinuation: Sufficient functional and pain recovery. There is a consideration for a trial of stepwise elimination of restrictions in those without significant functional recovery to help ascertain surgical case status and document pre-operative abilities.

Rationale: There are no quality trials of limitations, however limitations are necessary for allowing the ability to perform job tasks which are not significantly aggravating and thus they are recommended.

Comments: Work limitations may be necessary depending on the severity of the condition. Those performing high physical demand tasks or those who have no ability to avoid repeating physically demanding job tasks thought to have resulted in the condition are recommended to have work limitations, but in other cases, there is no recommendation for or against the use of work limitations.

Exercise

See Hip OA Guideline

Medications

NSAIDS for Treatment of Lower Abdominal Strains

Recommended.

NSAIDS are recommended for treatment of lower abdominal strains.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Level of Confidence – **Moderate**

Indications: Most patients with sufficient pain from lower abdominal strains needing medication.

Benefits: Reduced pain without functional impairments in a working-age population.

Harms: See also Hip OA for detailed discussion of cardiovascular risks, GI and other adverse effects, and counter measures. Negligible in working age population. Risks for GI bleeding especially if there are combinations of age, diabetes and/or inflammatory arthritis.

Frequency/Dose/Duration: Per manufacturer's recommendations. Generally scheduled use is advised for acute and moderate to severe-cases until recovery begins to occur at which point PRN use is more commonly used.

Indications for Discontinuation: recovery, adverse effects, intolerance, non-compliance

Rationale: There are no quality studies of NSAIDs for lower abdominal strains. Nonsteroidal anti-inflammatory medications are not invasive, have low adverse effects for a course of treatment in a working age population, are low cost and are recommended.

Devices

See Hip OA Guideline

Hot and Cold Therapies

ICE OR HEAT FOR TREATMENT OF LOWER ABDOMINAL STRAINS
Recommended.
Ice or heat is recommended for treatment of lower abdominal strains.
Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Most patients with sufficient pain from lower abdominal strains needing treatment and medication.
Benefits:	Ability to self-treat to reduce pain without functional impairments
Harms:	Negligible
Frequency/Dose/Duration:	Generally tailored according to severity and patient preferences. Use is generally greatest in the acute and peri-/post-operative stages and then tapered off as recovery occurs.
Indications for Discontinuation:	Recovery, adverse effects, intolerance, non-compliance
Rationale:	There are no quality trials of heat or cold treatments or ace wraps. These treatments are non-invasive, have negligible adverse effects, are low cost when self-applied, and are thus recommended.

Electrical Therapies
See Hip OA *Guideline*

Injections
See Hip OA *Guideline*

Surgical Considerations
See Hip OA *Guideline*

Rehabilitation Programs

THERAPY FOR TREATMENT OF LOWER ABDOMINAL STRAINS
Recommended.
Rehabilitation Programs
Therapy is recommended for treatment of lower abdominal strains.
Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Moderate**

Indications:	Most patients may benefit from a course of therapy, but particularly those with strength deficits and/or significant functional impairments. Thus, lower abdominal strains, generally at least moderate in severity. Mild cases usually resolve with elimination of exposure(s), NSAIDs, and time.

Benefits:	Facilitate earlier recovery, address functional deficits, and facilitate graded increase in activity as recovery occurs.
Harms:	Negligible; rarely significant worsening with therapy.
Frequency/Dose/Duration:	Generally, 1-2 appointments/week, with sets of 6-8 appointments ordered. Another set of appointments is a consideration if there is lack of complete objective recovery or failure to reach an acceptable plateau. Another set of 6-8 appointments would rarely be indicated if there was ongoing objective evidence of improvement after 12-16 appointments.
Indications for Discontinuation:	Full recovery, completion of a course of therapy and reaching a plateau in healing, non-compliance
Rationale:	There are no quality studies of exercise. Exercise has low adverse effects, is generally low to moderate cost depending on the numbers of appointments, is able to address functional deficits, and is thus recommended.

Epididymo-Orchitis

Summary of Recommendations

Culturing Urine to Diagnose Epididymitis or Epididymito-orchitis ..... Recommended, Insufficient Evidence (I)
Work Limitations for Treatment of Epididymitis or Epididymo-orchitis ..... Recommended, Insufficient Evidence (I)
Bed Rest for Treatment of Epididymitis or Epididymo-orchitis ..... Not Recommended, Insufficient Evidence (I)
NSAIDS or Age-appropriate Antibiotics for Treatment of Epididymitis or Epididymo-orchitis ..... Recommended, Insufficient Evidence (I)
Ice or Intermittent Elevation for Treatment of Epididymitis or Epididymo-orchitis ..... No Recommendation, Insufficient Evidence (I)
Therapy for Treatment of Epididymitis or Epididymo-orchitis ..... Not Recommended, Insufficient Evidence (I)

Introduction

Epididymitis is an acute or chronic inflammation of the epididymis – the tube that collects sperm from the testicle and passes it to the vas deferens. Orchitis is an inflammation of the testicle. Epididymo-orchitis is an inflammation of both the epididymis and testicle. The vast majority of cases of epididymitis or combined epididymito-orchitis have infectious origins [3-14] [13, 1830]. More than 80% of cases in patients under ages 35 or 45 reportedly have *Chlamydia trachomitis* infections [4, 15] [1831, 1832]. Older patients tend to have gram-negative rod infections [3, 12], as do those who have had vasectomies, other urological procedures, a history of prostatitis, or have engaged in anal intercourse [4, 16, 17]. A few cases have been attributed to amiodarone [18, 19].

There is a small, but not insignificant, minority of patients who report a history of a heavy lift or strain that precipitated the symptoms [20-23], thus giving rise to the possibility that this entity may sometimes be an occupational disease or injury [24-28] outside of the obvious setting of direct work-related trauma [29]. Proposed mechanisms are reflux of urine in the course of the strain [23, 25, 30-32] [1833] or elicitation of symptoms from a latent infection [20]. In occupationally oriented medical clinics, patients whose jobs require heavy exertion appear to present more frequently with this diagnosis, whereas those with unequivocally non-occupational etiologies present less frequently [20, 25]. One industrial plant survey showed no difference in the frequency of epididymitis between wage and salary workers [16]. A case report noted a history of epididymal pain after lifting heavy lumber that was evaluated with a largely negative workup until, on aspiration of the epididymis, *Chlamydia trachomatis* was isolated [3]. There is no quality study that has documented negative infectious disease workups in these patients; thus, there is no definitive method to solve this question of work-relatedness.

Patients should be evaluated for testicular torsion (a surgical emergency), tumor, and genitourinary infections [26]. Those with evidence suggesting any of these other conditions should be referred to a primary health care provider or urologist. Criteria have been published for potentially occupational cases:

1. Recent history of lifting within 48 hours
2. No fever
3. Negative urinalysis
4. Vague pain in the lower abdomen
5. Tenderness of epididymis to palpation [24]

Diagnostic Recommendations

Culturing Urine to Diagnose Epididymitis or Epididymito-orchitis

Recommended.

Urine cultures are recommended for select patients to diagnose epididymitis or epididymito-orchitis.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications: Potentially all cases, and with a low threshold amongst many.

Benefits: Precision of diagnosis and direct treatment.

Frequency/Dose/Duration: Once

Rationale: There are no quality trials that address treatments for epididymitis or epididymo-orchitis. For this subset of patients, urine cultures are recommended, but there is no recommendation for or against the use of needle aspiration. Empiric treatment with age-appropriate and other risk factor-appropriate antibiotics (e.g., chlamydial coverage under 35 years, gram-negative over 35 years) is recommended [20, 24], as is treatment with NSAIDs (see NSAIDs for dose, frequency, and discontinuation information). Patients with a clinical course that does not resolve rapidly should be evaluated by a urologist.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Epididymitis, Epididymo-orchitis; diagnostic, diagnosis, sensitivity, specificity, positive predictive value, negative predictive value, and predictive value of tests, efficacy, and efficiency. We found and reviewed 85 articles in PubMed, 78 in Scopus, 27 in CINAHL, 40 in Cochrane Library, 7,550 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero of the articles considered for inclusion met the inclusion criteria.

Treatment Recommendations

Work and Activity Modifications

Work Limitations for Treatment of Epididymitis or Epididymo-orchitis

No Recommendation.

Work limitations are recommended for patients with moderate and severe epididymitis or epididymo-orchitis, especially with high job physical demands.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Moderate or severe epididymitis or epididymo-orchitis, particularly if the job physical demands are moderate or high.
Benefits:	Facilitate the ability to continue to be active, yet not perform significantly aggravating activities.
Harms:	
	Negligible
Indications for Discontinuation:	Resolution, sufficient recovery to allow performance of the job demands.
Rationale:	Work limitations may be necessary depending on the severity of the condition and the physical job demands, but have not been uniformly required [20]. Thus, they are recommended for those with more severe symptoms and particularly with moderate to high job physical demands (e.g., lifting).
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Epididymitis, Epididymo-orchitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 94 articles in PubMed, 1,002 in Scopus, 26 in CINAHL, 40 in Cochrane Library, 3,050 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria

Bed Rest for Treatment of Epididymitis or Epididymo-orchitis

Not Recommended.

Bed rest is not recommended for treatment of epididymitis or epididymo-orchitis.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **High**

Rationale:	Bed rest is not recommended due to concern regarding deep venous thrombosis, deconditioning, and other adverse effects. There are no quality studies that address ice or intermittent elevation to treat epididymitis or epididymo-orchitis; therefore, there is no recommendation for or against their use.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Epididymitis, Epididymo-orchitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 94 articles in PubMed, 1,002 in Scopus, 26 in CINAHL, 40 in Cochrane Library, 3,050 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Exercise

See Hip OA *Guideline*

Medications

NSAIDS or Age-appropriate Antibiotics for Treatment of Epididymitis or Epididymo-orchitis

Recommended.

NSAIDS or age-appropriate antibiotics are recommended for treatment of epididymitis or epididymo-orchitis.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **High**

Indications: If the etiology is infectious, antibiotics are considered essential. NSAIDs are helpful for pain relief.

Benefits: Treat the cause with antibiotics. Treat the symptoms with NSAIDs for the non-infectious cases.

Harms: Negligible for short courses in workers.

Frequency/Dose/Duration: One course

Indications for Discontinuation: Completion of course of antibiotics; sufficient recovery for NSAIDs.

Rationale: There are no quality trials that address treatments for epididymitis or epididymo-orchitis. For this subset of patients, urine cultures are recommended, but there is no recommendation for or against the use of needle aspiration. Empiric treatment with age-appropriate and other risk factor-appropriate antibiotics (e.g., chlamydial coverage under 35 years, gram-negative over 35 years) is recommended [20, 24], as is treatment with NSAIDs (see NSAIDs for dose, frequency, and discontinuation information). Patients with a clinical course that does not resolve rapidly should be evaluated by a urologist.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Epididymitis, Epididymo-orchitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 94

articles in PubMed, 1,002 in Scopus, 26 in CINAHL, 40 in Cochrane Library, 3,050 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Devices

See Hip OA *Guideline*

Hot and Cold Therapies

Ice or Intermittent Elevation for Treatment of Epididymitis or Epididymo-orchitis

No Recommendation.

There is no recommendation for or against the use of ice or intermittent elevation for treatment of epididymitis or epididymo-orchitis.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale: There are no quality trials that address treatments for epididymitis or epididymo-orchitis. Other treatments have included ice, intermittent elevation, and bed rest [24]. There are no quality studies that address ice, heat, or intermittent elevation to treat epididymitis or epididymo-orchitis; therefore, there is no recommendation for or against their use.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Epididymitis, Epididymo-orchitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 94 articles in PubMed, 1,002 in Scopus, 26 in CINAHL, 40 in Cochrane Library, 3,050 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Electrical Therapies

See Hip OA *Guideline*

Surgical Considerations

See Hip OA *Guideline*

Rehabilitation Programs

Therapy for Treatment of Epididymitis or Epididymo-orchitis

Recommended.

Therapy is not recommended for the treatment of epididymitis or epididymo-orchitis.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	There are no quality trials that address treatments for epididymitis or epididymo-orchitis. There is no clear rationale for use of therapy for this condition and thus there is no recommendation.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Epididymitis, Epididymo-orchitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 94 articles in PubMed, 1,002 in Scopus, 26 in CINAHL, 40 in Cochrane Library, 3,050 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Anesthesia/Analgesia Techniques

Summary of Recommendations

Surgical Wound Infiltration with Local Anesthetic ..... No Recommendation, Insufficient Evidence (I)
Posterior Lumbar Plexus Block ..... Recommended, Evidence (C)
Psoas Compartment Block (PCB) with or without I.V. Clonidine ... No Recommendation, Insufficient Evidence (I)
Regional Blocks – Caudal Block with Buprenorphine ..... Recommended, Evidence (C)
Femoral Nerve Block ..... Moderately Recommended, Evidence (B)
Epidural – Single Injection-Extended Release Epidural Morphine . Recommended, Insufficient Evidence (I)
Continuous Epidural Local Anesthetics Only ..... No Recommendation, Insufficient Evidence (I)
Spinal/Local Anesthetic Only ..... Recommended, Insufficient Evidence (I)
Spinal Continuous/Local Anesthetic ..... Recommended, Evidence (C)
Spinal – Clonidine in Combination with Local Anesthetics ..... Recommended, Evidence (C)
Spinal Infusion – Ziconotide ..... Moderately Not Recommended, Evidence (B)
Tropisetron for Control of Adverse Effects of Spinal Opioid Anesthesia ..... Not Recommended, Insufficient Evidence (I)
Spinal – Naloxone for Control of Respiratory Depression ..... Not Recommended, Evidence (C)
Nicardipine to Induce Hypotension ..... Not Recommended, Evidence (C)

Introduction

Major hip/knee surgery is most commonly performed under anesthesia delivery through one or more techniques, including general anesthesia, intrathecal (spinal) block, epidural block, and/or regional blocks. Unfortunately, high-quality trials of different techniques are rare with significant literature weaknesses and biases identified in Cochrane reviews (e.g., performance bias, detection bias, allocation concealment issues, dropouts, loss to follow-up, and incomplete outcomes data) that are present despite inclusion in those systematic reviews of a much wider range of surgeries (e.g., thoracotomy, breast cancer surgery) than merely those of the lower extremity [1834-1836]. Thus, selection of the best anesthesia technique is usually individualized based on underlying patient medical history and practitioner preferences.

Post-operative pain control is achieved through a wide number of techniques that are often combined, including parenteral opioid administration through patient-controlled anesthesia delivery systems (PCAs); single dose or continuous infusion of local anesthetic and/or opioids through intrathecal or epidural indwelling catheters; adjuvant regional blocks such as caudal block, femoral 3-in-1 block, psoas compartment block, facia iliaca compartment block, or lumbar plexus block; local infusion at the surgical site; and administration of oral medications such as opioids, non-steroidal anti-inflammatories and acetaminophen (see anesthesia evidence table

for RCTs reviewed related to major hip/knee surgery and anesthetic/analgesic technique for post-operative pain control).
Post-operative analgesia that attenuates pain and improves patient satisfaction in the immediate recovery period is the most common outcome measure found in quality literature. Poor pain control is thought to restrict rehabilitation and functional recovery. Two moderate-quality studies have shown a reduced hospital stay with adequate pain control versus comparison groups [872, 1837]. However, these studies were conducted in other health care systems and may not be applicable in the United States. In contrast, another quality study examining analgesia quality and functional improvement showed no difference in recovery of physical independence despite improved pain relief [1838]. The significance of pain control and long-term rehabilitation and functional outcomes measures appears somewhat uncertain, requiring further research.

Recommendations

Surgical Wound Infiltration with Local Anesthetic

No Recommendation.

Surgical Considerations

There is no recommendation regarding surgical wound infiltration with local anesthetic for major joint surgery.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**
Level of Confidence – **Low**

Rationale:	A moderate-quality study investigated if wound infiltration of ropivacaine prolongs the analgesia provided by bupivacaine/fentanyl spinal block compared with PCA morphine and ketorolac analgesia and showed reduced pain, rescue medication usage, and a nearly 2.5-day reduction in hospital stay [1837]. However, another trial found a lack of efficacy and no reduction in opioids consumption [1839]. As the quality studies substantially conflict, there is no recommendation, however, this technique has generally negligible adverse effects and so selective use especially if objective outcomes can be shown, may be reasonable pending resolution of the conflicts in the quality data.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Caudal Blocks with Buprenorphine, Posterior Lumbar Plexus Block, Psoas Compartment Block (PCB) with or without I.V. Clonidine, Surgical Wound Infiltration with Local Anesthetic, Femoral Nerve Block; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 103 articles in PubMed, 2132 in Scopus (Went through the first 150), 42 in CINAHL, 7 in Cochrane Library, 160 in Google Scholar, and 149 from other sources. We considered for inclusion 18 from PubMed, 14 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 2 from Google Scholar, and 20 from other sources. Of the 51 articles considered for inclusion, 38 randomized trials and 13 systematic studies met the inclusion criteria.

Posterior Lumbar Plexus Block

Moderately Recommended.

Medications (including topical creams)

Posterior lumbar plexus block is moderately recommended.

Strength of Evidence – **Recommended, Evidence (C)**

Level of Confidence – **Low**

Indications:	Need for anesthesia for lower extremity surgery.
Benefits:	Evidence suggests improved anesthesia compared with general [1840].
Harms:	Infrequent injuries to vasculature, nerves
Rationale:	A trial found superiority of a lumbar plexus block to general anesthesia [1840]. One trial reported a lumbar plexus block had adjunctive benefit to a PCA pump [1841]. One trial suggested a plexus block had comparable efficacy to a paravertebral block [1842]. However, one trial found a spinal had greater efficacy [1843]. As most trials found efficacy of a lumbar plexus block, this is recommended as an option for anesthesia for the lower extremity.
Rationale:	A high-quality study demonstrated lumbar plexus block improving pain control and reducing PCA morphine requirements up to 4 hours after surgery over sham block. Long-term reduction of morphine (24 hours) and reduced hospital stay trended positive, but the study lacked statistical power to reach significance [1844]. A moderate-quality study comparing posterior lumbar plexus block in general anesthesia patients demonstrated reduced postoperative analgesic requirements and reduced blood loss in both postoperative (170 mL vs. 310 mL) and intraoperatively (420 mL vs. 538 mL) [1845]. Another moderate-quality study demonstrated improved patient satisfaction and analgesia with a continuous lumbar plexus block compared with PCA morphine alone [1841]. Therefore, there is evidence that lumbar plexus block is effective for short-term pain control and may have the added benefit of reducing blood loss, although of limited clinical significance in most patients. Continuous lumbar plexus block may be an effective alternative to epidural or spinal analgesia.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Caudal Blocks with Buprenorphine, Posterior Lumbar Plexus Block, Psoas Compartment Block (PCB) with or without I.V. Clonidine, Surgical Wound Infiltration with Local Anesthetic, Femoral Nerve Block; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 103 articles in PubMed, 2132 in Scopus (Went through the first 150), 42 in CINAHL, 7 in Cochrane Library, 160 in Google Scholar, and 149 from other sources.

We considered for inclusion 18 from PubMed, 14 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 2 from Google Scholar, and 20 from other sources. Of the 51 articles considered for inclusion, 38 randomized trials and 13 systematic studies met the inclusion criteria.

Psoas Compartment Block With or Without Intravenous Clonidine

No Recommendation.

Medications (including topical creams)

There is no recommendation for or against the use of psoas compartment block (PCB) with or without intravenous clonidine.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale: There are a few quality studies that substantially conflict, and thus there is no recommendation. A moderate-quality study comparing psoas block to PCA morphine demonstrated no added benefit for psoas block except in the immediate 4 hours post-operatively [1846]. Another moderate-quality study demonstrated clonidine administered I.V. prolonged the duration of analgesia compared to perineural block and placebo [1847]. However, despite improvement in duration, there were no differences in analgesic requirements or pain scores, making the result of uncertain clinical significance.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Caudal Blocks with Buprenorphine, Posterior Lumbar Plexus Block, Psoas Compartment Block (PCB) with or without I.V. Clonidine, Surgical Wound Infiltration with Local Anesthetic, Femoral Nerve Block; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 103 articles in PubMed, 2132 in Scopus (Went through the first 150), 42 in CINAHL, 7 in Cochrane Library, 160 in Google Scholar, and 149 from other sources. We considered for inclusion 18 from PubMed, 14 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 2 from Google Scholar, and 20 from other sources. Of the 51 articles considered for inclusion, 38 randomized trials and 13 systematic studies met the inclusion criteria.

Regional Blocks

Caudal Block with Buprenorphine

Moderately Recommended.

Medications (including topical creams)

A caudal block with buprenorphine is moderately recommended.

Strength of Evidence – **Recommended, Evidence (C)**

Level of Confidence – **Low**

Indications: Caudal block needed for anesthesia for lower extremity surgery.
Benefits: Evidence suggests some efficacy with buprenorphine [1848].
Harms: Respiratory depression in addition to other risks of caudal blocks.
Frequency/Dose/Duration: The single trial added buprenorphine to bupivacaine [1848].
Rationale: A high-quality study comparing the addition of buprenorphine to bupivacaine caudal block provided increased duration of analgesia on average 8 hours (2 versus 10 hours); thus, it is selectively recommended [1848].
Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Caudal Blocks with Buprenorphine, Posterior Lumbar Plexus Block, Psoas Compartment Block (PCB) with or without I.V. Clonidine, Surgical Wound Infiltration with Local Anesthetic, Femoral Nerve Block; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 103 articles in PubMed, 2132 in Scopus (Went through the first 150), 42 in CINAHL, 7 in Cochrane Library, 160 in Google Scholar, and 149 from other sources. We considered for inclusion 18 from PubMed, 14 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 2 from Google Scholar, and 20 from other sources. Of the 51 articles considered for inclusion, 38 randomized trials and 13 systematic studies met the inclusion criteria.

Femoral Nerve Block

Recommended.

Medications (including topical creams)

Femoral nerve block is recommended, especially for hip fractures.

Hip fracture: Strength of Evidence – **Moderately Recommended, Evidence (B)**
Level of Confidence – **Moderate**

Other lower extremity surgery: Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications: Particularly effective in the emergency department for treatment of hip fractures with improved longer-term pain [1488, 1849-1852]. One trial reported a 3-in-1 femoral nerve block to be superior to standard care (Beaudoin 2013). One trial suggested a quadratus lumborum block was superior to the femoral nerve block [1853]. There is some evidence of efficacy for other lower extremity surgeries.
Benefits: Improved short- and longer-term pain management.
Harms: Rare nerve damage, arterial puncture.

Frequency/Dose/Duration: Most commonly accomplished as a 3-in-1 block, with epinephrine plus various combinations of anesthetics, and two others, commonly lidocaine, ropivacaine, or bupivacaine.

Rationale: All quality trials for treatment of hip fractures suggest short- and longer-term efficacy of femoral blocks [1488, 1849-1853] (Beaudoin 2013). One moderate quality trial suggested a quadratus lumborum block was superior to a femoral nerve block [1853]. Thus, the evidence is consistent that a femoral nerve block is effective for hip fracture patients and is recommended, including in the emergency department setting [1849].

There are far fewer trials among non-hip fracture patients and results are less impressive. Some trials reported short-term efficacy [1854-1856]. A few report results that suggest a lack of clear efficacy [1846, 1857] and one trial reported efficacy but significant problems with post-operative falls [1858]. Therefore, aside from hip fracture patients, there is limited evidence that femoral nerve block is modestly effective and is recommended for other lower extremity patients. The problem of post-operative falls in one relatively recent trial is concerning and deserves careful monitoring [1858].

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Caudal Blocks with Buprenorphine, Posterior Lumbar Plexus Block, Psoas Compartment Block (PCB) with or without I.V. Clonidine, Surgical Wound Infiltration with Local Anesthetic, Femoral Nerve Block; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 103 articles in PubMed, 2132 in Scopus (Went through the first 150), 42 in CINAHL, 7 in Cochrane Library, 160 in Google Scholar, and 149 from other sources. We considered for inclusion 18 from PubMed, 14 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 2 from Google Scholar, and 20 from other sources. Of the 51 articles considered for inclusion, 38 randomized trials and 13 systematic studies met the inclusion criteria.

Epidural Anesthesia/Analgesia

EPIDURAL – SINGLE INJECTION-EXTENDED RELEASE EPIDURAL MORPHINE

Recommended.

Surgical Considerations

An epidural injection of extended release morphine is selectively recommended.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Level of Confidence – **Low**

Indications: Lower extremity surgery in need of anesthesia

Benefits: Improved pain control and lower opioids requirements.

Harms:	Epidural injections can have major complications from bleeding when DVT prophylaxis is also instituted. Respiratory depression also requires monitoring. Nausea/vomiting is common with opioids.
Frequency/Dose/Duration:	One injection of an extended-release opioid, such as morphine. Clonidine may be used as an adjunct.
Rationale:	There is quality, placebo-controlled evidence that single epidural injection of extended release morphine results in reduced requirements for opioids [1859], also suggesting it is more effective than parenteral or oral opioid medications for post-operative analgesia in this group of patients. There is one high-quality study that shows significant pain relief over placebo for 48 hours with a single epidural injection of extended release epidural morphine [1859]. This technique has a primary advantage of eliminating the indwelling epidural catheter. There are no quality data comparing extended release epidural morphine to other opioid or opioid-local combination continuous infusions. There was a statistically significant increase in vomiting and pruritus versus placebo. There were an increased number of patients with respiratory depression, although not statistically significant. Another moderate-quality study [1860] demonstrated a single epidural bolus of 2 mg morphine (non-extended release) was superior to a single I.M. morphine 10 mg injection. Another moderate-quality study also suggests an additional benefit of pre-operative epidural opioid (morphine 75 µg/kg) injection in reducing physiological stress to surgery reflected by lower serum cortisol levels [1861]. However, either injections or catheters utilized when there is DVT prophylaxis have also been associated with major adverse effects. Thus, use of injections and catheters when patients are treated for DVT prophylaxis should be carefully considered and balanced with the adverse risks and highly select use is recommended with careful monitoring of adverse effects.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Epidural Anesthesia-Analgesia; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 299 articles in PubMed, 264 in Scopus, 17 in CINAHL, 5 in Cochrane Library, 14300 in Google Scholar, and 13 from other sources. We considered for inclusion 7 from PubMed, 0 from Scopus, 3 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 13 from other sources. Of the 24 articles considered for inclusion, 16 randomized trials and 8 systematic studies met the inclusion criteria.

CONTINUOUS EPIDURAL LOCAL ANESTHETICS ONLY

No Recommendation.

There is no recommendation for continuous epidural infusion of local anesthetics.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Level of Confidence – **Low**

Rationale:	A high-quality study demonstrated adequate post-operative pain relief without detectable motor blockade using a high concentration of levobupivacaine (0.25%) [1838]. A moderate-quality study showed continuous infusion of bupivacaine provided significantly better analgesia than PCA morphine, and allowed patients to be discharged sooner from the post-anesthesia care unit [1862]. Another moderate-quality study demonstrated epidural ropivacaine at multiple rates of infusion was superior to PCA morphine in all doses, and suggested an optimal dose of 10 mL/hr of 0.2% to limit adverse effects of urinary retention and hypotension [1863]. There are no quality studies comparing local anesthetic infusions to combination local-opioid infusions, or to other local anesthetic agents (i.e., bupivacaine versus levobupivacaine). Continuous epidural local anesthetics may provide effective post-operative analgesia, and theoretically may provide an alternative to opioid analgesia for patients who have contraindications. However, epidural catheters and injections in the presence of DVT prophylaxis are associated with potentially severe adverse effects and a high adverse effect profile for hypotension has been reported [1838]. Therefore, there is no recommendation for or against use of continuous epidural local anesthesia. There may be indications for highly selective use in this patient population.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Epidural Anesthesia-Analgesia; Acetabular Fracture, Femur Fracture, Hip-Pelvic fracture, latrogenic femoral fracture, occult hip fracture, hip fractures, trochanteric fractures, intertrochanteric fractures, sub trochanteric fractures, femoral neck fracture, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 299 articles in PubMed, 264 in Scopus, 17 in CINAHL, 5 in Cochrane Library, 14300 in Google Scholar, and 13 from other sources. We considered for inclusion 7 from PubMed, 0 from Scopus, 3 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 13 from other sources. Of the 24 articles considered for inclusion, 16 randomized trials and 8 systematic studies met the inclusion criteria.

Intrathecal Anesthesia/Analgesia

Spinal administration of local anesthetic and other medications is another technique for delivery of operative anesthesia and postoperative analgesia. Controlled trials of intrathecal (IT) administration of local anesthetics, opioids, and combinations of the two are available. Intrathecal analgesia, while effective, has a high incidence of manageable adverse effects, primarily pruritus, nausea, vomiting, urinary retention and respiratory depression. **However, epidural catheters and injections in the presence of DVT prophylaxis are associated with potentially severe adverse effects. Therefore, it is recommended for highly select use in patients who are without contraindications and who are closely monitored for adverse effects.**

SPINAL/LOCAL ANESTHETIC ONLY

Recommended.

Spinal/local anesthetic is recommended for use in patients who are without contraindications and who are closely monitored.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**
Level of Confidence – **Low**

Indications:	Need for spinal anesthesia for lower extremity surgery. However, some evidence suggests continuous spinal has better duration of anesthesia [1864].
Benefits:	Evidence suggests some efficacy, although there is a reported prolonged duration of anesthesia with continuous spinal [1864].
Harms:	The single comparative trial found continuous spinal anesthesia produced better hemodynamic stability during anesthesia induction compared with a spinal and PCA morphine for total hip arthroplasty [1864]. Spinals can have major complications from bleeding when DVT prophylaxis is also instituted.
Rationale:	There is one comparative trial of continuous spinal with a spinal and PCA morphine and found better analgesia and fewer induction-related complications [1864]. A spinal is invasive, has adverse effects, is high cost, and has some evidence of efficacy, although efficacy appears better with a continuous spinal; thus, a single spinal may be an option for a limited patient population, especially where there is a desire to not use a continuous spinal.
Rationale:	There are no quality studies of local anesthetic vs. saline placebo. However, many of the studies reviewed include intrathecal local anesthesia as a control arm. Intrathecal anesthesia generally with bupivacaine or ropivacaine provides post-operative analgesia for approximately 6 hours. Intrathecal anesthesia in most cases is enhanced by the use of opioid adjuvants. Therefore, intrathecal anesthesia with bupivacaine is effective in postoperative pain relief, but another technique is usually added to enhance duration and quality after the immediate post-operative period.
Evidence:	A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Intrathecal Anesthesia or Analgesia, Local Anesthetic, Continuous Anesthetic, Clonidine with Anesthetics, Ziconotide, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 360 articles in PubMed, 386 in Scopus, 2540 in CINAHL, 220 in Cochrane Library, 6620 in Google Scholar, and 18 from other sources. We considered for inclusion 4 from PubMed, 6 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 3 from Google Scholar, and 18 from other sources. Of the 32 articles considered for inclusion, 28 randomized trials and 4 systematic studies met the inclusion criteria.

Spinal Continuous/Local Anesthetic

Recommended.

Spinal continuous/local anesthetic is recommended for use in patients who are without contraindications and who are closely monitored.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Low**

Indications:

Need of spinal anesthesia for lower extremity surgery

Benefits: Prolonged duration of anesthesia [1864].

Harms: The single comparative trial found continuous spinal anesthesia produced better hemodynamic stability during anesthesia induction compared with a spinal and PCA morphine for total hip arthroplasty [1864]. Spinals can have major complications from bleeding when DVT prophylaxis is also instituted.

Rationale: There is one comparative trial of continuous spinal with a spinal and PCA morphine and found better analgesia and fewer induction-related complications [1864]. Other trials utilized continuous spinals in both treatment arms [1865, 1866]. Continuous spinals are invasive, have adverse effects, are high cost, have evidence of efficacy with a superior adverse effect profile, and thus are recommended as an option for lower extremity surgeries.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Intrathecal Anesthesia or Analgesia, Local Anesthetic, Continuous Anesthetic, Clonidine with Anesthetics, Ziconotide, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 360 articles in PubMed, 386 in Scopus, 2540 in CINAHL, 220 in Cochrane Library, 6620 in Google Scholar, and 18 from other sources. We considered for inclusion 4 from PubMed, 6 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 3 from Google Scholar, and 18 from other sources. Of the 32 articles considered for inclusion, 28 randomized trials and 4 systematic studies met the inclusion criteria

Spinal – Clonidine in Combination with Local Anesthetics

Recommended.

Spinals with clonidine are recommended for select use in patients who are without contraindications and who are closely monitored.

Strength of Evidence – **Recommended, Evidence (C)**
Level of Confidence – **Low**

Indications:

Spinal anesthesia for lower extremity surgery

Benefits: Prolonged duration of anesthesia [1866-1868] and some evidence of better quality of anesthesia [1867].

Harms: Most trials suggest no significant adverse effects. However, spinals can have major complications from bleeding when DVT prophylaxis is also instituted.

Frequency/Dose/Duration: Successful combinations used in trials include: (1) bupivacaine and ropivacaine 1 mg/mL, plus 1 mL sterile saline, plus 10 µg/mL clonidine [1867]; (2) 7.5 µg sufentanil and 30 µg clonidine in 2 mL NS [1866]; and (3) 0.5% Bupivacaine, 18 mg, plus clonidine 75 µg [1868].

Rationale: Multiple quality trials have assessed clonidine as an anesthesia adjunct for lower extremity surgery and most trials suggest prolongation of the anesthetic effect with low adverse effects [1866-1868]. The addition of clonidine has no additive invasiveness, has low adverse effects, has low added costs, has evidence of efficacy, and is thus recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Intrathecal Anesthesia or Analgesia, Local Anesthetic, Continuous Anesthetic, Clonidine with Anesthetics, Ziconotide, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 360 articles in PubMed, 386 in Scopus, 2540 in CINAHL, 220 in Cochrane Library, 6620 in Google Scholar, and 18 from other sources. We considered for inclusion 4 from PubMed, 6 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 3 from Google Scholar, and 18 from other sources. Of the 32 articles considered for inclusion, 28 randomized trials and 4 systematic studies met the inclusion criteria.

Spinal Infusion – Ziconotide

Moderately Not Recommended.

Medications (including topical creams)

Spinal infusion with ziconotide is moderately not recommended.

Strength of Evidence – **Moderately Not Recommended, Evidence (B)**

Level of Confidence – **Moderate**

Rationale: Continuous intrathecal infusion of ziconotide among hip/knee arthroplasty patients was compared with placebo in a high-quality RCT while using two different doses (7 µg/h versus 0.7 µg/h) [1869]. The high dose was demonstrated to be significantly more effective than placebo in analgesia. However, there was a high adverse effect profile that resulted in discontinuation of the higher dose. The lower dose was not statistically different than placebo. Therefore, ziconotide spinal infusion is not recommended at either of the doses in this study. Future studies may determine if there is an effective dose that balances adverse effects.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Intrathecal Anesthesia or Analgesia, Local Anesthetic, Continuous Anesthetic, Clonidine with Anesthetics, Ziconotide, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 360 articles in PubMed, 386 in Scopus, 2540 in CINAHL, 220 in Cochrane Library, 6620 in Google Scholar, and 18 from other sources. We considered for inclusion 4 from PubMed, 6 from Scopus, 0

from CINAHL, 1 from Cochrane Library, 3 from Google Scholar, and 18 from other sources. Of the 32 articles considered for inclusion, 28 randomized trials and 4 systematic studies met the inclusion criteria

Prevention of Adverse Effects

Tropisetron for Control of Adverse Effects of Spinal Opioid Anesthesia

Not Recommended.

Medications (including topical creams)

Tropisetron is not recommended for patients receiving spinal anesthesia.

Spinal – Naloxone for Control of Respiratory Depression

Not Recommended.

The addition of intravenous naloxone infusion in combination with local/opioid intrathecal infusion is not recommended.

Strength of Evidence – **Not Recommended, Evidence (C)**
Level of Confidence – **Low**

Rationale: A moderate-quality study compared ventilation in patients given intrathecal bupivacaine and morphine with and without I.V. naloxone. At 8 and 24 hours postoperatively, there were no significant differences between the comparison groups in ventilation [1870].

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Naloxone, respiratory insufficiency, respiratory depression narcan, evzio, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 42 articles in PubMed, 546 in Scopus, 374 in CINAHL, 19 in Cochrane Library, 14700 in Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

Nicardipine to Induce Hypotension

Not Recommended.

Medications (including topical creams)

Nicardipine to induce hypotension is not recommended.

Strength of Evidence – **Not Recommended, Evidence (C)**
Level of Confidence – **Low**

Rationale: A moderate-quality study demonstrated nicardipine to have no advantage over nitroprusside inducing deliberate hypotension during hip surgery to reduce blood loss [1871]. Nicardipine had cumulative and persistent effects after discontinuation. Therefore, nicardipine to induce hypotension is not recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: nicardipine, hypotension, hypertension, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 174 articles in PubMed, 91 in Scopus, 40 in CINAHL, 7 in Cochrane Library, 11900 in Google Scholar, and 2 from other sources. We

considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 3 articles considered for inclusion, 1 randomized trials and 2 systematic studies met the inclusion criteria.

Appendix 1: Low-quality Randomized Controlled Trials and Non-Randomized Studies

The following low-quality randomized controlled studies (RCTs) and other non-randomized studies were reviewed by the Evidence-based Practice Hip Panel to be all inclusive, but were not relied upon for purpose of developing this document's guidance on treatments because they were not of high quality due to one or more errors (e.g., lack of defined methodology, incomplete database searches, selective use of the studies and inadequate or incorrect interpretation of the studies' results, etc.), which may render the conclusions invalid. ACOEM's Methodology requires that only moderate- to high-quality literature be used in making recommendations [511].

Appendix 2: Antiemetics

A wide variety of antiemetic agents are administered by various routes to prevent and treat peri-operative nausea and vomiting [1872] [1873-1875] [1876] [1877] [1878-1880], including serotonin receptor antagonists (5HT3 and H1) [1878], dopamine receptor antagonists, substance P antagonists [1881], antihistamines, and anticholinergics [1882]. Less commonly used agents have included dexamethasone [1883], anticonvulsants [1884, 1885], [1886-1891], dimenhydrinate [1876], and neurokinin-1 receptor antagonists [1892]. The most commonly used antiemetics reportedly are droperidol, metroclopramide [1873], and ondansetron [1880]. Some systematic reviews suggest no clear superiority of any single antiemetic [1879, 1885].

Antiemetics

Recommended.

Medications (including topical creams)

Antiemetics are moderately recommended for peri-operative nausea and vomiting.

Strength of Evidence – **Moderately Recommended, Evidence (B)**

Level of Confidence – **High**

Indications: Pre-, peri- and post-operative nausea and emesis. Often used prophylactically either pre-operatively or at the end of the operative procedure when emesis is anticipated and/or has significant impacts on the type of surgical procedure/wound.

Benefits: Reduced, prevented, or resolved nausea and vomiting

Harms: Adverse effects vary based on type of medication. Common adverse effects include drowsiness, dry mouth, urinary retention, blurred vision, sedation, tremor.

Frequency/Dose/Duration: Per manufacturer recommendation. Most studies administered medication by I.V. at close of surgery with some studies administering medication immediately pre-operative. Routes used besides I.V. have included oral, PCA pump and I.M.. Rectal route is used typically as a tertiary strategy after common routes and/or combinations of medications have failed, although supportive quality studies were not found for PR administration. Medications and doses used in quality studies include (most given I.V.):

a. Aprepitant 40, 80, 125mg and 40mg postoperative
b. Cyclinzine 50mg.
c. Dimenhydrinate 50mg and 1mg/kg
d. Dolasetron mesylate 12.5, 25, 50, 100 mg
e. Droperidol 0.625, 1.25, 2.5, 5, 10, 15, 50mg and 0.014 micrograms/kg
f. Granisteron 0.1, 1, 3mg and 20, 40 micrograms/kg
g. Metoclopramide 10,20mg and 0.25mg/kg and 10mg PO

h. Ondansetron 1, 2, 4, 8mg and 100 micrograms/kg and 4, 8mg PO
i. Palonosetron 0.025, 0.05, 0.075mg
j. Perphenazine 5mg
k. Prochlorperazine 0.1,10mg
l. Ramosetron 0.15, 0.3, 0.6mg and 4 micrograms/kg and 0.1mg postoperative
m. Rolapitant 20, 70, 200mg
n. Tropisteron 2.5mg and 0.1mg/kg

Various combinations of agents have been used and generally suggest superiority over single agent approaches, thus providing potential tertiary treatment strategies for more difficult cases. Quality evidence supports combinations including Dolasetrong and Droperidol; Droperidol and Odansetron, and Dimenhydrate and Droperidol [1873].

Indications for Discontinuation: Resolution of symptoms

Rationale: There are multiple anti-emetic agents with demonstrated efficacy, although not all studies report efficacy. Anti-emetic agents are either non-invasive or minimally invasive depending on administration route, have low adverse effects, are mostly low cost, have demonstrated efficacy and are thus recommended.

Evidence: A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Antiemetics, Antiemetic Agents; Hip Osteoarthritis, Hip Degenerative Joint Disease, Hip Osteoarthrosis, Hip Degenerative Arthritis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 1119 articles in PubMed, 279 in Scopus, 14 in CINAHL, 38 in Cochrane Library, 497 in Google Scholar (Went through first 100), and 50 from other sources. We considered for inclusion 36 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 83 from other sources. Of the 119 articles considered for inclusion, 86 were randomized controlled trials and 33 systematics reviews.

Appendix 3: PICO Questions

Hip Osteoarthrosis

P Workers and/or patients with hip pain/suspected hip osteoarthrosis
I Antibodies for evaluating hip pain
C Are antibodies superior to other screening and testing tools for hip pain?
O Identification of hip pain and/or differentiating inflammatory rheumatic disorders from hip osteoarthrosis

P Workers and/or patients with hip pain/suspected hip osteoarthrosis
I C-Reactive Protein for evaluating hip pain
C Is the use of C-Reactive Protein superior to other screening and testing tools for hip pain?
O Identification of hip pain and/or differentiating inflammatory rheumatic disorders from hip osteoarthrosis

P Workers and/or patients with hip pain/suspected hip osteoarthrosis
I Erythrocyte Sedimentation Rates (ESRs) for evaluating hip pain
C Is the use of ESRs superior to other screening and testing tools for hip pain?
O Identification of hip pain and/or differentiating inflammatory rheumatic disorders from hip osteoarthrosis

P Workers and/or patients with hip pain/suspected hip osteoarthrosis
I Other Non-Specific Inflammatory Markers for evaluating hip pain
C Is the use of Other Non-Specific Inflammatory Markers superior to other screening and testing tools for hip pain?
O Identification of hip pain and/or differentiating inflammatory rheumatic disorders from hip osteoarthrosis.

P Workers and/or patients with hip pain/suspected hip osteoarthrosis
I Arthroscopic Examinations for evaluating hip osteoarthrosis
C Is the use of Arthroscopic Examinations superior to other screening and testing tools for hip osteoarthrosis
O Identification of hip pain and/or differentiating inflammatory rheumatic disorders from hip osteoarthrosis.

P Workers and/or patients with hip pain/suspected hip osteoarthrosis
I Bone Scans for evaluating hip pain
C Are Bone Scans superior to other screening and testing tools for hip pain?
O Identification of hip pain and/or assisting in the diagnosis of osteonecrosis, neoplasms, or other conditions with increased polyostotic bone metabolism

P Workers and/or patients with hip pain/suspected hip osteoarthrosis
I Cytokines for evaluating hip pain
C Are Cytokines superior to other screening and testing tools for hip pain?
O Identification of hip pain and/or differentiating inflammatory rheumatic disorders from hip osteoarthrosis

P Workers and/or patients with hip pain/ suspected hip osteoarthrosis

I Computerized Tomography for evaluating hip osteoarthrosis
C Is Computerized Tomography superior to other screening and testing tools for hip osteoarthrosis?
O Identification of hip pain and/or differentiating inflammatory rheumatic disorders from hip osteoarthrosis

P Workers and/or patients with hip pain, loss of function and/or suspected osteoarthrosis
I Computerized Tomography for evaluating recurrent post-arthroplasty dislocations

C Is Computerized Tomography superior to other screening tools for diagnosing recurrent post-arthroplasty dislocations?

O Identification of dislocations, hip pain and/or differentiating inflammatory rheumatic disorders from hip osteoarthrosis

P Workers and/or patients with hip pain/suspected osteoarthrosis
I Helical Computerized Tomography for evaluating hip pain
C Is Helical Computerized Tomography superior to other screening and testing tools for hip pain?
O Identification of hip pain and/or differentiating inflammatory rheumatic disorders from hip osteoarthrosis

P Workers and/or patients with hip pain/suspected osteoarthrosis
I Local Anesthetic Injections for evaluating hip pain
C Are Local Anesthetic Injections superior to other screening and testing tools for hip pain?
O Identification of hip pain etiology

P Workers and/or patients with suspected peripheral nerve entrapment
I Electromyography including Nerve Conduction Studies for evaluating hip pain/ peripheral nerve entrapments
C Are Electromyography/Nerve Conduction Studies superior to other screening and testing tools for peripheral nerve entrapments?
O Identification of peripheral nerve entrapment/hip pain etiology

P Workers and/or patients with hip pain/suspected osteoarthrosis
I Functional Capacity Evaluations for evaluating hip pain
C Are Functional Capacity Evaluations superior to other screening and testing tools for hip pain?
O Identification of hip pain etiology

P Workers and/or patients with suspected hip joint pathology including degenerative joint disease (DJD)
I Magnetic Resonance Imaging (MRI) for evaluating hip joint pathology including DJD
C Is MRI superior to other screening and testing tools for diagnosing hip joint pathology including DJD?
O Identification of hip joint pathology and/or DJD

P Workers and/or patients with hip pain/suspected osteoarthrosis
I Radiography for evaluating hip osteoarthrosis
C Are Radiographs superior to other screening and testing tools for hip osteoarthrosis?
O Identification of hip pain and/or differentiating inflammatory rheumatic disorders from hip osteoarthrosis

P Workers and/or patients with hip pain/suspected osteoarthrosis
I Ultrasound for evaluating hip osteoarthrosis
C Is Ultrasound superior to other screening and testing tools for hip osteoarthrosis?
O Identification of hip osteoarthrosis

P Workers and/or patients with hip osteoarthrosis who have a positive fall history
I Fall Protection Programs for preventing frequency of falls
C Are Fall Protection Programs effective for preventing recurrent falls?
O Prevention of recurrence of falls

P Workers and/or patients with hip and groin disorders
I Ergonomic Interventions for facilitation of recovery of hip and groin disorders
C Are Ergonomic Interventions effective for speeding recovery of hip and groin disorders?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Aerobic Exercise for treatment of hip osteoarthrosis
C Is Aerobic Exercise effective or superior to other interventions for symptoms hip osteoarthrosis?

O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Stretching Exercises for treatment of hip osteoarthrosis
C Are Stretching Exercises effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Strengthening Exercises for treatment of hip osteoarthrosis
C Are Strengthening Exercise effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Aquatic Therapy (Hydrotherapy) for treatment of hip osteoarthrosis
C Is Aquatic Therapy effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Tai Chi for treatment of hip osteoarthrosis
C Is Tai Chi effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Gait Training for treatment of hip osteoarthrosis
C Is Gait Training effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis requiring surgery
I Prophylactic Antibiotics for prevention of wound infections post hip surgery
C Is the use of Antibiotics effective for prevention of post-operative wound infections?
O Prevention of post-operative wound infections

P Workers and/or patients with hip pain/osteoarthrosis
I Norepinephrine Reuptake Inhibitors for treatment of hip pain
C Are Norepinephrine Reuptake Inhibitors effective or superior for treatment of hip pain
O Faster recovery/improved pain and function

P Workers and/or patients with hip pain/osteoarthrosis
I Selective Serotonin Reuptakes Inhibitors (SSRIs) for treatment of hip pain
C Are SSRIs effective or superior for treatment of hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip pain/osteoarthrosis
I Anticonvulsants including Gabapentin and Pregabalin for treatment of hip pain
C Are Anticonvulsants effective or superior for treatment of hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip pain/osteoarthrosis
I Preoperative or Perioperative Gabapentin for treatment of hip pain
C Is the use of Preoperative or Perioperative Gabapentin effective or superior for treatment of hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain

I Nonsteroidal Anti-inflammatory Drugs (NSAIDs) for treatment of hip pain
C Are NSAIDs effective or superior for treatment of symptoms hip osteoarthrosis/hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis and known cardiovascular disease and/or risk factors
I NSAIDs for treatment of hip osteoarthrosis in those with an increased cardiovascular disease history
C Are NSAIDs effective for treatment of hip osteoarthrosis and concomitant cardiovascular risk factors?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Acetaminophen for treatment of hip pain
C Is Acetaminophen effective or superior for treatment of symptoms hip osteoarthrosis/hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis and known cardiovascular disease and/or risk factors
I Acetaminophen for treatment of hip pain in those who also have cardiovascular risk factors
C Is Acetaminophen effective or superior for treatment of hip osteoarthrosis in those with cardiovascular risk factors?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Proton Pump Inhibitors for prevention of gastrointestinal adverse effects such as bleeding
C Are Proton Pump inhibitors effective for prevention of associated symptoms NSAID use
O Reduction of symptoms associated with the use of NSAIDs (such as bleeding) in hip osteoarthrosis

P Workers and/or patients with hip osteoarthrosis/hip pain
I Sucralfate for prevention of gastrointestinal adverse effects such as bleeding
C Is Sucralfate effective for prevention of associated symptoms NSAID use
O Reduction of symptoms associated with the use of NSAIDs (such as bleeding) in hip osteoarthrosis

P Workers and/or patients with hip osteoarthrosis/hip pain
I H2 Blockers for prevention of gastrointestinal adverse effects such as bleeding
C Are H2 Blockers effective for prevention of associated symptoms NSAID use
O Reduction of symptoms associated with the use of NSAIDs (such as bleeding) in hip osteoarthrosis

P Workers and/or patients with hip osteoarthrosis/hip pain
I Skeletal Muscle Relaxants for treatment of hip osteoarthrosis/hip pain not relieved by NSAIDs
C Are Skeletal Muscle Relaxants effective or superior for treatment of hip osteoarthrosis/hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Capsicum for treatment of hip osteoarthrosis/hip pain
C Is Capsicum effective or superior for treatment of hip osteoarthrosis/hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Topical NSAIDs for treatment of hip osteoarthrosis/hip pain
C Are Topical NSAIDs effective or superior for treatment of hip osteoarthrosis/hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Lidocaine Patch for treatment of hip osteoarthrosis/hip pain
C Are Lidocaine Patches effective or superior for treatment of hip osteoarthrosis/hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Eutectic Mixture of Local Anesthetics (EMLA)for treatment of hip osteoarthrosis/hip pain
C Is the use of EMLA effective or superior for treatment of hip osteoarthrosis/hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Miscellaneous Other Creams/Ointments for treatment of hip osteoarthrosis/hip pain
C Is the use of Other Creams/Ointments effective or superior for treatment of hip osteoarthrosis/hip pain?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Tumor Necrosis Factor (TNF), Alpha Blockers for treatment of hip osteoarthrosis/hip pain
C Is the use of TNF effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Nerve Growth Factor for treatment of hip osteoarthrosis
C Is the use of Nerve Growth effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Glucosamine Sulfate for treatment of hip osteoarthrosis
C Is Glucosamine Sulfate effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Chondroitin Sulfate for treatment of hip osteoarthrosis
C Is Chondroitin Sulfate effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Methylsulfonylmethane for treatment of hip osteoarthrosis
C Is Methylsulfonylmethane effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Complimentary/Alternative/Dietary Supplements for treatment of hip osteoarthrosis
C Are Complimentary/Alternative/Dietary Supplements effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Herbal/Other Preparations for treatment of hip osteoarthrosis
C Are Herbal/Other Preparations effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip pain/hip osteoarthrosis
I Canes and/or Crutches for assistance in individuals with hip pain/hip osteoarthrosis
C Are Canes and/or Crutches effective or superior to other devices for assistance with hip osteoarthrosis
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Orthotics for assistance in individuals with of hip pain/hip osteoarthrosis
C Is Glucosamine Sulfate effective or superior to other devices for assistance with hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Magnets/Magnetic Stimulation for treatment of hip osteoarthrosis
C Are Magnets effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Physical Therapy or Occupational Therapy for treatment of hip osteoarthrosis
C Is Physical Therapy or Occupational Therapy effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Manipulation for treatment of hip osteoarthrosis
C Is Manipulation effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Massage for treatment of hip osteoarthrosis
C Is Massage effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip pain
I Reflexology for treatment of hip osteoarthrosis
C Is Reflexology effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Cryotherapy (Home Use) for treatment of hip osteoarthrosis
C Is Cryotherapy effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Cryotherapy (Postoperative) for treatment of hip osteoarthrosis
C Is Postoperative Cryotherapy effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Diathermy for treatment of hip osteoarthrosis
C Is Diathermy effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/other hip pain
I Infrared Therapy for treatment of hip osteoarthrosis
C Is Infrared Therapy effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Ultrasound for treatment of hip osteoarthrosis
C Is Ultrasound effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Low-Level Laser Therapy for treatment of hip osteoarthrosis
C Is Low-Level Laser Therapy effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis/hip pain
I Low-Tech Heat Therapy (Self Applied) for treatment of hip osteoarthrosis
C Is Low-Tech Heat Therapy effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis or other hip pain
I Electrical Stimulation Therapies for treatment of hip osteoarthrosis and associated pain
C Are Electrical Stimulation Therapies effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Transcutaneous Electrical Stimulation (TENS) for treatment of hip osteoarthrosis
C Is TENS effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Acupuncture for treatment of hip osteoarthrosis
C Is Acupuncture effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Intraarticular Glucocorticosteroid Injection for treatment of hip osteoarthrosis
C Are Intraarticular Glucocorticosteroid Injection effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Intraarticular Hip Viscosupplementation Injections for treatment of hip osteoarthrosis
C Are Intraarticular Hip Viscosupplementation Injections effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Platelet-Rich Plasma Injections for treatment of hip osteoarthrosis
C Are Platelet-Rich Plasma Injections effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Prolotherapy for treatment of hip pain
C Is Prolotherapy effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis and other hip disorders
I Botulinum Toxin Injections for treatment of hip osteoarthrosis and other hip disorders
C Are Botulinum Injections effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Glucosamine Sulfate Intramuscular Injections for treatment of hip osteoarthrosis
C Are Glucosamine Sulfate Intramuscular Injections effective or superior to other interventions for symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis
I Glucosamine Sulfate Intraarticular Injections for treatment of hip osteoarthrosis
C Are Glucosamine Sulfate Intraarticular Injections effective or superior to other interventions or symptoms hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing surgery
I Preoperative Autologous Blood Transfusions for increasing red blood cell count pre-operative
C Are Preoperative Autologous Blood Transfusions effective for improving red blood cell counts preoperatively
O Faster recovery from surgery

P Workers and/or patients with hip osteoarthrosis undergoing surgery
I Hip Arthroplasty for treatment of hip osteoarthrosis
C Is Hip Arthroplasty effective or superior to other interventions for hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing surgery
I Bilateral Hip Arthroplasty for treatment of hip osteoarthrosis
C Is Bilateral Hip Arthroplasty effective or superior to other interventions (including single hip arthroplasty) for hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing surgery
I Metal-on-Metal Resurfacing Hip Arthroplasty for treatment of hip osteoarthrosis
C Is Metal-on-Metal Resurfacing Hip Arthroplasty effective or superior to other interventions for hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing surgery
I Osteotomy for treatment of hip osteoarthrosis
C Is Osteotomy effective or superior to other interventions for hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing surgery
I Acupuncture for Hip Arthroplasty for treatment of post-operative pain associated with hip surgery
C Is Acupuncture for Hip Arthroplasty effective or superior to other interventions for post-operative surgical hip pain?
O Faster recovery/improved pain and function/reduced opioid consumption

P Workers and/or patients with hip osteoarthrosis undergoing surgery
I Hip Resurfacing treatment of hip osteoarthrosis
C Is Hip Resurfacing effective or superior to other interventions for hip osteoarthrosis?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing hip surgery
I Preoperative Education prior to hip surgery
C Is Preoperative Education effective or superior in hip surgery patients?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing hip surgery
I Pre and Postoperative Rehabilitation prior to hip surgery
C Are Pre and Postoperative Rehabilitation effective or superior to other interventions in hip surgery
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing hip surgery
I Postoperative Exercise/Rehabilitation Program post hip surgery
C Is Postoperative Exercise/Rehabilitation effective or superior in hip surgery patients?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing hip surgery
I Late Postoperative Exercises for Patients with Significant Weakness and Unsteady Gait in rehabilitation post hip surgery
C Are Late Postoperative Exercises for patients with Significant Weaknesses and Unsteady Gait effective or superior to other rehabilitation interventions in hip surgery patients?
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing surgery
I Postoperative Work, Avocational Activities and/or Sports in rehabilitation post hip surgery
C Are Postoperative Work, Avocational Activities and/or Sports effective or superior to other rehabilitation interventions in hip surgery patients
O Faster recovery/improved pain and function

P Workers and/or patients with hip osteoarthrosis undergoing hip surgery
I VTE Prevention in of hip surgery patients
C Is VTE Prevention effective for prevention of venous thromboembolic disease in hip surgery patients?
O Decreased incidence of venous thromboembolic disease post hip surgery/faster recovery/improved pain and function

Hip Osteonecrosis

P Workers and/or patients with suspected hip osteonecrosis
I Bone Scanning with SPECT in evaluation of hip osteonecrosis
C Is Bone Scanning with SPEC effective or superior to other diagnostic tools in detection of hip osteonecrosis?
O Detection of hip osteonecrosis

P Workers and/or patients with suspected hip osteonecrosis
I Computerized Tomography (CT) for evaluation of hip osteonecrosis in patients with a contraindication to Magnetic Resonance Imaging (MRI)
C Is CT effective or superior to other diagnostic tools for the detection of hip osteonecrosis?
O Detection of hip osteonecrosis

P Workers and/or patients with suspected hip osteonecrosis
I Helical CT in evaluation of hip osteonecrosis
C Is Helical CT effective or superior to other diagnostic tools in the detection of hip osteonecrosis?
O Detection of hip osteonecrosis

P Workers and/or patients with suspected hip osteonecrosis
I MRI for evaluation of hip osteonecrosis
C Is MRI effective or superior to other diagnostic tools for the detection of hip osteonecrosis?
O Detection of hip osteonecrosis

P Workers and/or patients with suspected hip osteonecrosis
I Radiography for the evaluation of hip osteonecrosis
C Is Radiography effective or superior to other diagnostic tools in the detection of hip osteonecrosis?
O Detection of hip osteonecrosis

P Workers and/or patients with suspected hip osteonecrosis
I Ultrasound for the evaluation of hip osteonecrosis
C Is Ultrasound effective or superior to other diagnostic tools in the detection of hip osteonecrosis?
O Detection of hip osteonecrosis

P Workers and/or patients with hip osteonecrosis
I Avoidance of Dysbaric Activities/Symptom Provoking Activities of hip osteonecrosis
C Is Avoidance of Dysbaric Activities/Symptom Provoking Activities of hip osteonecrosis effective?
O Improved/modified disease course, faster recovery

P Workers and/or patients with hip osteonecrosis and coronary disease risk factors
I Aggressive Targeting of Coronary Disease Risk Factors in those with hip osteonecrosis
C Is Aggressive Targeting of Coronary Disease Risk Factors (Diabetes, Smoking, etc.,) in those with osteonecrosis effective?
O Improved/modified disease course, faster recovery

P Workers and/or patients with hip osteonecrosis
I Non-Weight Bearing Activities in treatment of hip osteonecrosis
C Are Non-Weight Bearing Activities effective or superior to other interventions for symptoms hip osteonecrosis?
O Improved/modified disease course, faster recovery

P Workers and/or patients with hip osteoarthrosis
I VTE Prevention in treatment of hip osteoarthrosis
C Is VTE Prevention effective or superior to other interventions for symptoms hip osteonecrosis?
O Improved/modified disease course, faster recovery

P Workers and/or patients with hip osteonecrosis
I Hyperbaric Oxygen in treatment of hip osteonecrosis
C Is Hyperbaric Oxygen effective or superior to other interventions for symptoms hip osteonecrosis?
O Improved/modified disease course, faster recovery

P Workers and/or patients with hip osteonecrosis
I Biphosphonates in treatment of hip osteoarthrosis
C Are Biphosphonates effective or superior to other interventions for symptoms hip osteonecrosis?
O Improved/modified disease course, faster recovery

P Workers and/or patients with hip osteonecrosis
I NSAIDs in treatment of hip osteonecrosis
C Are NSAIDs effective or superior to other interventions for symptoms hip osteonecrosis?
O Improved/modified disease course, faster recovery

Hip Fractures

P Workers and/or patients with suspected hip fracture
I CT in evaluation of suspected hip fracture
C Is CT effective or superior to other diagnostic tools for diagnosing hip fracture?
O Diagnosis of hip fracture

P Workers and/or patients with suspected hip fracture
I Helical CT in evaluation of suspected hip fracture
C Is Helical CT effective or superior to other diagnostic tools for diagnosing hip fracture?
O Diagnosis of hip fracture

P Workers and/or patients with suspected hip fracture
I MRI in evaluation of suspected hip fracture
C Is MRI effective or superior to other diagnostic tools for diagnosing hip fracture?
O Diagnosis of hip fracture

P Workers and/or patients with suspected hip fracture
I Ultrasound in evaluation of suspected hip fracture
C Is Ultrasound effective or superior to other diagnostic tools for diagnosing hip fracture?
O Diagnosis of hip fracture

P Workers and/or patients with hip fracture
I Ergonomics in treatment of hip fracture
C Is the implementation of Ergonomics Measures effective for hip fracture?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Fall Protection in treatment of hip fracture
C Is Fall Protection effective for hip fracture?
O Prevention of future hip fractures

P Workers and/or patients with hip fracture
I Bed Rest in treatment of unstable hip fracture
C Is Bed Rest effective or superior to other treatments for unstable hip fracture?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Biphosphonates in treatment of hip fracture
C Are Biphosphonates effective or superior to other interventions for treatment of hip fracture?
O Improved bone mass, reduction of subsequent fractures, faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Calcitonin in treatment of hip fracture
C Is Calcitonin effective or superior to other interventions for treatment of hip fracture?
O Improved bone mass, reduction of Subsequent fractures, faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I NSAIDs and Acetaminophen in treatment of hip fracture
C Are NSAIDs and/or Acetaminophen effective or superior to other interventions for treatment of hip fracture?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Hot and Cold Therapies in treatment of hip fracture
C Are Hot and Cold Therapies effective or superior to other interventions for treatment of hip fracture?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I TENS in Emergency Transport of hip fracture patients prior to receiving surgery
C Is TENS in Emergency Transport effective for hip fracture patients awaiting surgery?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Acupressure for Transporting hip fracture patients prior to receiving surgery
C Is Acupressure for Transporting hip fracture patients effective for patients awaiting surgery?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Fascia Iliaca Compartment Block (FICB) in Emergency Room Management of hip fracture prior to surgery
C Is FICB in Emergency Room effective for hip fracture patients awaiting surgery?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Surgery in treatment of hip fracture
C Is Surgery effective or superior to other interventions for treatment of hip fracture?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Arthroplasty in treatment of hip fracture
C Is Arthroplasty effective or superior to other interventions for treatment of hip fracture?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Hemiarthroplasty in treatment of hip fracture
C Is Hemiarthroplasty effective or superior to other interventions for treatment of hip fracture?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Systemic Antibiotics in treatment of hip fracture for postoperative wound infections
C Is a Single Day of Systemic Antibiotics effective for preventing postoperative wound infections?
O Reduction in both deep and superficial postoperative wound infections/faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Acupuncture in treatment of hip fracture (both preoperative and postoperative)
C Is Acupuncture effective or superior to other interventions for treatment hip fracture?
O Faster recovery/improved pain and function

P Compression Stockings for VTE Prevention in treatment of hip fracture
I Compression Stockings for VTE Prevention in treatment of hip fracture
C Are Compression Stockings effective or superior to other interventions for VTE Prevention in hip fracture?
O Prevention/Reduction of VTE, faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Lower Extremity Pumps for VTE Prevention in treatment of hip fracture
C Are Lower Extremity Pumps effective or superior to other interventions for VTE Prevention in hip fracture?
O Prevention /Reduction of VTE, faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Low Molecular Weight Heparin for VTE Prevention in treatment of hip fracture
C Is Low Molecular Weight Heparin effective or superior to other interventions for VTE Prevention in hip fracture?
O Prevention/Reduction of VTE, faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Factor Xa Inhibitors for VTE Prevention in treatment of hip fracture
C Are Factor Xa Inhibitors effective or superior to other interventions for VTE Prevention in hip fracture?
O Prevention/Reduction of VTE, faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Warfarin or Heparin for VTE Prevention in treatment of hip fracture
C Are Warfarin and/or Heparin effective or superior to other interventions for VTE Prevention in hip fracture?
O Prevention/Reduction of VTE, faster recovery/improved pain and function

P Workers and/or patients with hip fracture
I Aspirin in treatment of hip fracture
C Is Aspirin effective or superior to other interventions for VTE Prevention in hip fracture?
O Prevention/Reduction of VTE, faster recovery/improved pain and function

P Workers and/or patients with hip fracture who underwent surgery
I Postoperative Exercise and Rehabilitation in treatment of postoperative hip fracture patients
C Is Postoperative Exercise and Rehabilitation effective for treatment of postoperative hip fracture?
O Faster recovery/improved pain and function

P Workers and/or patients with hip fracture with other comorbidities
I Geriatric Unit in treatment of hip fracture in with other comorbidities
C Is placement in a Geriatric Unit effective or superior to other interventions in hip fracture patients with other comorbidities?
O Faster recovery/improved pain and function

Femoroacetabular Impingement, "Hip Impingement" and Labral Tears

P Workers and/or patients with suspected hip impingement and/or labral tear
I MR Arthrogram for evaluation of suspected hip impingement and/or labral tear
C Is use of MR Arthrograms effective or superior to other tools for diagnosing hip impingement and/or labral tear?
O Diagnosis of hip impingement and/or labral tears

P Workers and/or patients with suspected hip impingement and/or labral tear
I Ultrasound for the evaluation of suspected hip impingement and/or labral tear
C Is Ultrasound effective or superior to other tools for diagnosing hip impingement and/or labral tear? fracture?
O Diagnosis of hip impingement and/or labral tear

P Workers and/or patients with hip impingement and/or labral tear
I Local Glucocorticoid Injections for hip impingement and/or labral tear
C Are Glucocorticoid Injections effective or superior to other interventions for treating hip impingement and/or labral tear?
O Faster recovery/improved pain and function

P Workers and/or patients with suspected or confirmed hip impingement and/or labral tear
I Hip Arthroplasty for Evaluating and/or Treating hip impingement and/or labral tear
C Is Hip Arthroplasty effective or superior to other tools/interventions for diagnosing and/or treating hip impingement and/or labral tear?
O Diagnosis of hip impingement and/or labral tear/faster recovery/improved pain and function

P Workers and/or patients with suspected hip impingement and/or labral tear
I Therapy post-Surgical Repair of hip impingement and/or labral tear for treatment
C Is Therapy post-Surgical Repair effective or superior to other interventions for the treatment of Impingement and/or labral tear?
O Faster recovery/improved pain and function

Gluteus Medius Tendinosis and Tears, Greater Trochanteric Pain Syndrome and Trochanteric Bursitis

P Workers and/or patients with suspected gluteus medius tendinosis, tears, or pain or bursitis
I MR Arthrogram for evaluating suspected gluteus medius tendinosis, tears, or pain or bursitis
C Is MR Arthrogram effective or superior to other tools for the diagnosis of gluteus medius tendinosis, tears, pain or bursitis
O Diagnosis of gluteus medius tendinosis, tears, greater trochanteric pain syndrome or bursitis

P Workers and/or patients with suspected gluteus medius tendinosis, tears, pain or bursitis
I Ultrasound for evaluating suspected gluteus medius tendinosis, tears, pain or bursitis
C Is Ultrasound effective or superior to other tools for the diagnosis of gluteus medius tendinosis, tears, pain or bursitis?
O Diagnosis of gluteus medius tendinosis, tears, greater trochanteric pain syndrome or bursitis

P Workers and/or patients with gluteus medius tendinosis, tears, pain or bursitis
I Activity Limitations for treatment of gluteus medius tendinosis, tears, pain or bursitis
C Are Activity Limitations effective for the treatment of gluteus medius tendinosis, tears, pain or bursitis?
O Faster recovery/improved pain and function

P Workers and/or patients with gluteus medius tendinosis, tears, pain or bursitis
I Progressive Exercise for acute, subacute or chronic gluteus medius tendinosis, tears or pain or bursitis
C Is Progressive Exercise effective or superior to other interventions for the treatment of gluteus tendinosis, tears, pain or bursitis?
O Faster recovery/improved pain and function

P Workers and/or patients with gluteus medius tendinosis, tears, pain or bursitis
I Glucocorticosteroid Injections for treatment of acute, subacute or chronic gluteus medius tendinosis, tears, pain or bursitis.
C Are Glucocorticosteroids effective or superior to other interventions for treatment of gluteus medius tendinosis, tears, pain or bursitis?
O Faster recovery/improved pain and function

P Workers and/or patients with gluteal medial tears
I Surgical Repair of gluteal medial tears
C Is Surgery effective or superior to other interventions for treatment of gluteal medial tears
O Faster recovery/improved pain and function

Hamstring Tears

P Workers and/or patients with suspected hamstring tear/strain or hip flexor strain
I Radiography in evaluation of hamstring tear
C Is Radiography effective or superior to other diagnostic tools for detection of hamstring tear?
O Diagnosis of hamstring tear

P Workers and/or patients with suspected hamstring tear/strain or hip flexor strain
I MRI in evaluation of hamstring tear
C Is MRI effective or superior to other diagnostic tools for detection of hamstring tear?
O Diagnosis of hamstring tear

P Workers and/or patients with suspected hamstring tear/strain or hip flexor strain
I Ultrasound in evaluation of hamstring tear
C Is Ultrasound effective or superior to other diagnostic tools for detection of hamstring tear?
O Diagnosis of hamstring tear

P Workers and/or patients with suspected hamstring tear/strain or hip flexor strain
I Work Limitations in treatment of hamstring tear/strain or hip flexor strain
C Are Work Limitations effective or superior to other interventions for treatment of hamstring tear/strain or hip flexor strain?
O Faster recovery/improved pain and function

P Workers and/or patients with hamstring tear/strain or hip flexor strain
I Bed Rest in treatment of hamstring tear/strain or hip flexor strain
C Is Bed Rest effective or superior to other interventions for treatment of hamstring tear/strain or hip flexor strain?
O Faster recovery/improved pain and function

P Workers and/or patients with hamstring tear/strain or hip flexor strain
I NSAIDs in treatment of hamstring tear/strain or hip flexor strain
C Are NSAIDs effective or superior to other interventions for treatment of hamstring tear/strain or hip flexor strain?
O Faster recovery/improved pain and function

P Workers and/or patients with hamstring tear/strain or hip flexor strain
I Ice/Heat/Wraps in treatment of hamstring tear/strain or hip flexor strain
C Are Ice/Heat/Wraps effective or superior to other interventions for treatment of hamstring tear/strain or hip flexor strain?
O Faster recovery/improved pain and function

P Workers and/or patients with hamstring tear/strain or hip flexor strain
I Therapy in treatment of hamstring tear/strain or hip flexor strain
C Is Therapy effective or superior to other interventions for treatment of hamstring tear/strain or hip flexor strain?
O Faster recovery/improved pain and function

P Workers and/or patients with hamstring tear/strain or hip flexor strain
I Surgical Repair of Hamstring Tear in treatment of hamstring tear/strain or hip flexor strain
C Is Surgery effective or superior to other interventions for treatment of hamstring tear/strain or hip flexor strain?
O Faster recovery/improved pain and function

Groins Strains, Sports Hernias, and Adductor-Related Groin Pain

P Workers and/or patients with suspected groin strains/sports hernia/adductor groin pain
I Radiography in evaluation of groin strains/sports hernia/adductor groin pain
C Is Radiography effective or superior to other tools for detection of groin strains/sports hernia/adductor groin pain?
O Diagnosis of muscle tear

P Workers and/or patients with suspected groin strains/sports hernia/adductor groin pain
I MRI in evaluation of groin strains/sports hernia/adductor groin pain
C Is MRI effective or superior to other tools for detection of groin strains/sports hernia/adductor groin pain?
O Diagnosis of muscle tear

P Workers and/or patients with suspected groin strains/sports hernia/adductor groin pain
I Ultrasound in evaluation of groin strains/sports hernia/adductor groin pain
C Is Ultrasound effective or superior as a tool for detection of groin strains/sports hernia/adductor groin pain?
O Diagnosis of muscle tear

P Workers and/or patients with groin strains/sports hernia/adductor groin pain

I Work Limitations in treatment of groin strains/sports hernia/adductor groin pain
C Are Work Limitations effective or superior to other interventions for treatment of groin strains/sports hernia/adductor groin pain?
O Faster recovery/improved pain and function

P Workers and/or patients with groin strains/sports hernia/adductor groin pain
I Bed Rest in treatment of groin strains/sports hernia/adductor groin pain
C Is Bed Rest effective or superior to other interventions for treatment of groin strains/sports hernia/adductor groin pain?
O Faster recovery/improved pain and function

P Workers and/or patients with suspected groin strains/sports hernia/adductor groin pain
I NSAIDs in treatment of groin strains/sports hernia/adductor groin pain
C Are NSAIDs effective or superior to other interventions for treatment of groin strains/sports hernia/adductor groin pain?
O Faster recovery/improved pain and function

P Workers and/or patients with suspected groin strains/sports hernia/adductor groin pain
I Ice/Heat/Wraps in treatment of groin strains/sports hernia/adductor groin pain
C Are Ice/Heat/Wraps effective or superior to other interventions for treatment of groin strains/sports hernia/adductor groin pain?
O Faster recovery/improved pain and function

P Workers and/or patients with groin strains/sports hernia/adductor groin pain
I Therapy in treatment of groin strains/sports hernia/adductor groin pain
C Is Therapy effective or superior to other interventions for treatment of groin strains/sports hernia/adductor groin pain?
O Faster recovery/improved pain and function

Meralgia Paresthetica

P Workers and/or patients with suspected meralgia paresthetica
I MRI Neurography in evaluation of suspected meralgia paresthetica
C Is MRI Neurography effective or superior to other tools for detection of meralgia paresthetica?
O Diagnosis of meralgia paresthetica

P Workers and/or patients with suspected meralgia paresthetica
I Nerve Conduction Studies in evaluation of suspected meralgia paresthetica
C Are Nerve Conduction Studies effective or superior to other tools for detection of meralgia paresthetica?
O Diagnosis of meralgia paresthetica

P Workers and/or patients with meralgia paresthetica
I Weight Loss/Avoidance of Aggravating Exposures/Loose Clothing in treatment of meralgia paresthetica
C Are Weight Loss/Avoidance of Aggravating Exposures/Loose Clothing effective or superior to other interventions for treatment of meralgia paresthetica?
O Reduction of paresthesia/faster recovery/improved pain and function

P Workers and/or patients with meralgia paresthetica
I NSAIDs in treatment of meralgia paresthetica
C Are NSAIDs effective or superior to other interventions for treatment of meralgia paresthetica?
O Reduction of paresthesia/faster recovery/improved pain and function

P Workers and/or patients with meralgia paresthetica
I Topical Lidocaine in treatment of meralgia paresthetica
C Is Topical Lidocaine effective or superior to other interventions for treatment of meralgia paresthetica?
O Reduction of paresthesia/faster recovery/improved pain and function

P Workers and/or patients with meralgia paresthetica
I Glucocorticosteroids in treatment of meralgia paresthetica
C Are Glucocorticosteroids effective or superior to other interventions for treatment of meralgia paresthetica?
O Reduction of paresthesia/faster recovery/improved pain and function

P Workers and/or patients with meralgia paresthetica
I Surgical Release in treatment of meralgia paresthetica
C Is Surgical Release of entrapped nerve effective or superior to other interventions for treatment of meralgia paresthetica?
O Reduction of paresthesia/faster recovery/improved pain and function

P Workers and/or patients with meralgia paresthetica
I Spinal Cord Stimulation in treatment of meralgia paresthetica
C Is Spinal Cord Stimulation effective or superior to other interventions for treatment of meralgia paresthetica?
O Reduction of paresthesia/faster recovery/improved pain and function

Lower Abdominal Strains

P Workers and/or patients with lower abdominal strain
I Urine Culturing in evaluation of lower abdominal strain etiology
C Is Urine Culturing effective or superior to other tools for detection of lower abdominal strain etiology?
O Rule out infectious etiology of abdominal strain

P Workers and/or patients with lower abdominal strain
I Bed Rest in treatment of lower abdominal strain
C Is Bed Rest effective or superior to other interventions for treatment of lower abdominal strain?
O Faster recovery/improved pain and function

P Workers and/or patients with lower abdominal strain
I Work Limitations in treatment of lower abdominal strain
C Are Work Limitations effective or superior to other interventions for treatment of lower abdominal strain?
O Faster recovery/improved pain and function

P Workers and/or patients with lower abdominal strain
I NSAIDs in treatment of lower abdominal strain
C Are NSAIDs effective or superior to other interventions for treatment of lower abdominal strain?
O Faster recovery/improved pain and function

P Workers and/or patients with lower abdominal strain
I Ice or Heat in treatment of lower abdominal strain
C Are either Ice or Heat effective or superior to other interventions for treatment of lower abdominal strain?
O Faster recovery/improved pain and function

P Workers and/or patients with lower abdominal strain
I Therapy in treatment of lower abdominal strain
C Is Therapy effective or superior to other interventions for treatment of lower abdominal strain?
O Faster recovery/improved pain and function

Epididymo-Orchitis

P Workers and/or patients with suspected epididymo-orchitis
I Urine Culturing in evaluation of lower epididymo-orchitis
C Is Urine Culturing effective or superior to other tools for detection of epididymo-orchitis?
O Diagnosis of epididymo-orchitis

P Workers and/or patients with epididymo-orchitis
I Work Limitations in treatment of epididymo-orchitis
C Are work Limitations effective or superior to other interventions for treatment of epididymo-orchitis?
O Faster recovery/improved pain and function

P Workers and/or patients with epididymo-orchitis
I Bed Rest in treatment of epididymo-orchitis
C Is Bed Rest effective or superior to other interventions for treatment of epididymo-orchitis?
O Faster recovery/improved pain and function

P Workers and/or patients with epididymo-orchitis
I NSAIDs in treatment of epididymo-orchitis
C Are NSAIDs effective or superior to other interventions for treatment of epididymo-orchitis?
O Faster recovery/improved pain and function

P Workers and/or patients with epididymo-orchitis
I Ice or Intermittent Elevation in treatment of epididymo-orchitis
C Are either Ice or Intermittent Elevation effective or superior to other interventions for treatment of epididymo-orchitis?
O Faster recovery/improved pain and function

P Workers and/or patients with epididymo-orchitis
I Therapy in treatment of epididymo-orchitis
C Is Therapy effective or superior to other interventions for treatment of epididymo-orchitis?
O Faster recovery/improved pain and function

Anesthesia/Analgesia Techniques

P Workers and/or patients undergoing hip/groin surgery
I Local Anesthesia Injections into the surgical wound to reduce post-operative opioid use
C Is Local Anesthesia effective or superior for reduction of opioid use in hip/groin surgical patients?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Posterior Lumbar Plexus Block versus standard anesthesia for post-operative pain control
C Is Posterior Lumbar Plexus Block effective or superior to other anesthesia for treatment of post-operative hip/groin pain?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Psoas Compartment Block (PCB) in treatment of post-operative pain
C Is PCB effective or superior to other anesthesia for treatment of post-operative hip/groin pain?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Regional Block/Caudal Block with added Buprenorphine to Bupivicaine in treatment of post-operative pain
C Is Regional Block/Caudal Block (Buprenorphine added to Bupivicaine) effective or superior to other interventions for treatment of post-operative hip/groin pain
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Femoral Nerve Block in treatment of post-operative pain
C Is Femoral Nerve Block effective or superior to other interventions for treatment of post-operative hip/groin pain?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/pain surgery
I Epidural (Single Injection Extended Release Morphine) in treatment of post-operative hip/groin pain?
C Is a Single Injection Extended Release Morphine Epidural effective or superior to other interventions for treatment of post-operative hip/groin pain?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Continuous Epidural Infusion with Local Anesthetics in treatment of post-operative hip/groin pain
C Is Continuous Epidural Infusion effective or superior to other interventions for treatment of post-operative hip/groin pain?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Intrathecal Anesthesia in treatment of post-operative hip/groin pain
C Is Intrathecal Anesthesia effective or superior to other interventions for treatment of post-operative hip/groin pain
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Is Continuous Intrathecal Anesthesia in treatment of post-operative hip/groin pain
C Is Continuous Intrathecal Anesthesia effective or superior to other interventions for treatment of post-operative hip/groin pain?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Combination Intrathecal Anesthesia with Clonidine Infusion in treatment of post-operative hip/groin pain
C Is Combination Intrathecal Anesthesia with Clonidine Infusion effective or superior to other interventions for treatment of hip/groin pain?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Combination Intrathecal Anesthesia Infusion with Ziconotide in treatment of post-operative hip/pain
C Is Combination Intrathecal Anesthesia with Ziconotide Infusion effective or superior to other interventions for treatment of post-operative hip/groin pain?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Tropisetron for Adverse Effect Prevention of Spinal Opioids in treatment of post-operative hip/groin surgery
C Is Tropisetron effective or superior to other interventions for prevention of spinal opioid adverse effects?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Spinal-Naloxone for Prevention of Respiratory Depression in hip/groin surgery
C Is Spinal Naloxone effective or superior to other interventions for treatment of respiratory depression post-operatively in hip/groin surgery?
O Faster recovery/improved post-operative pain control/decreased post-operative opioid consumption

P Workers and/or patients undergoing hip/groin surgery
I Nicardipine for minimalization of blood loss in hip/groin surgery
C Is Nicardipine effective or superior to other interventions for inducing hypotension in hip/groin patients to decrease blood loss?
O Faster recovery, decreased blood loss

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