AMERICAN COLLEGE OF OCCUPATIONAL AND ENVIRONMENTAL MEDICINE

Eye Disorders

Effective December 22, 2025

TABLE OF CONTENTS

SUMMARY OF RECOMMENDATIONS

The Evidence-based Practice Panel's recommendations are based on critically appraised higher-quality research evidence and on expert consensus observing First Principles when higher-quality evidence is unavailable or inconsistent (see Methodology). The reader is cautioned to utilize the more detailed indications, specific appropriate diagnoses, temporal sequencing, preceding testing, and noninvasive treatment options that are elaborated in more detail for each test or treatment in this guideline when using these recommendations in clinical practice or medical management. These recommendations are not simple "yes/no" criteria.

All ACOEM guidelines include analyses of numerous interventions, whether or not FDA-approved. For non-FDA-approved interventions, recommendations are based on the available evidence; however, this is not an endorsement of their use.

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

Adenovirus Screening	Adenovirus Screening for Infectious Conjunctivitis	Recommended, Evidence (C)
Anesthetics	Topical Anesthetics for Eye Injuries	No Recommendation, Insufficient Evidence (I)
Antibiotics	Antibiotics for Bacterial Conjunctivitis and Bacterial Infections Complicating Corneal Ulcers	Moderately Recommended, Evidence (B)
	Antibiotics for Blepharoconjunctivitis	No Recommendation, Insufficient Evidence (I)
	Antibiotics for Viral Conjunctivitis	Not Recommended, Insufficient Evidence (I)
	Prophylactic Ophthalmic Antibiotics for Organic Matter Injuries	Recommended, Insufficient Evidence (I)
	Prophylactic Ophthalmic Antibiotics for Simple Corneal Abrasion, Rust Rings, and Foreign Bodies	No Recommendation, Insufficient Evidence (I)
Antiemetics	Antiemetics for Eye Injuries	See the ACOEM Antiemetics Guideline
	Antiemetics for Pterygium	See the ACOEM Antiemetics Guideline

Antifungals	Antifungal Medications for Fungal Conjunctivitis and Fungal Infections Complicating Corneal Ulcers	Recommended, Evidence (C)
	Prophylactic Ophthalmic Antifungals for Corneal Abrasions, Rust Rings, and Foreign Bodies	Not Recommended, Insufficient Evidence (I)
Antihistamines	Antihistamine and/or Mast Cell Stabilization Medications for Allergic Diseases	Strongly Recommended, Evidence (A)
Artificial Tears	Artificial Tears or Lubrication for Ocular Chemical Burns	Recommended, Insufficient Evidence (I)
	Artificial Tears or Lubrication for Eye Injuries	Recommended, Insufficient Evidence (I)
	Artificial Tears or Lubrication for Thermal Ocular Burns	Recommended, Insufficient Evidence (I)
Computed Tomography	Computed Tomography (CT) for Ocular Foreign Bodies	Recommended, Insufficient Evidence (I)
	Computed Tomography (CT) for Eye Injuries	Strongly Recommended, Evidence (A)
Contact Lenses	Therapeutic Contact Lens for Corneal Abrasions	Not Recommended, Evidence (C)
	Therapeutic Contact Lens for Corneal Lacerations	Recommended, Insufficient Evidence (I)
	Therapeutic Contact Lens for Rust Rings and Foreign Bodies	Not Recommended, Insufficient Evidence (I)
Culture and Sensitivity	Gram Stain for Eye Infections	Recommended, Evidence (C)
	Potassium Iodide for Eye Infections	Recommended, Evidence (C)
	Culture and Sensitivity of Eye Infections	Recommended, Evidence (C)
Education	Education on Eye Allergies	Recommended, Insufficient Evidence (I)
	Education on Eye Injuries	Recommended, Evidence (C)
Epidermal Growth Factor	Epidermal Growth Factor (EGF) for Corneal Abrasions	Not Recommended, Insufficient Evidence (I)
	Epidermal Growth Factor (EGF) for Rust Rings and Foreign Bodies	Not Recommended, Insufficient Evidence (I)
Exposure Reduction	Management of Allergic Eye Symptoms without Asthma (Reduction of Exposure)	Recommended, Insufficient Evidence (I)
Eye Patching	Eye Patching for Chemical Ocular Burns	Recommended, Insufficient Evidence (I)
	Eye Patching for Corneal Abrasion	Moderately Not Recommended, Evidence (B)

	Eye Patching for Thermal Ocular Burns	Recommended, Insufficient Evidence (I)
	Eye Patching for Welder's Flash	Not Recommended, Insufficient Evidence (I)
Foreign Body Removal	Removal of Superficial Eye Foreign Body with Cotton Swab, Needle, or Magnet	Recommended, Insufficient Evidence (I)
	Stabilization and Referral for Penetrating Traumatic Injury	Recommended, Insufficient Evidence (I)
Glucocorticosteroids	Adjuvant Glucocorticosteroids for Bacterial Conjunctivitis and Bacterial Infections Complicating Corneal Ulcers	Not Recommended, Insufficient Evidence (I)
	Glucocorticosteroid Drops for Chemical Ocular Burns	Recommended, Insufficient Evidence (I)
	Glucocorticosteroid Drops for Inflamed Pterygia or Pingueculae	Recommended, Evidence (C)
	Glucocorticosteroid Eye Drops for Eye Allergies	Recommended, Insufficient Evidence (I)
	Intracanalicular Devices with Glucocorticosteroids for Allergic Eye Disorders	No Recommendation, Insufficient Evidence (I)
	Intracanalicular Devices with Glucocorticosteroids for Postoperative Inflammation	Recommended, Insufficient Evidence (I)
	Glucocorticosteroids for Viral Conjunctivitis	Moderately Recommended, Insufficient Evidence (B)
Immunological Testing	IgG Specific Immunological Testing for High Molecular Weight Specific Antigens	No Recommendation, Insufficient Evidence (I)
	Low Molecular Weight Specific Antigens	No Recommendation, Insufficient Evidence (I)
	Specific Immunological Testing for Allergens	Strongly Recommended, Evidence (A)
Irrigation	Copious Eye Irrigation for Chemical Exposures	Recommended, Insufficient Evidence (I)
	Copious Eye Irrigation for Superficial Foreign Body Removal	Recommended, Insufficient Evidence (I)
	Copious Irrigation for Eye Thermal Burns	Recommended, Insufficient Evidence (I)
	Eye Irrigating Systems (Morgan Lens) for Chemical Exposure	Recommended, Insufficient Evidence (I)
	Irrigating Systems (Morgan Lens) for Eye Thermal Burns	Not Recommended, Insufficient Evidence (I)

Lid Hygiene	Daily Lid Hygiene for Blepharoconjunctivitis	Moderately Recommended, Evidence (B)
Magnetic Resonance Imaging	MRI for Eye Foreign Bodies and Corneal Abrasion	Not Recommended, Insufficient Evidence (I)
Medications, Other	Bevacizumab for Prevention of Pterygia Recurrence	Recommended, Evidence (C)
	Mydriatic Medications for Eye Injuries	Moderately Not Recommended, Evidence (B)
	Retinoic Acid for Adjunctive Treatment of Corneal Lacerations	No Recommendation, Insufficient Evidence (I)
	Topical Opioids for Analgesia after Eye Injury	Not Recommended, Evidence (C)
	Topical Aminocaproic Acid for Traumatic Hyphema	Moderately Recommended, Evidence (B)
	Tranexamic Acid for Traumatic Hyphema	Recommended, Evidence (C)
NSAIDS	Non-steroidal Anti-inflammatory Drugs for Viral Conjunctivitis	Not Recommended, Evidence (C)
	NSAID Drops after Removal of Rust Ring or Eye Foreign Body	Moderately Recommended, Evidence (B)
	NSAID Drops for Chemical Ocular Burns	Recommended, Insufficient Evidence (I)
	NSAID Drops for Inflamed Pterygia or Pingueculae	Recommended, Evidence (C)
	NSAID Eye Drops for Thermal Ocular Burns	Recommended, Insufficient Evidence (I)
	NSAID Eye Drops for Welder's Flash	Recommended, Insufficient Evidence (I)
	NSAID Eye Drops for Eye Allergies	Moderately Recommended, Evidence (B)
Protective Eyewear	Protective Eyewear for Prevention of Eye Injuries	Recommended, Evidence (C)
	Safety Glasses in Most Employment Settings	Recommended, Evidence (C)
	Safety Goggles, Face Shields and/or Splash Guards in High-Risk Jobs for Penetrating Eye Trauma or Chemical Splashes	Recommended, Insufficient Evidence (I)
Rust Ring Removal	Removal of Corneal Rust Ring	Recommended, Insufficient Evidence (I)
Screening	Color Vision Screening	Recommended, Evidence (C)
	Depth Perception Screening	Recommended, Insufficient Evidence (I)
	Peripheral Vision Screening	Recommended, Insufficient Evidence (I)
	Visual Acuity Screening	Recommended, Insufficient Evidence (I)

	Vision Screening	Recommended, Evidence (C)
Slit Lamp	Slit Lamp and Fluorescein Stain for Eye Foreign Body and Corneal Abrasion	Recommended, Insufficient Evidence (I)
Surgery	Pterygium Excision for Pterygia	Recommended, Evidence (C)
Transplantation	Amniotic Membrane Transplantation for Chemical Ocular Burns	Moderately Recommended, Evidence (B)
	Amniotic Membrane Transplantation with Medical Therapy for Thermal Ocular Burns	Recommended, Evidence (C)
	Corneal Transplantation for Blindness or Other Corneal Scarring/Defects after Chemical Eye Exposures	Strongly Recommended, Evidence (A)
X-ray	X-ray for Simple Ocular Abrasions, Rust Rings, and Nonpenetrating Foreign Bodies	Not Recommended, Insufficient Evidence (I)
	X-ray for Ocular Foreign Bodies	Recommended, Insufficient Evidence (I)
	X-ray for Evaluation of Orbital Fracture	Recommended, Insufficient Evidence (I)

WORKFLOWS

- Master Algorithm. ACOEM Guidelines for Care of Eye Disorders
- Algorithm 1. Care of Red Eye Disorders
- Algorithm 2. Initial Evaluation of Occupational Red Eye Disorders
- Algorithm 3. Initial and Follow-up Management of Non-red Flag Occupational Eye Disorders
- Algorithm 4. Evaluation of Slow-to-recover Patients with Occupational Eye Disorders (Symptoms >7 Days)
- Algorithm 5. Surgical Considerations for Patients with Persistent Visual Symptoms
- Algorithm 6. Further Management of Occupational Eye Disorders
- Algorithm 7. Visual Screening (Fitness-for-Duty Evaluation)
- Algorithm 8. Care of Eye Disorders - Blurred Vision
- Algorithm 9. Care of Eye Disorders - Visual Fatigue

INTRODUCTION

The Eye Disorders treatment guideline is designed to provide clinicians with evidence-based guidance on the treatment of working-age adults with potentially work-related eye disorders, whether acute, subacute, chronic, or postoperative. While the primary patient population target is working-age adults, the principles may apply more broadly.

This treatment guideline discusses the initial assessment and diagnosis of patients with eye injuries and disorders that are potentially work-related, identification of red flags that may suggest the presence of a serious underlying medical condition, initial management, diagnostic considerations, and special studies to identify clinical pathology, work-relatedness, modified duty and activity, and return to work, as well as further management considerations including delayed recovery. Algorithms for patient management are also included and schematize how to generally manage eye disorders. This guideline does not address eye disorders that are unlikely to be work-related, such as congenital disorders or malignancies. It also does not address specific intraoperative procedures. For patients with allergies who also have work-related asthma, the Occupational/Work-Related Asthma Guideline includes recommendations on exposure management of sensitizer-induced asthma, irritant-induced asthma, and criteria for removal from exposure.

The objectives of this guideline include baseline evaluations, diagnostic tests and imaging, return to work, medications, patching, injections, and operative procedures. Comparative effectiveness is addressed where available. To be more inclusive, this guideline includes some disorders that may not be considered work-related by certain jurisdictions. It excludes disorders that are considered to be entirely nonoccupational. It is recognized that there are differences in workers' compensation systems [1], prevalence of eye specialists and visual impairments [2, 3, 4], and regional differences in treatment approaches [5, 6, 7, 8].

The Evidence-based Practice Eye Panel and the Research Team have complete editorial independence from the American College of Occupational and Environmental Medicine and Reed Group, neither of which influenced the guidelines. The literature is routinely monitored and searched at least annually for evidence that would overturn this guidance. A detailed methodology document used for guideline development including evidence selection, scoring, incorporation of cost considerations [9, 10], and formulation of recommendations is available online as a full-length document and has also been summarized elsewhere [11, 12, 13].

The health questions for acute, subacute, chronic, and postoperative eye disorders addressed by this guideline include:

1. What diagnostic studies have been used for pre/placement examinations? Screening examinations?
2. What evidence supports the initial assessment and diagnostic approach?
3. What red flags signify serious underlying condition(s)?
4. What diagnostic approaches and special studies identify clinical pathology?
5. What initial treatment approaches have evidence of efficacy?
6. What is the evidence of work-relatedness for various diagnoses?
7. When is patching appropriate?
8. What modified duty limitations are effective and recommended?
9. When is return to work status recommended?
10. When initial treatment options fail, what evidence supports other interventions?

11. When and for what conditions are injections and other invasive procedures recommended?
12. When and for what conditions is surgery recommended?
13. Which surgeries are recommended for which conditions?

The classifications of *acute* (<1 month), *subacute* (1 to 3 months), and *chronic* (>3 months) are used in this guideline where appropriate and are based on commonly accepted durations.

Rationales for recommendations may refer to costs, which are defined as *low* (<$100), *moderate* ($100-$500), and *high* (>$500).

All evidence in the prior eye disorders guidelines garnered from four databases (Cochrane, PubMed, CINAHL, and Scopus) is included in this guideline. Additionally, new comprehensive searches for evidence were performed in those databases up through 2025 to help assure complete capture. There was no limit on year of publication. Search terms are listed with each table of evidence. Guidance was developed with sufficient detail to facilitate the assessment of compliance [9] and auditing/monitoring [10, 14]. Alternative options to manage conditions are provided.

Because few studies solely evaluate patients with work-related eye disorders, studies that include different populations were used to develop the recommendations. In addition, most studies that focus on pharmaceuticals, appliances, and specific devices are industry sponsored. In certain areas, this may have made little difference as the comparisons were between the medication and placebo and the results may be stark. However, in other studies, the comparison groups may have been suboptimally treated and produced a bias in favor of the medication or device. In addition, industry-sponsored studies have been shown to frequently have better results and lower complication rates than studies conducted by independent investigators.

This guideline has undergone extensive external peer review. This guideline includes all criteria for the AGREE II [10, 14], IOM criteria [9] AMSTAR 2 [15-19] and GRADE II [20, 21] criteria. In accordance with the IOM's Trustworthy Guidelines, detailed records are kept, including responses to external peer reviewers [9].

IMPACT

Population-based studies indicate that 23.4 million people (7.2%) in the general US population have either blindness or binocular visual correction less than 20/50, with both increasing rates with age and considerable differences based on race/ethnicity [22]. In the United States in 2015, 1.02 million individuals were reported to be blind, 3.22 million had visual impairment in the best corrected eye, and 8.2 million had visual impairment due to an uncorrected refracted error [23]. These prevalence measures are expected to approximately double by 2050 [23], particularly in Black/African American and Hispanic/Latino individuals [23].

The Centers for Disease Control and Prevention (CDC) has estimated that 12 million US adults over 40 years of age have blindness or visual impairments (visual fields less than 20 degrees and/or visual impairment of 20/40 or less) [24]. Approximately 16% of adults over age 40 have cataracts, 3% are blind (20/200 or less), and 2% have glaucoma [25]. Adequacy of

visual acuity is a major criterion for many jobs, and visual impairments have been associated with increased risks of injuries [26]. The UK's Department of Transportation reported that among those drivers ages 70+ years, 42% of motor vehicle-related injuries were due to sight problems, highlighting age-related risks [27]. Color deficiencies are common but highly variable; their prevalence rates also differ widely based on genetic factors, affecting approximately 8% of the male population with European ancestry [28, 29]. Color perception is a requisite criterion for numerous occupations; these specific occupational requirements vary widely depending on the commensurate specific workplace demands.

Globally, 160.7 million working-age people are estimated to have severe visual deficiencies (MSVI) or blindness. These individuals incur a 30.2% reduction in employment associated with a $410.7 billion loss in gross domestic product [30]. Causes of visual impairments range widely across the world [31].

The workplace is a common source of ocular injury [32] and emergency department surveillance data indicate males in their third decade of life have the highest incidence rates [33]. The highest risk occupations are in welding, farming, metalworking, grinding, construction, fishing, forestry, and manufacturing. CDC/NIOSH has estimated that there are over 2, 000 daily workplace eye injuries requiring medical treatment, of which 90% are preventable [24, 34]. In comparison, the US Bureau of Labor Statistics received reports of 18, 510 eye-related injuries and illnesses in 2020 [35], highlighting the differences between the occurrence of injuries and whether they are reportable and recordable. Chemicals are involved in an estimated 27% of US eye injuries [34]. A registry-based, multicenter South Korean study reported that 92% of 1, 424 severe eye injuries were among males and that 4.2% occurred despite use of protective eyewear [36]. Some permanent eye disability cases are also occupationally related. For example, disabling ocular injuries (8.5%) are reportedly the second most common injury in construction workers after low back pain (14.8%) [37].

The average cost of an occupationally-related eye injury has been estimated at $1, 463 (OSHA), although this is likely an underestimate due to inadequate inclusion of indirect costs to employers for rehiring and retraining replacement workers, the loss of productivity, reduced quality work, administrative costs, and losses to the patient and patient's family (including productivity at home). The National Safety Council reported a total worker's compensation cost (medical and indemnity) for eye injuries of $34, 560 in 2021-22; however, this category also includes face, teeth, and mouth injuries [38].

RISK AND CAUSATION

The etiology of most ocular injuries is noncontroversial. The eye is well innervated with nociceptors (pain sensation). The mechanism of injury and onset of symptoms is thus acute, noticeable, and readily discernible. Ocular diseases are naturally more challenging, with many factors producing ocular diseases such as pterygia and cataracts (see Work-Relatedness Guideline).

ACUTE TRAUMA

Determining the work-relatedness of ocular injuries (e.g., foreign bodies, rust rings, corneal lacerations, abrasions, contusions, hyphemas, burns, penetrating trauma) is not difficult because the mechanism of injury and acuity of symptom onset generally begets a straightforward determination of work-relatedness [24, 32-36, 39-61]. Chemical injuries are common [34, 62-75].

The construction industry has many reported risks for ocular injuries [74, 76-81]. Manufacturing is also a common industry with reportedly elevated risks [65, 74, 82, 83].

Welding-related tasks constituted an estimated 8.2% of all workers' compensation claims at the largest US workers' compensation insurer, with actual welding as the most common cause of occupational eye injury (38.5%), followed by grinding (17.5%), multiple tasks (3.8%), standing/walking/observing (3.4%), cleaning/brushing (3.3%), manual material handling (2.6%), and numerous other activities [39]. Employment in that study was most commonly in manufacturing (60.7%), construction (13.7%), services (12.1%), and wholesale/retail trade (5.9%).

NIOSH estimates that 90% of workplace eye injuries are preventable [24], and eyewear is believed to be strongly protective for eye injuries, although quality studies are sparse (likely largely due to the ease of implementation of eyewear programs) [42, 83-93]. Barriers to eyewear usage and/or injury reportedly include younger age [94], lack of comfort/fit [95], fogging [95], scratching of the eyewear [95], being rushed [96], fatigue [96], faulty equipment [96], foreign workforces [73, 97-100], and lack of safety training [94, 95, 101]. A case-crossover trial found unfamiliar work to be associated with a 57-fold increased risk for ocular injury [96]. An ecological study found an inverse relationship between unemployment conditions and risks of report of ocular injury [102].

Enucleation is a sequalae of severe work-related eye injuries [40, 103]. A university-based case series reported occupational causes in 13.5% of cases and motor vehicle crashes in 13.5% of cases [40]. Open globe injuries are similarly reported to commonly arise from occupational injuries [43, 47, 55, 73, 78, 91, 104-111].

WELDER'S FLASH (PHOTOKERATITIS)

Acute, unprotected ultraviolet radiation exposures (UV-A, UV-B, UV-C) burn the cornea and conjunctiva [112-118]. Welding is the most commonly reported exposure. Other reported examples include ultraviolet lamps for poultry abattoir disinfection [119], germicidal medical lamps [120], lasers, and damaged protective covers on mercury vapor lamps [121, 122, 123].

PTERYGIA

The worldwide prevalence of pterygia is estimated at 10.2-12% [124, 125], and there are strong ethnic risk factors [125]. Men have an approximately 7% higher risk for pterygia compared with women [125-127]. For individuals in their 40s to 60s, the risk for pterygia approximately doubles [127]. Cigarette smoking is estimated to reduce risk of pterygia by 18% [128]. Conjunctival tumors are more common among farmers compared with controls [129]. Outdoor activity has been associated with 46-76% higher risk of pterygia [125, 127, 130-137]. There is a 3.6-fold higher risk of pterygia among those living at latitudes of 0°-10° compared with those at 40°-50° [127]. Other reported risks include alcohol [125, 138], low educational status [138, 139, 140], high systolic blood pressure [141], dry eyes [138, 140], 53% lower for not using sunglasses [125, 138, 140], not using a hat [138, 140], light complexion [131], and dark complexion [137]. Outdoor occupations are associated with a 46% increased risk [125]. Use of sunglasses has been estimated to reduce risk 53% [125, 131].

RETINAL LASER-INDUCED DAMAGE

Lasers are highly variable in their intensity and ability to damage tissue [142-144]. Reports include associated retinal and other ocular damage [145-154] among military [155, 156, 157], those

Post-traumatic cataracts occur, although there is no classification system for these more heterogeneous cataracts. The outcomes are more varied, largely because of the diversity and severity of causes [235-237]. Prospective cohort data suggest that a recalled history of ocular injury was associated with increased risk of posterior subcapsular and cortical cataracts [238].

INITIAL ASSESSMENT

The principal recommendations for assessing and treating patients with eye complaints are as follows:

- Initial assessment should focus on detecting indications of potentially serious ocular pathology, termed red flags, and determining an accurate diagnosis. For these purposes, red flags are defined as a sign or symptom of a potentially serious condition indicating that further consultation, support, or specialized treatment may be necessary.
- In the absence of red flags, experienced clinicians can safely and effectively handle most work-related eye injuries. Conservative treatment can proceed for 48 to 72 hours for superficial foreign bodies, corneal abrasions, conjunctivitis, and ultraviolet radiation damage. Normally, eye tissues heal rapidly. If eye damage is not well on the way to resolution within 48 to 72 hours and the clinician is not experienced with the condition, referral to a specialist (i.e., ophthalmologist and optometrist typically for non-surgical eye injuries) is indicated.
- Ocular diseases and nonspecific eye complaints usually require longer treatment timelines.
- The treatment focus is on assuring optimal treatment, monitoring for complications, facilitating the healing process, and determining fitness for return to work in a modified- or full-duty capacity.

If the patient does not have red flags for serious conditions, the clinician may then determine which other eye disorder is present. The criteria presented in Table 1 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 any tests were needed to guide treatment at this stage.

Several symptoms and signs are common to a number of eye injuries or disorders (see Tables 2 and 3). Therefore, accurate diagnosis depends on linking the mechanism of injury or pathogenesis, symptoms, signs, and findings of the eye examination with findings on magnification and, if necessary, with fluorescein staining of the eye.

Special studies are not generally indicated during the first 2 to 3 days of treatment, except for in red flag conditions. Most patients with eye problems improve quickly once any red flag issues are ruled out. The clinical history and physical findings generally are adequate to diagnose the problem and provide treatment. If the patient's limitations due to eye symptoms, other than nonspecific symptoms, do not improve in 3 to 5 days, reassessment is recommended. After again reviewing the patient's limitations, history, and physical findings, the clinician may consider referral for further diagnostic studies and discuss these options with the patient. For patients with limitations after 3 to 5 days and unexplained physical findings, such as localized pain or visual disturbance, referral may be indicated to clarify the diagnosis and assist recovery.

Radiography of the globe may be indicated if the patient's history indicates the possibility of injury by a penetrating high-speed radiopaque foreign body. Ultrasonography can be used to locate non- and radiopaque foreign bodies. Computed tomographic (CT) scan of the orbit may be indicated in cases of significant blunt trauma and associated fractures at the time of initial evaluation and treatment. Magnetic resonance imaging (MRI) is never indicated when there may be a possibility of a metallic foreign body. Table 1 compares (generally) the abilities of different techniques to identify physiologic insult and define anatomic injury.

In the following lists, an asterisk (*) after a symptom or sign indicates a **red flag**.

SYMPTOMS OF RED EYE (SEE TABLE 2)

- **Blurred Vision.** Blurred vision often indicates serious ocular disease. Blurred vision that improves with blinking suggests a discharge or mucus on the ocular surface.
- **Visual Loss.** Any visual loss is a red flag.
- **Severe pain.*** Pain may indicate keratitis, ulcer, iridocyclitis, or acute glaucoma. Patients with conjunctivitis may complain of a scratchiness or mild irritation, but do not have severe pain.
- **Photophobia.*** Photophobia is an abnormal sensitivity to light that accompanies iritis. It may occur either alone or secondary to corneal inflammation. Patients with conjunctivitis have normal light sensitivity.
- **Colored halos.*** Rainbow-like fringes or colored halos seen around a point of light are usually a symptom of corneal edema, often resulting from an abrupt rise in intraocular pressure. Therefore, colored halos are a danger symptom suggesting acute glaucoma as the cause of a red eye.
- **Exudation.** Exudation, also called mattering, is a typical result of conjunctival or eyelid inflammation and does not occur with iridocyclitis or glaucoma. Patients often complain that their lids are "stuck together" on awakening. Corneal ulcer is a serious condition that may or may not be accompanied by exudate. Mucoid discharge generally is related to allergic conditions. Watery discharge may occur with viral conditions, and a purulent discharge is related to bacterial conditions.
- **Itching.** Although a nonspecific symptom, itching most commonly indicates an allergic conjunctivitis.

SIGNS OF RED EYE (SEE TABLE 3)

- **Reduced visual acuity.*** Reduced visual acuity suggests a serious ocular disease, such as an inflamed cornea, iridocyclitis, glaucoma, or vitreous hemorrhage. It never occurs in simple conjunctivitis unless the associated cornea is involved. Acceptable of passable visual acuity for driving and injuries without a known baseline is considered 20/40 or better in each eye separately and both eyes together.
- **Ciliary flush.*** Ciliary flush is an injection of the deep conjunctival and episcleral vessels surrounding the cornea. It is seen most easily in daylight and appears as a faint violaceous ring in which individual vessels cannot be seen by the unaided eye. These engorged vessels, whose origin is the ciliary body, are a manifestation of inflammation of the ciliary body and the anterior segment of the eyeball. Ciliary flush is a danger sign often seen in eyes with corneal inflammations, iridocyclitis, or acute glaucoma. Usually ciliary flush is not present in conjunctivitis.

- **Conjunctival hyperemia.** Conjunctival hyperemia is an engorgement of the larger and more superficial bulbar conjunctival vessels. A nonspecific sign, it may be seen in almost any of the conditions causing a red eye.
- **Corneal opacification.*** In a patient with a red eye, corneal opacities always denote disease. These opacities may be detected by direct illumination with a penlight, or they may be seen with a direct ophthalmoscope (with a plus lens in the viewing aperture) outlined against the red fundus reflex. Several types of corneal opacities may occur, including:
    - Keratic precipitates, or cellular deposits on the corneal endothelium, usually too small to be visible. Occasionally forming large clumps, these precipitates can result from iritis or chronic iridocyclitis.
    - A diffuse haze obscuring the pupil and iris markings. This may be characteristic of corneal edema. It is frequently seen in acute glaucoma.
    - Localized opacities. These may be due to keratitis or ulcer.
- **Corneal epithelial disruption.*** Disruption of the corneal epithelium, which occurs in corneal inflammations and trauma, can be detected in two ways. The first method uses fluorescein vital stain, which detects disruption of the epithelium.
    - The examiner should be positioned in such a way as to observe the reflection from the cornea of a single light source (e.g., window or penlight) as the patient moves his or her eye into various positions. Epithelial disruptions cause distortion and irregularity of the light reflected by the cornea. Apply fluorescein to the eye. Areas denuded of cells of the epithelium will stain a bright green with a blue filter.
    - The second method uses rose bengal vital stain, which detects degeneration or absence of one or more layers of the epithelium. The examiner should be positioned in the same manner as described above. Apply rose bengal vital stain. Diseased epithelium will stain a reddish purple color.
- **Pupillary abnormalities.*** The pupil in an eye with iridocyclitis typically is somewhat smaller than that of the other eye due to reflex spasm of the iris sphincter muscle. The pupil is also distorted occasionally by posterior synechiae, which are inflammatory adhesions between the lens and the iris. In acute glaucoma, the pupil is usually fixed, mid-dilated (about 5 to 6 mm), and slightly irregular. Conjunctivitis does not affect the pupil.
- **Shallow anterior chamber depth.*** In a red eye, a shallow anterior chamber (especially related to acute ocular pain, nausea, and sometimes vomiting) suggests the possibility of acute angle-closure glaucoma. Anterior chamber depth can be grossly estimated through side illumination with a penlight. The most exact technique and practice standard involves using a slit lamp with or without a diagnostic anterior segment contact lens. Intraocular pressure (IOP) is then measured.
- **Elevated Intraocular Pressure (IOP).*** IOP is unaffected by common causes of red eye other than iridocyclitis and glaucoma. In any red eye without obvious infection, IOP can be measured to rule out glaucoma as clinically indicated (routinely at the time of all eye screening examinations generally after age 40); however, under some circumstances, routine screening for IOP should be part of the examination.
- **Proptosis.*** Proptosis is a forward displacement of the globe. Proptosis of sudden onset suggests serious trauma, orbital infection, or tumor. The most common cause of chronic proptosis is thyroid disease, especially Grave's disease, and is bilateral. Orbital mass lesions also result in proptosis and should be considered. Proptosis may be accompanied by conjunctival hyperemia or limitation of eye movement. Small amounts of proptosis are detected most easily by standing behind a seated patient and looking downward to

compare the positions of the two corneas. Acute orbital proptosis secondary to trauma is an ophthalmologic emergency because it may cause severe pressure on the eyeball, which may lead to central retinal artery occlusion.

- **Preauricular nodes.** The type of ocular discharge may be an important clue to the cause of conjunctivitis. Preauricular node enlargement can be a prominent feature of common viral as well as some unusual varieties of chronic granulomatous conjunctivitis, known collectively as Parinaud's oculoglandular syndrome. Usually, such enlargement does not occur in acute bacterial conjunctivitis. The adenovirus is found most commonly, especially in epidemic keratoconjunctivitis, which generally is readily spread by direct contact with the secretions of affected individuals.

HISTORY

The patient will typically present with either: (i) an acute injury or event or (ii) an ocular disease. Acute injury or events generally have fairly simple mechanisms of injury that often beget a straightforward treatment approach (e.g., immediate irrigation for a chemical splash). If immediate treatment is not required, then a careful history and physical examination will commence to identify the most likely diagnosis of the patient's symptoms and signs.

Information obtained from a careful history and examination directs the approach to management. This section is separated into history elements for acute, ocular injury and for ocular diseases. However, it is recognized that there are many cases where both sets of questions are needed.

ELEMENTS OF THE HISTORY OF OCULAR INJURY

While a detailed, accurate history is essential in all injuries, it is especially important to obtain a detailed history of an ocular injury because incorrect or misleading information may lead to blindness. Such information may be obtained from a variety of sources, including the patient, the first responder(s), and others involved in or associated with the accident. Information for acute trauma should include the four Ws:

1. Where: Location of the accident
2. When: Time and date
3. Who: Other individuals involved
4. What: A detailed description of the accident circumstances, including force and load. If chemical exposure was involved, seek available Safety Data Sheet (SDS) information. Critical data include:
    a. What chemical (SDS information‡)
    b. Type of chemical (alkali, acid, solvent)
    c. Type of exposure (liquids, solids, fumes)
    d. Dose of exposure
    e. pH of the material
    f. Concentration of the material
    g. Solubility of the material
    h. Contact time
5. Emergency medical care provided by first responder(s), with information from:
    a. Product manufacturer
    b. Availability of chemical data
    c. Safety Data Sheets

d. Regional poison control center
e. Internet

ELEMENTS OF THE HISTORY OF OCULAR DISEASES

Asking open-ended questions generally allows the clinician to assess the primary focus for the visit, diagnose the condition more accurately, and identify a preferred treatment approach.

1. Do you wear glasses or contacts? Do you wear protective eyewear at work?
2. What are your symptoms?
   a. Are you experiencing pain? Sensitivity to light? Blurry vision? Loss of vision? Headache?
   b. Is your problem located primarily in the eye or near the eye? Do you have pain or other symptoms elsewhere? Nose? Sinus? Throat? Ear? Head?
   c. Are your symptoms constant? Intermittent? Resolve when not at work?
   d. What makes the problem worse or better?
3. How do these symptoms limit you?
   a. How long can you look at something?
   b. Can you see clearly?
4. When did your current limitations begin?
   a. How long has your vision been limited? More than a day or two?
   b. Have your symptoms changed? How?
5. Have you had similar episodes previously?
6. Have you had any previous testing or treatment? With whom?
7. What do you think caused the problem?
8. What are your specific job duties? How long do you spend performing each duty?
9. Do you have other medical problems? Diabetes? High blood pressure? Glaucoma?
10. What do you hope to accomplish during this visit?

The onset of a red eye, duration of the redness, and clinical course should be noted to help to distinguish the causative agents (see Table 4). The patient's chief complaint often identifies or suggests the cause of the red eye. For example, itching may signify allergies. A scratchy or burning sensation suggests lid, conjunctival, or corneal disorders, including foreign bodies, in-turning eyelashes, and dry eyes. Localized lid pain or tenderness is a common presenting complaint of a stye or an acute chalazion of the lid.

Deep, non-localizing, intense, aching pain may reflect disorders such as iritis, or acute glaucoma, as well as sinusitis, cluster headache, or ocular migraine. Photophobia suggests problems arising from the anterior segment of the eye, such as corneal abrasions, iritis, and acute glaucoma. A halo effect around lights is a sign of corneal edema commonly seen in acute glaucoma. Individuals who have corneal edema associated with contact lens wear may also experience halo vision.

PHYSICAL EXAMINATION

The eye examination differs somewhat based on whether the presenting problem is an acute, discrete injury or an occupational disease (including red eye not due to trauma).

A comprehensive examination is preferred in patients with ocular diseases. A more abbreviated and focused examination is typically initially performed for obvious, acute injuries. At a minimum, a visual acuity assessment is performed prior to any treatment. The main exception is with chemical injuries, where immediate irrigation is mandated.

OCULAR EXAMINATION FOR EYE INJURY

For chemical exposures, this examination usually occurs after decontamination or while it is in progress, if that is feasible. Otherwise, initial ocular (visual) screening is highly useful as the initial test of choice.

The examination of the injured eye should include the following:

1. Visual acuity (each eye separately) with best correction or pinhole
2. Inspection of the ocular structure (If an open globe is suspected, no pressure should be exerted on the globe.)
3. Position of the eyes and eye movements (six cardinal positions) if the globe is intact
4. Examination of the pupils for size and reaction to light
5. Gross visual fields by confrontation
6. Ophthalmoscopy
7. Intraocular pressure (IOP) determination if the globe is intact
8. Injury to lid(s) or other adnexal structures

It is important to make immediate referrals to the closest specialist when eye injuries exceed the treating clinician's capability. Make the patient comfortable (with intravenous analgesics, if necessary) and protect the eye from further injury by applying a rigid Fox shield or equivalent. Depending on the type of injury, transport the patient on a stretcher.

HOW TO EXAMINE FOR OCULAR DISEASE, INCLUDING RED EYE

Visual complaints from diseases, including red eye, are initially evaluated with a visual acuity chart, a penlight (slit lamp preferred), a tonometer, a sterile fluorescein dye strip, topical anesthetic drops, and an ophthalmoscope. Many clinics use a vision screening device screener, a noncontact “puff” tonometer, and a slit lamp or biomicroscope. A systematic approach to the examination is recommended, beginning by examining the face, orbital area, and lids and ending with a close view of the eyeball. The preferred method for examining the eyeball is with a slit-lamp biomicroscope and the ophthalmoscope.

The American Academy of Ophthalmology specifies nine diagnostic steps to use when evaluating a patient with a red eye [239, 240, 241, 242]:

1. Determine whether visual acuity is normal or decreased using a Snellen chart or (preferred) ETDRS chart at 20 feet or 6 meters, or the 1 meter ETDRS chart if required.
2. Inspect the pattern of redness present and determine whether it is due to subconjunctival hemorrhage, conjunctival hyperemia, ciliary flush, or a combination of these.
3. Ascertain the presence of conjunctival discharge and categorize it as to amount (profuse or scant) and character (purulent, mucopurulent, serous, or hemorrhagic).
4. Identify opacities of the cornea, including large keratic precipitates, or irregularities of the corneal surface, such as corneal edema, corneal leukoma (a white opacity caused by scar tissue), and irregular corneal reflection. Conduct the examination using a slit lamp

biomicroscope, or at least penlight and transilluminator. Biomicroscopy is the practice standard.

5. Search for disruption of the full thickness of the corneal epithelium by staining the cornea with fluorescein. Search for a lack of corneal epithelium vitality by staining with rose bengal.

6. Use a slit lamp (biomicroscope) to estimate the depth of the anterior chamber as normal or shallow and to detect any microscopic blood or white blood cells, which would indicate either hyphema or hypopyon, respectively. (A hypopyon is indicated by the presence of protein and white blood cells in the anterior chamber [e.g., when a corneal ulcer is present] and a hyphema is indicated by protein and red blood cells in the anterior chamber. These typically "layer" out in the inferior cornea.)

7. Detect irregularity of the pupils and determine whether one pupil is larger than the other. Observe the reactivity of the pupils to light to determine whether one pupil is more sluggish than the other or is nonreactive.

8. Determine whether the intraocular pressure is high, normal, or low by performing tonometry. This is especially important if acute angle closure glaucoma is suspected. (Tonometry is contraindicated when external infection or lack of globe integrity is obvious.)

9. Detect the presence of proptosis, lid malfunction, or any limitations of eye movement.

METHODS OF TESTING

Visual Acuity: Quantitative Bilateral Tests. Acuity is measured at infinity (as a minimum) and near and intermediate distances (based on job description) and is performed with and without corrective devices (e.g., glasses or contact lenses) and without removing other corrective devices (e.g., intraocular lenses).

Slit-Lamp Biomicroscopic Examination (aka, slit-lamp exam). Slit-lamp examination is the standard method of examining the eye. The slit lamp uses intense illumination and magnification.

How to Interpret the Findings of Red Eye. The associated signs and symptoms (see Tables 2 and 3) of various disorders overlap to some extent. Although many conditions may cause a red eye, several signs and symptoms signal greater concerns. The presence of one or more of these signals (i.e., a red flag) alerts the physician that the patient may have a disorder requiring definitive care that often includes referral if the examiner has insufficient experience with that particular condition. See Table 4 for differential diagnosis.

VISION AND DEPTH PERCEPTION SCREENING

Vision screening is performed for a wide range of purposes. Categories of vision screenings include pre-placement, periodic surveillance, post-injury and postoperative [243-245]. It is also performed for motor vehicle driver licensure. See also Tables 5 and 6.

VISION SCREENING

Recommended

Vision screening is recommended for jobs that require visual acuity for successful performance.

Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Occupations that require visual acuity for performance. Generally, most safety sensitive and safety critical jobs require corrected visual acuity of at least 20/40 in both eyes and each eye separately. Vision screening includes preplacement, periodic, post-injury and post-operative.

Rationale

Vision screening is widely performed as a component of essentially all eye-related examinations, most commonly with either a Snellen chart or a vision screening device that is comparable to a Snellen chart. For preplacement examinations, there are data to suggest increased risk of motor vehicle crashes with reduced visual acuity that is usually worse with 20/40 corrected (Wood et al., 1999, Gresset et al., 1994, Burg, 1966, Owsley et al., 2010), thus indirect evidence that both preplacement examinations and surveillance examinations are likely successful. Visual deficits also develop with ocular diseases (Xiong et al., 2020, Guymer et al., 2021, Kopplin et al., 2015, Alarcon Carrillo et al., 2023), providing further rationale for screening.

There are many protocols for screening, with the most frequent interval typically being either annual or biennial. For specific occupations, there is an absence of evidence of efficacy of visual screening, but strong belief it is successful. Occupation-specific visual acuity testing beyond Snellen tests is recommended for specific occupations (see Table 6). For postinjury and postoperative examinations, vision screening is used to track the recovery, but there are naturally no studies without vision screening being performed to assess its comparable utility.

Vision screening has some evidence of efficacy, is without adverse effects, is low cost and is thus recommended for pre-placement, periodic surveillance, post-injury, and postoperative examinations.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Vision Screening, visual Field Tests, preplacement examinations; eye diseases, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 4,000 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 4,000 articles, 132 in CINAHL, 110 in Cochrane Library, 18, 600 in Google Scholar, and 0 from other sources†. We considered for inclusion 3 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 3 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

COLOR VISION SCREENING

Color vision screening is commonly performed as a component of preplacement and periodic examinations. It is sometimes performed prior to return to work for post-injury and postoperative patients, particularly for those in safety critical jobs.

Color vision is critical for countless occupations that require varying degrees of color detection. Color vision testing is also performed for motor vehicle driver licensure. Color detection is commonly segregated into several discrete categories including normal, deuteranopia (difficulty detecting red/purple from green/purple), protanopia (difficulty detecting blue/green from red/green), tritanopia (difficulty detecting yellow/green from blue/green), and achromatopsia (absence of ability to detect colors) [246]. Although often categorized into these categories, there is an unappreciated and tremendous degree of heterogeneity within these groups. This heterogeneity has functional impacts such that some individuals within a given group can accurately perform a given occupation's tasks while others cannot [247, 248].

As an added complication, there is a widespread misconception that color signals are of uniform color hue when they are not. This produces further difficulties with determining safety to perform a given job. There is yet anothe common misperception that color detection is fixed for life, but multiple retinal intracranial diseases, metabolic disorders and pharmaceuticals all may result in serious, functional color vision impairments [249-254]. Such examples include diabetic retinopathy [253], multiple sclerosis [255, 256], chloroquine, and amiodarone [257-259]. There also are some decrements in color vision discrimination ability with aging [260], mercury toxicity [261], and use of petroleum-based solvents [262].

As an example of the consequences of failure to detect color vision deficiencies, acquired color vision deficiencies have resulted in transportation injury fatalities [263-265]. Yet, color

vision deficiency is also associated with advantages in discerning camouflaged objects, animals or humans [266, 267].

COLOR VISION SCREENING

Recommended

Color vision screening is recommended for jobs that require color vision detection.

Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Occupations that require color visual detection for accurate performance. Generally, most safety sensitive and safety critical jobs (e.g., air, rail, maritime, fire, police) require some degree of color detection, although the color discrimination requirements vary widely (e.g., greater color vision detection requirements for rail operations due to wide variations and non-standardized signal hues and distant signal detection requirements against widely varying backgrounds, than for trucking). These include almost all jobs requiring commercial operation of motorized equipment. There also are inspection jobs in manufacturing, electronics, electricians, graphic designers, painters, photographers, histopathologists, etc. that may require varying degrees of color discrimination. Preplacement and periodic screening is recommended for such job positions.

Color vision screening is not needed for jobs that do not require color vision detection. These include most jobs in healthcare, manufacturing, warehousing, construction, mining, agriculture, forestry, services, education and the retail trade sectors. Still there may be select jobs within those sectors where color vision detection is important, and in which case, screening to detect sufficient color discrimination for that specific job is important (e.g., a specific multi-colored product and/or where quality is linked to specific hues; red/yellow/green signal detection for vehicle operations on public streets; see Table 5.)

Pseudochromatic plates are generally the most efficient way to screen a population and are thus recommended. Functional tests (e.g., on-the-job test) are of unclear validity and, if used, must test a wide array of circumstances (e.g., array of representative hues to be encountered, time of day/night, varying backgrounds) to have the potential to be valid. The higher the degree of color discrimination and the greater the degree of color discrimination required, the more essential it is to periodically screen for color deficiency which can occur with various disorders (e.g., diabetic retinopathy) or as a complication of other factors such as aging and medications. Computerized tests are now widespread, required by the FAA; however, performance of some jobs requiring a high degree of discrimination may not be as easily tested with computers due to lack of standardization of hues.

Rationale

Color vision deficiency is well associated with increased failures on signal detection (Cole, 2004, Steward et al., 1989). Fatalities in the transportation sector have been attributed to

operator color vision deficiencies, including acquired deficiencies due to e.g., diabetic retinopathy (Abebe, 2002, Dille, 1976, Dille et al., 1980). Thus, there is a strong basis for screening for color vision deficiency. It is also noteworthy that the military has historically selected those with color vision deficiency for select tasks due to their superior camouflage (or animal) detection abilities among those with color vision deficiency (Morgan et al., 1992, Saito et al., 2006).

There are many color vision screening tests used, including: Ishihara, Farnsworth Panel D-15, Farnsworth Munsell 100 Hue (FM-100), Roth 28-hue desaturated, L'Anthony's desaturated D-15/D-15DS, Medmont C100, Color Assessment and Diagnosis Test; Nagel anomaloscope, Bowman's Color Confusion Index, Cambridge Colour Test (CCT), Color Assessment and Diagnosis test (CAD), Vingrys test, King-Smith's test, SPP-2, Nagel anomaloscope, Color Vision Testing Made Easy (CVMET); City University Colour Vision Test (CUT); Waggoner computerized color vision test (CCVT) Richmond Hardy-Rand-Rittler (HRR), American Optical Hardy-Rand-Rittler (AO-HRR), Malbrel's chromatometer and luminance perception; electronics; Lantern test (Hyon et al., 2005, Thyagarajan et al., 2007, Erb et al., 1998, LeSage, 1984, Ramaswamy et al., 2009, Vu et al., 1999, Rodrigues et al., 2007, Rodriguez-Carmona et al., 2012, Vingrys et al., 1988, Hackman, 2001, Huna-Baron et al., 2013, Ing et al., 1994, Seshadri et al., 2005, Shoji et al., 2009, Rabin et al., Abramov et al., 2009, Birch, 1997, Birch, 2008, Birch, 2010, McCulley et al., 2006, Cole et al., 2007, Cole et al., 2003, Ng et al., 2015, Gundogan et al., 2005, Cotter et al., 1999, Squire et al., 2005, Atchison et al., 1991, Aroichane et al., 1996, Hovis et al., 2000, Good, Ganley et al., 1997, Gaudart et al., 2005)(Walsh, 2016). The Lantern test has been reportedly insufficiently accurate for detecting type and severity of color vision deficiency (Bailey JE, 2004), with another quality study suggesting inferiority of the Beyne and Fletcher lantern tests (Marechal et al., 2018).

Testing has been either paper-based, incorporated with vision screening devices, and/or light signal-based. Recently, computerized/web-based applications for color vision detection have been increasingly used. Reports of computer-based color vision deficiency detection products mostly support their discriminant abilities with some suggesting superiority of the computer-based tests; however, the lack of standardization of color hues across computers and monitors renders their utility for safety critical work that requires a high degree of color discrimination questionable and unproven (Gao et al., 2023, Zhang, 2022, de Fez, 2018, Marey, 2014), although other reports suggest some limitations. Pseudoisochromatic plates are the most commonly administered tests used to screen for color deficiency, with Ishihara being the most widely used. Functional tests, such as the lantern test, a signal detection test, or on-the-job function tests are often used to attempt to ascertain sufficient discriminant abilities to perform a specific job after failure on pseudoisochromatic plate testing.

Functional tests have not been validated for determination of ability to both accurately perform the job tasks and prevent injuries/fatalities. Thus, they are generally of unclear ability to properly determine safe and accurate job performance. Carefully performed, functional testing that includes a wide array of circumstances likely to be encountered (e.g., variety of representative hues to be encountered, time of day/night, season of year, varying backgrounds behind a signal or light) may be sufficiently accurate for some jobs. The use of

unvalidated functional tests is particularly concerning for safety critical jobs. Validated functional tests should be validated for both accuracy under a wide array of performance circumstances (e.g., array of hues to be encountered, time of day/night, season of year, varying backgrounds), as well as for ability to perform without elevated accident crash or other critical outcome performance measure(s).

Color vision screening is recommended for pre-placement and periodic screening for all jobs that require color vision detection. For safety sensitive and safety critical jobs, greater frequency of periodic screening is recommended, generally either annually or biennially. For safety critical jobs, screening post-injury and postoperative is also recommended. For those with risks for acquired color vision deficiency, greater frequency of color vision screening may be considered.

Color vision screening has some indirect evidence of efficacy, is low cost and is thus recommended for pre-placement, periodic surveillance, as well as select postinjury and postoperative examinations.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Color vision screening, preplacement examinations; eye diseases, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 959 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 959 articles, 2 in CINAHL, 130 in Cochrane Library, 17100 in Google Scholar, and 0 from other sources. We considered for inclusion 4 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and - from other sources. Of the 4 articles considered for inclusion, 4 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PERIPHERAL VISION SCREENING

Peripheral vision is particularly required to appreciate objects that are approaching the person or for situations where the person is moving and thus needing peripheral vision for accident avoidance. This is necessary for motor vehicle accident avoidance, avoidance of injury from a forklift driven by another worker, avoidance of injury from moving parts (e.g., suspended parts from an overhead crane), operation of overhead cranes, etc. Some safety sensitive and non-safety sensitive jobs require full visual fields to function.

PERIPHERAL VISION SCREENING

Recommended

Peripheral vision screening is recommended for jobs that require peripheral vision.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Occupations that require peripheral vision, generally including most safety sensitive and safety critical jobs. Optimum means for testing are unclear. Screening the temporal field of vision with simple equipment that can measure degrees of visual field is a reasonable option. Confirmatory testing with standard automated perimetry testing equipment is required for definitive determinations, particularly those with reductions in visual fields or glaucoma. Screening includes preplacement, periodic/surveillance, post-injury and post-operative.

Rationale

Peripheral vision is necessary for most safety-sensitive and safety-critical jobs and job tasks, although no studies that address risks among those with impaired peripheral vision were identified among most occupations. Cohort and longitudinal studies reported elevated crash risks among subjects with reduced useful field of view (Owsley et al., 1998, Rubin et al., 1997, Rubin et al., 2007). Other study designs have suggested visual field and/or useful field of vision (Goode et al., 1998, Ball et al., 1988) are associated with crashes (Goode et al., 1998, Ball et al., 1993, Szlyk et al., 1992). Yet, multiple studies suggest no increased risk for peripheral vision (Burg, 1966, Owsley et al., 1998, Decina et al., 1993, Hu et al., 1998). Driving simulator studies (Coeckelbergh et al., 2002, Bronstad et al., 2013, Lockhart et al., 2009, Wood et al., 1994, Szlyk et al., 2005) and road tests (Coeckelbergh et al., 2002, Racette et al., 2005) suggest performance problems with one finding participants with bilateral central scotomas had higher risks of failing to detect pedestrians, slower and missed responses (Bronstad et al., 2013). Another found performance impairments associated with peripheral vision impairments (Lockhart et al., 2009).

The degree of peripheral vision required varies among occupations. The most common screening tests used in primary care are manual kinetic testing (typically, “finger wiggle” moving from the lateral side forward) and confrontation fields, however more accurate testing can be achieved with minimal cost. There are multiple tests that have been used mostly in comparative studies, including: Standard automated perimetry, Short-wavelength automated perimetry (SWAP), Frequency-doubling technology perimetry (FDT), High-pass resolution perimetry (HPRP), Scanning Laser Polarimetry (SLP, GDx VCC), Optical coherence tomography (OCT), pattern-electroretinography (PERG), Pattern Electrand Heidelberg Retina Tomography (HRT), Octopus tendency-oriented perimetry (TOP), and the Humphrey Swedish Interactive Threshold Algorithm (SITA)-fast (HSF), SITA 24-2 SAP, virtual reality headsets, and Humphrey Matrix perimetry (Selvan et al., 2024, Akar et al., 2022, Alawa et al., 2021, Behera et al., 2023, Blumberg, 2016, Boland et al., 2016, Fogagnolo et al., 2016,

Hekmatjah et al., 2025, Horn et al., 2016, Hu et al., 2016, Hu et al., 2017, Ichhpujani et al., 2021, Johnson et al., 2023, Kalyani et al., 2021, Kim et al., 2023, Kimura et al., 2019, Kumar et al., 2022, Lowry et al., 2016, Meethal et al., 2019, Meyerov et al., 2023, Monsalve et al., 2017, Nishida et al., 2023, Nishijima et al., 2024, Onyekaba et al., 2023, Portengen et al., 2022, Rao et al., 2015, Razeghinejad et al., 2021, Richardson et al., 2023, Rowe et al., 2021, Stapelfeldt et al., 2021, Toprak et al., 2017, Zhou et al., 2020)(Robin et al., 2005, Sample et al., 2006, Sample et al., 2011, Liu et al., 2011, Liu et al., 2014, Landers et al., 2000, Landers et al., 2003, Nomoto et al., 2009, Cello et al., 2000, Delgado et al., 2002, Terry et al., 2010, Kerr et al., 2010, Su et al., 2004, Shahinfar et al., 1995, Szatmary et al., 2002, Soliman et al., 2002, Thomas et al., 2002) (Pandit et al., 2001, Leeprechanon et al., 2007, Siatkowski et al., 1996, Fan et al., 2010) (Rao et al., 2015, Wu et al., 2011, Zeppieri et al., 2010, Choi et al., 2009, Bayer et al., 2002, Bayer et al., 2002, Horn et al., 2012, Horn et al., 2014, Wong et al., 2000, Wall et al., 2002, Wall et al., 2009, Kaushik et al., 2011, Wadood et al., 2002, Heeg et al., 2009, Salvetat et al., 2010, Redmond et al., 2013, Shah et al., 2006) (Kim et al., 2007, Horn et al., 2012, Thomas et al., 2001, Tafreshi et al., 2009, Tafreshi et al., 2010, Bowd et al., 2001, Corallo et al., 2008, Cioffi et al., 2000, Hollo et al., 2001, Hirashima et al., 2013, Clement et al., 2009, Taravati et al., 2008, Anderson et al., 2005, Sakai et al., 2007, Brusini et al., 2006, Fredette et al., 2015, Lamparter et al., 2013, Vislisel et al., 2011, Zein et al., 2010, Haymes et al., 2005, Artes et al., 2005, Artes et al., 2009). There are no validated tests that demonstrate a given test is able to predict both inability to accomplish normal peripheral vision as well as to not successfully avoid crashes or accidents. Thus, the means to accomplish screening are unclear. Automated equipment is commonly used for confirmatory testing (or for monitoring glaucoma) and Wagner is most commonly used.

Peripheral vision screening is nevertheless recommended for pre-placement and periodic screening for jobs that require peripheral vision. This includes most safety sensitive and safety critical jobs. When injuries or surgeries potentially impair peripheral vision, peripheral vision screening of post-injury and postoperative patients is also recommended. For those in jobs requiring peripheral vision who also have risks for acquired or progressive loss of peripheral vision (e.g., glaucoma), greater frequency of peripheral vision screening is recommended.

Peripheral vision screening has some indirect evidence of efficacy, is low cost and is thus recommended for select pre-placement, periodic surveillance, as well as select post-injury and postoperative examinations.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: peripheral vision screening, preplacement examinations, peripheral vision screening for preplacement evaluations; eye diseases, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 0 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 0 articles, 0 in CINAHL, 0 in Cochrane Library, 25, 400 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

DEPTH PERCEPTION

Depth perception is the ability of the eye to help ascertain three dimensions and be able to judge the distance of an object. Depth perception is also involved in ascertaining the length, width, and the height of an object. When the head is held steady and the body is not moving, both eyes are required to ascertain depth perception, known as stereopsis. While depth perception is commonly thought to require both eyes, this is not completely correct. When the head and/or body is moving (e.g., moving the head or traveling by vehicle), some depth perception is possible based on experiences, the relative changes in the size and position of objects. Still, people with stereopsis will use these clues much less frequently.

Overall, there were two review articles that partially included the condition of monocular vision as a risk factor for occupational injury. One review found that balance issues related to problems of depth perception and visual ambiguity caused by monocular vision increased the risk of falling off a roof for roofers [(268)]. The second review showed little evidence that visual impairment increased risks for occupational injury and no studies were found that directly assessed monocular vision as a risk factor for occupational injury [(269)]. Overall, the lack of evidence for monocular vision as a risk factor for occupational injury seems to be related to not properly defining eye pathology in current research [(269)].

DEPTH PERCEPTION SCREENING

Recommended

Depth perception screening is selectively recommended for jobs that require depth perception.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Occupations that require a high degree of depth perception for accurate performance. Optimum means for testing are unclear. A functional test that either accomplishes the required job functions or one that mimics the required job task(s) may be best.

Rationale

Depth perception is necessary for select jobs and job tasks. The degree of depth perception required varies widely, and the prevalence and degree of depth perception deficits varies widely (Holmin J, 2016, Moyegbone et al., 2025). There are multiple tests that have been

used mostly in comparative studies, including: Polarized Stereoscopic Monitor, Distance Randot Stereotest, Titmus stereo test (static depth perception), Frisby stereotest, Randot circles and FNS, Wirt Fly Stereotest, TNO test, stereoacuity, stereogram (Kim, 2011, Watanabe et al., 2008, Yang et al., 2004, Holmes et al., 2005, Rosner et al., 1984, Lindstrom et al., 2009, Gomez et al., 2012, Leske et al., 2004). There are no validated tests that demonstrate a given test is able to predict both inability to accomplish normal depth perception as well as to not successfully perform job tasks. Thus, the means to accomplish the testing are unclear.

Depth perception screening is nevertheless recommended for select pre-placement and periodic screening for jobs that require a high degree of depth perception. For those in jobs requiring depth perception who also have risks for acquired or progressive loss of depth perception (e.g., keratoconus), greater frequency of depth perception screening may be advisable.

Depth perception screening is without adverse effects, is low cost and is thus recommended for select pre-placement, periodic surveillance, as well as select postinjury and postoperative examinations.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Depth Perception, depth perception pre placement exam; eye diseases, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 738 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 738 articles, 29 in CINAHL, 134 in Cochrane Library, 17, 700 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 2 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PREVENTION OF EYE INJURIES

EDUCATION

The employer's roles include primary prevention as well as facilitating secondary and tertiary prevention. Primary prevention activities include engineering interventions such as machine guarding to prevent exposure to the generation of projectiles from hammering, grinding, drilling, and use of other high-speed machines [270].

Education is an important component of prevention [270]. Most often, in higher risk settings, eye protection is still required after consideration of engineering controls to prevent ocular injuries. Safety eye wear, includes glasses, goggles face shields and splash guards, and should be selected based on the exposure(s) to adequately prevent work-related eye injuries.

The employer's roles include eyewear provision, education, and promotion of the use of appropriate eye safety wear [271]. Employer's roles also include facilitating appropriate medical care for eye injuries that are incurred at the workplace. Employers sometimes also facilitate consultations when suboptimal clinical results occur.

One role of an employer is education of the susceptible workforce regarding ocular hazards [272, 273].

EDUCATION ON EYE INJURIES

Recommended

Education is recommendation for workers who have potential for eye injuries, e.g., from chemical splashes, impacting metal and/or wind-blown objects.

Strength of evidence Recommended, Evidence (C)
Level of confidence High

Rationale

Behavioral and education training on injury prevention has been shown to be successful in a few studies, although it is combined with protective eye wear (Forst et al., 2006, Mancini et al., 2005, Chatterjee et al., 2017, Forst et al., 2004). Training to prevent eye injuries is of negligible cost, has demonstrated 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: Education, training, educate, classes; eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 775 articles in PubMed, 1, 199 in CINAHL, 4, 223 in Cochrane Library, 1, 170, 000 in Google Scholar, and 0 from other sources†. We considered for inclusion 3 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 4 articles

considered for inclusion, 4 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PROTECTIVE EYEWEAR

PROTECTIVE EYEWEAR FOR PREVENTION OF EYE INJURIES

Recommended

Protective eyewear is recommended for prevention of eye injuries.

Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Moderate and high risk occupations and at-risk workforces, with include numerous construction, mining, manufacturing, industries, but also includes recreational and sports settings where employees work in as trainers, instructors, and professional athletes. The employer should educate the workers regarding the potential for ocular injury and the means of protection (Adams et al., 2013). Especially in high-risk settings, it is recommended that this should then be followed by enforcement.

Benefits

Proactive reductions in risks of injury.

Harms

Time to educate.

Frequency/Dose/Duration

Generally at baseline and at least annually in moderate and high risk settings.

Indications for discontinuation

At-risk exposure(s) have been engineered out.

Rationale

Protective eyewear promotion (PEP) has been shown to be effective for improving compliance and reducing eye injuries, although not in some studies that may be underpowered (Chatterjee et al., 2017, Forst et al., 2004, Forst et al., 2006, Mancini et al., 2005). Other studies combining education and protective eyewear have shown reductions in injuries (Mancini et al., 2005, Chatterjee et al., 2017). In one study, there was a 2.4-fold odds of wearing appropriate eyewear compared with controls (Eime et al., 2005). Protective eyewear has some evidence of efficacy is low cost, without adverse effects and likely quite effective in high-risk settings, and thus is recommended. In settings were exposures risks and/or consequences of exposures are higher, safety goggles, face shields, and/or splash guards are recommended for prevention of eye injuries. However, safety glasses likely prevent ocular injuries from splashes and injuries associated with penetrating eye trauma. Goggles, face shields and/or splash guards may be preferable where risk of splashes is high or where risks of projectile metal is quite high. This recommendation may require (re)inforcement for efficacy.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: protective eyewear, safety glasses, goggles, safety goggles; eye diseases, eye disorder, eye abnormality, eye, eyes; 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 269 articles in PubMed, 110 in CINAHL, 6 in Cochrane Library, 16, 700 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 1 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SAFETY GLASSES IN MOST EMPLOYMENT SETTINGS

Recommended

Safety glasses suffice for most employment settings with risk of eye injuries and are recommended for most low to moderate-risk exposure situations.

Strength of evidence Recommended, Evidence (C)
Level of confidence High

Rationale

Safety glasses and/or safety eyewear have been shown to be effective for reductions in eye injuries, although some studies are likely underpowered (Mancini et al., 2005, Chatterjee et al., 2017, Forst et al., 2004, Forst et al., 2006). Safety glasses are recommended for prevention of eye injuries and the specific type of protection is ideally selected to address the worker(s) specific job task(s). Safety glasses suffice for most employment settings. Where there are high-risks of penetrating eye trauma or chemical splashes, safety goggles, face shields and/or splash guards are generally preferable.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Eye Protective Devices; eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 2 in CINAHL, 0 in Cochrane Library, 30, 900 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SAFETY GOGGLES, FACE SHIELDS, AND/OR SPLASH GUARDS IN HIGH-RISK JOBS FOR PENETRATING EYE TRAUMA OR CHEMICAL SPLASHES

Recommended

Where there are high risks of chemical splashes or penetrating eye trauma, safety goggles, face shields and/or splash guards are recommended.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Workers at risk of penetrating trauma, hammering/pounding metal, chemical splashes or performing work that previously resulted in foreign bodies.

Benefits

Injury prevention.

Indications for discontinuation

Removal from at-risk task.

Rationale

There are no quality studies and no quality comparative trials. In settings were exposures risks and/or consequences of exposures are higher, especially chemical splashes, safety goggles, face shields, and/or splash guards are recommended for prevention of eye injuries. Goggles, face shields and/or splash guards are generally preferable to safety glasses where risk of splashes is high or where risks of projectile metal is high.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: safety goggles, face shields, splash guards, eye protective devices; eye diseases, eye disorder, eye abnormality, eye, eyes; 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 159 articles in PubMed, 92 in CINAHL, 24 in Cochrane Library, 17100 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ALLERGIC DISORDERS

Symptom onset in an occupational setting may be rapid or gradual. In general, the higher the dose of exposure, the faster and more intense the symptom development tends to be. Still there is a wide range. Subsequent symptom experiences tend to parallel frequency, intensity and duration of the exposure(s). Typically, both eyes are equally affected in allergic conjunctivitis. Eyes may be unequally affected if there is differential introduction of the allergen into the eyes (e.g., flour dust rubbed into one eye).

Symptoms of allergic conjunctivitis may include:

- Bilateral itchy eyes (pruritus)
- Bilateral watery eyes
- Bilateral swollen eyelids (ocular edema)
- Bilateral erythematous eyes
- Bilateral eye pain (usually not severe)
- Bilateral eye inflammation
- Rhinorrhea (runny nose)
- Itchy nose, itchy roof of mouth
- Sneezing

If symptoms worsen or persist (swelling, inflammation, etc.) there may be something more serious than allergic conjunctivitis.

If visual acuity worsens, it is probably not allergic in etiology.

- Acquired abnormal visual fields
- Purulence
- Systemic diseases, especially auto-immune

The initial assessment consists of a careful history and limited testing to rule out other conditions. The history focuses on symptoms, patterns of symptoms and probable allergens.

Recently proposed criteria for allergic conjunctivitis include symptoms, signs and limited testing [(274)]. A clinical history and assessment of environmental factors are considered to be the first step in diagnosing allergic conjunctivitis [(274)]. Following the initial assessment, an allergy workup based on skin tests and determination of serum specific IgE is generally recommended. Occasionally, a conjunctival challenge is performed [(274, 275)]. Increased conjunctival sickle cells, frequent eosinophils in corneal scrapings and a high total serum IgE are indicators of allergic conjunctivitis [(274)].

Allergic eye diseases present with episodic bilateral pruritic, watery, erythematous eyes, and photophobia [(274)]. Symptoms most often wax and wane based on exposure, although persistent symptoms may be present if exposures are ongoing. For those with intermittent symptoms, a pattern of symptom development, or aggravation after exposures is present that is often quite helpful in assessing the causative allergen(s). The degree of pruritus is highly helpful diagnostically to increase the probability of allergic disease, although infectious diseases may present with some pruritus. Confirmatory testing of atopy is possible for some specific allergens (see Occupational/Work-Related Asthma Guideline).

Some patients also have systemic symptoms, such as asthma. All patients with allergic eye disease should be assessed for systemic manifestations as those with asthma and ongoing exposure may incur progressive pulmonary impairments that may become permanent (See Occupational/Work-Related Asthma Guideline). Occupational asthma also increases the potential for a fatal outcome (See Occupational/Work-Related Asthma Guideline).).

CLASSIFICATION

The consensus classification for allergic conjunctivitis (AC) takes into account the frequency and severity of ocular signs and symptoms [(274)]. AC generally affects both eyes and is considered *intermittent* when it involves ocular signs and symptoms (conjunctival pruritus,

tearing, a burning sensation, blurred vision, photophobia, and hyperemia) for up to 4 days a week or up to 4 consecutive days. AC is considered *persistent* when the ocular signs and symptoms have been present more than 4 days per week or more than 4 consecutive days [(274)].

The severity of AC is classified as *mild* when signs and symptoms are 1) not bothersome, 2) do not effect vision, 3) there are no interferences with activities of daily living, and 4) no interferences with school or work tasks. It is considered *moderate* when 1-3 items are met and *severe* when all conditions are met [(274)].

DIAGNOSTIC RECOMMENDATIONS

SPECIFIC IMMUNOLOGICAL TESTING

Note: The guidance below is from the Work-related Asthma Guideline. It is included here for completeness.

SPECIFIC IMMUNOLOGICAL TESTING FOR ALLERGENS

Recommended

See the ACOEM Occupational Asthma guideline for consideration of IgE and IgG testing for low and high molecular weight-specific antigens in patients with both occupational asthma and allergic conjunctivitis.

Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Immunoglobulin E, Immunologic Tests, Occupational Asthma, high molecular weight specific antigens; asthma, hypersensitivity, allergy, allergies, allergy reaction; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 34 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 34 articles, in 108 CINAHL, 479 in Cochrane Library, 17800 in Google Scholar, and 0 from other sources. We considered for inclusion 4 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 1 diagnostic studies and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

IGG SPECIFIC IMMUNOLOGICAL TESTING FOR HIGH MOLECULAR WEIGHT SPECIFIC ANTIGENS

Not Recommended

See the ACOEM Occupational Asthma guideline for consideration of IgE and IgG testing for low and high molecular weight-specific antigens in patients with both occupational asthma and allergic conjunctivitis.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Immunoglobulin G, asthma, hypersensitivity, allergy, allergies, allergic reaction; asthma, hypersensitivity, allergy, allergies, allergy reaction, eye disease, eye disorder, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 1, 436 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 1, 436 1 articles, 8 in CINAHL, 4 in Cochrane Library, 17, 100 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

LOW MOLECULAR WEIGHT SPECIFIC ANTIGENS

Not Recommended

See the ACOEM Occupational Asthma guideline for consideration of IgE and IgG testing for low and high molecular weight-specific antigens in patients with both occupational asthma and allergic conjunctivitis.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Moderate

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Immunoglobulin E OR IgE Testing; asthma, hypersensitivity, allergy, allergies, allergy reaction, eye disease, eye disorder, eyes ; diagnosis, diagnostic, sensitivity, specificity,

positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 7, 155 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 7160 articles, 162 in CINAHL, 1041 in Cochrane Library, 16, 700 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 3 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TREATMENT RECOMMENDATIONS

REDUCTION OF EXPOSURE

Medical removal is usually based on pulmonary symptoms and development of asthma, particularly if progressive loss is determined by spirometry. Medical removal solely for ocular symptoms is relatively rare, and typically only occurs after education, institution of exposure reduction, exposure controls, and persistence of symptoms beyond a tolerable level.

MANAGEMENT OF ALLERGIC EYE SYMPTOMS WITHOUT ASTHMA (REDUCTION OF EXPOSURE)

Recommended

For allergic eye symptoms, it is recommended that exposure reduction and medical monitoring to assess the presence or worsening of asthma should be performed to ensure ocular symptoms are acceptably reduced as well as to provide early identification of asthma (see also the ACOEM Occupational Asthma guideline).

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

All patients with moderate to severe symptoms of allergic conjunctivitis. Exposure reduction is also indicated for mild allergic conjunctivitis cases where feasible.

Benefits

Potential to eliminate the need for medical treatment. Otherwise, potential to reduce the intensity of other medical treatment(s) required.

Harms

May be problematic in some settings. May not be possible and worker may need to accept the symptoms due to economic issues. As noted in the Work-related Asthma guideline, "The clinical benefit of removal from exposure or exposure reduction should be balanced against the increased risk of unemployment."

Rationale

There are quality studies for evaluation of removal from work exposures in the settings of occupational asthma. This approach is not always effective, with the BOHRF and ACCP stating that reduction of exposure "is not always effective" (Nicholson et al., 2005) and that "there is little evidence for using this approach (Tarlo et al., 2008)." Still there are patients who appear to benefit significantly from reductions in exposure. Exposure reduction is not invasive, has low to high adverse effects, could be high cost and thus selective removal from exposure is indicated, especially for those with severe symptoms. There should be low threshold for screening and subsequent ongoing monitoring with spirometry.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Exposure Reduction; asthma, hypersensitivity, allergy, allergies, allergy reaction, eye disease, eye disorder, eyes; 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 798 articles in PubMed, 23 in CINAHL, 894 in Cochrane Library, 21, 900 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EDUCATION

EDUCATION ON EYE ALLERGIES

Recommended

Education is recommended for assisting patients to better manage their allergic condition (see also the ACOEM Occupational Asthma guideline).

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

All patients with ocular allergic manifestations, particularly those without the ability to avoid future exposure. Education includes exposure reduction, exposure elimination, hand hygiene to avoid contaminating the eyes, and medication management.

Rationale

There are no quality studies, however, education is low cost, likely has some efficacy and thus is recommended for those with allergic eye disorders.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Education OR Class OR Classes OR Training; asthma, hypersensitivity, allergy, allergies, allergy reaction, eye disease, eye disorder, eyes; 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, 353 articles in PubMed, 677 in CINAHL, 2055 in Cochrane Library, 60, 600 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MEDICATIONS

There are multiple medications in several medication classes that are used for allergic ocular symptoms. These different classes of medications have different strengths and weaknesses that may be utilized to optimize treatment and/or treatment compliance. Classes of medications include non-selective histamine receptor blockers, selective histamine receptor blockers, non-steroidal anti-inflammatory medications (NSAIDs), mast cell stabilizers, glucocorticosteroids, oral anti-histamines, and others. Normally, one medication suffices. Occasionally, moderate to severe symptoms may be addressed with combinations of agents, usually utilizing one medication from each of two different classes with different mechanisms of action.

Medications administered by ocular drops are cleared via the lacrimal ducts. These medications also tend to treat allergic nasal symptoms. Some evidence suggests ocular drops treat nasal symptoms better than ocular symptoms [(276)].

ANTIHISTAMINES AND/OR MAST CELL STABILIZATION MEDICATIONS

Recommended

Antihistamines and/or mast cell stabilization medications are strongly recommended for treatment of ocular symptoms from allergic diseases.

Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Indications

Ocular eye symptoms from presumptive or proven allergic disease. Exposure elimination is the preferred initial treatment before medication. However, many cases benefit from prompt medical treatment.

Benefits

Reduction in pruritus, watering eyes. May also reduce allergic nasal symptoms.

Harms

May briefly burn, sting and/or cause dry eyes.

Frequency/Dose/Duration

Medications used include below. Dose, Frequency, Duration is as per manufacturer's recommendations.

Histamine blockers:

- Alcaftadine 0.25% 1 drop QD
- Azelastine 0.05% 1 drop BID
- Emadastine 0.05% 1 drop up to QID

Anti-histamine/mast cell stabilizer

- Bepotastine 1.5% 1 drop BID
- Epinastine 0.05% 1 drop BID
- Olopatadine 0.1% 1 drop BID (or longer preparation QD use)

Mast Cell Stabilizer

- Cromolyn 1 drop 4-6 times/day
- Ketotifen 1 drop Q8-12 hrs
- Lodoxamide 1-2 drops QID
- Nedocromil 1-2 drops BID
- Pemirolast 1-2 drops QID

Indications for discontinuation

Resolution of symptoms, removal from exposure, intolerance, adverse effects.

Rationale

Antihistamines are typically used as the first-line medication. Both antihistamines and mast cell stabilizers have strong evidence of efficacy. While there is efficacy, there is less evidence of efficacy for ketorolac.

There are dozens of moderate and high-quality RCTs. Nearly all have documented efficacy. All of the following medications have been assessed in quality studies: rupatadine 10-20 mg (Marmouz et al., 2011); cetirizine 10 mg (Marmouz et al., 2011); levocetirizine 5-20 mg (Yonekura et al., 2019); bilastine 0.6% (Gomes et al., 2024); bepotastine esilate 1.0-1.5% Torkildsen et eal., 2010; alcaftadinee (Greiner et al., 2011, Torkildsen et al., 2011); epinastine HCl 0.05% (Fukushima et al., 2014); emedastine HCl (Borazan et al., 2009, Horak et al., 2003, Verin et al., 2001, Secchi et al., 2000, Orfeo et al., 2002, Discepola et al., 1999); ketotifen fumorate (Horak et al., 2003, Torkildsen et al., 2008, Abelson et al., 2003, Greiner et al., 2003, Kidd et al., 2003, Avunduk et al., 2005, Ganz et al., 2003, Greiner et al., 2002, Berdy et al., 2000); azelastine HCl (Esmaeilzadeh et al., 2022, Chen et al., 2022)(Torkildsen et al., 2008, Horak et al., 1998, Friedlaender et al., 2000, Sabbah et al., 1998, James et al., 2003, Nazarov et al., 2003, Lenhard et al., 1997, Giede-Tuch et al., 1998, Giede et al., 2000, Sodhi et al., 2003); olopatadine HCl 0.1% (Fukushima et al., 2014)(Greiner et al., 2011, Abelson et al., 2004, Mah et al., 2007, Borazan et al., 2009, Abelson et al., 2003, Avunduk et al., 2005, Ganz et al., 2003, Berdy et al., 2000, Mah et al., 2008, Leonardi et al., 2003, Abelson et al., 1998, Abelson et al., 2007, Katelaris et al., 2002, Ciprandi et al., 2004, Butrus et al., 2000, Deschenes et al., 1999, Berdy et al., 2002, Brodsky et al., 2003, Yaylali et al., 2003, Lanier et al., 2001, Celik et al., 2014), Levobastine (Whitcup et al., 2004, Ciprandi et al., 2004), Levocabastine (Kidd et al., 2003, Davies et al., 1993, Verin et al., 2001, Azevedo et al., 1991, Hammann et al., 1996, Secchi et al., 2000), Cromolyn sodium (Greiner et al., 2002, Ciprandi et al., 2004, Liu et al., 2011, Nizami, 1981, Abelson et al., 1995), Sodium cromoglycate (James et al., 2003, Davies et al., 1993, Azevedo et al., 1991) (Leino et al., 1990, Fujishima et al., 2009, Ciprandi et al., 1991, Lindsay-Miller, 1979), Nedocromil (Butrus et al., 2000, Hammann et al., 1996, Leino et al., 1990, Alexander M, 2000, Melamed et al., 2000, Blumenthal et al., 1992, Leino et al., 1992, Shulman, 2003, Miglior et al., 1993, Stockwell et al., 1994), Pentigetide (Kalpaxis et al., 1991), Oxymetazoline (Duzman et al., 1986), and Mequitazine (Persi et al., 1997).

Oral medications assessed in trials for eye symptoms include Loratadine (Ousler et al., 2007, Lanier et al., 2001), desloratadine 5 mg (Yonekura et al., 2019, Torkildsen et al., 2009). Cyclosporin A has been shown to be ineffective (Daniell et al., 2006).

Comparative trials have mostly found comparable efficacy among more recent medications. For example, more trials suggested Olopatadine is superior to Ketotifen (Berdy et al., 2000, Deschenes et al., 1999, Lanier et al., 2001) but one found the opposite (Ganz et al., 2003). Antihistamine eye drops and/or mast cell stabilizing medication eye drops are not invasive, have low adverse effects, are low to moderate cost depending on length of treatment, have proven efficacy and are thus recommended for treatment of allergic eye diseases.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Histamine antagonists, mast cell stabilizers, histamine antagonists, antihistamines, mast cell stabilizers; asthma, hypersensitivity, allergy, allergies, allergy reaction, eye disease, eye disorder, eyes; 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, 893 articles in PubMed, 8 in CINAHL, 107 in Cochrane Library, 10, 800 in Google Scholar, and 0 from other sources†. We considered for inclusion 10 from PubMed, 0 from CINAHL, 3 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 13 articles considered for inclusion, 7 randomized trials and 6 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

NSAID EYE DROPS FOR EYE ALLERGIES

Recommended

NSAID eye drops are moderately recommended for treatment of ocular symptoms from allergic diseases.

Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Ocular eye symptoms from presumptive or proven allergic disease. Exposure elimination is the preferred initial treatment before medication. However, many cases benefit from prompt medical treatment.

Benefits

Reduction in pruritus, watering eyes. May also reduce allergic nasal symptoms.

Harms

May briefly burn, sting and/or cause dry eyes.

Frequency/Dose/Duration

Medications used follow. Dose, Frequency, Duration is as per manufacturer's recommendations.

- Ketorolac 0.5% 1 drop QID

Indications for discontinuation

Resolution of symptoms, removal from exposure, intolerance, adverse effects.

Rationale

There are dozens of moderate and high-quality RCTs. Nearly all have documented efficacy. All of the following medications have been assessed in quality studies: Pranoprofen (Li et al., 2013), Ketorolac (Deschenes et al., 1999, Yaylali et al., 2003, Donshik et al., 2000) (Tauber et al., 1998, Tinkelman et al., 1993, Ballas et al., 1993); and Diclofenac (Tauber et al., 1998) (Laibovitz et al., 1995). A meta-analysis estimated significant standard mean differences pain score reductions at -0.69 (24 hrs) and -0.56 (48 hrs) (Yu et al., 2021). NSAIDs drops are not invasive, have low adverse effects, are low to moderate cost depending on length of treatment, have proven efficacy and are thus recommended for treatment of allergic eye diseases.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: TREATMENT TOPIC; asthma, hypersensitivity, allergy, allergies, allergy reaction; 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 17 articles in PubMed, 30, 710 in CINAHL, 8 in Cochrane Library, 17300 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

GLUCOCORTICOSTEROID EYE DROPS FOR EYE ALLERGIES

Sometimes Recommended

Glucocorticosteroid eye drops are selectively recommended for short-term treatment of severe ocular symptoms from allergic diseases.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Acute, severe ocular eye symptoms from presumptive or proven allergic disease. Exposure elimination is the preferred initial treatment before medication. However, many cases benefit from prompt medical treatment. Not indicated for mild to moderate disease due to adverse effects potentially outweighing potential benefits.

Benefits

Reduction in pruritus, watering eyes. May also reduce allergic nasal symptoms.

Harms

May briefly burn, sting and/or cause dry eyes.

Frequency/Dose/Duration

Medications used follow. Dose, Frequency, Duration is as per manufacturer's recommendations.

- Loteprednol 0.2% 1 drop up to QID
- Loteprednol 0.5% 1-2 drops QID
- Fluorometholone 0.1% TID

Indications for discontinuation

Resolution of symptoms, removal from exposure, intolerance, adverse effects.

Rationale

Quality trials suggest efficacy of glucocorticosteroids, including fluorometholone (Borazan et al., 2009, Celik et al., 2014, Li et al., 2013) and loteprednol etabonate (Berdy et al., 2002). Topical glucocorticosteroids have evidence of efficacy; however, they have adverse effects, especially cumulatively, and thus 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: Glucocorticosteroid Eye Drops, Glucocorticoid Eye Drops, Corticosteroid Eye Drops, Steroid Eye Drops, Ophthalmic Steroids; asthma, hypersensitivity, allergy, allergies, allergy reaction, eye disease, eye disorder, eyes; 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, 0 in CINAHL, 3 in Cochrane Library, 1230 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 6 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 5 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INTRACANALICULAR DEVICES WITH GLUCOCORTICOSTEROIDS FOR ALLERGIC EYE DISORDERS

No Recommendation

There is no recommendation for intracanalicular devices with glucocorticosteroids for treatment of allergic conjunctivitis.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Benefits

Studies among those with allergic conjunctivitis report improved symptoms of allergic conjunctivitis, but are only short-term studies and fail to compare with standard of care.

Rationale

There are several moderate quality RCTs suggesting efficacy to reduce symptoms of allergic conjunctivitis (Torkildsen et al., 2017, McLaurin et al., 2021, Kenyon et al., 2024, Alsudais et al., 2024). However, there are no RCTs to compare with common treatments and no quality data extend beyond 4 months. Intracanalicular devices with steroids have limited evidence of efficacy for allergic conjunctivitis, are somewhat invasive, have adverse effects, lack comparison with standard of care, and lack quality long-term safety data. Thus, there is no recommendation for treatment of allergic conjunctivitis.

Should these devices be used to treat allergic conjunctivitis, it is recommended that these devices not be used to manage severe allergic conjunctivitis symptoms due to workplace allergens while also continuing ongoing exposure(s) and particularly if the patient also has occupational asthma as occupational asthma with ongoing significant exposures may be irreversible and needs careful monitoring (see ACOEM Occupational Asthma guideline).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Glucocorticosteroid Eye Drops, Glucocorticoid Eye Drops, Corticosteroid Eye Drops, Steroid Eye Drops, Ophthalmic Steroids; asthma, hypersensitivity, allergy, allergies, allergy reaction, eye disease, eye disorder, eyes; 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, 0 in CINAHL, 0 in Cochrane Library, 401 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 3 randomized trials and 0 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

BLEPHAROCONJUNCTIVITIS

Blepharoconjunctivitis is a chronic inflammation of the eyelid along the base of the eyelashes. This results in irritation, itchy eyes, watery eyes, mattering, frequent blinking and may result in photophobia. It may be caused by insufficient oil gland production, bacterial infection, allergies, rosacea and other conditions. Staphylococcal infection is a common cause of blepharoconjunctivitis. Overall quality of the literature on this subject is notably poor [(277)]. Although It is generally considered a nonoccupational condition, it is commonly identified on clinical evaluation and is included in the guideline for completeness.

The most common treatment is lid hygiene, which involves daily washing of the eyelid with a cotton tip applicator, baby shampoo and water. Lid hygiene suffices for the majority of people. Artificial tears and warm compresses may be helpful. Thus treatment is also nearly always non-prescription self-care.

TREATMENT RECOMMENDATIONS

DAILY LID HYGIENE FOR BLEPHAROCONJUNCTIVITIS

Recommended

Daily lid hygiene is recommended for treatment of blepharitis.

Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence High

Indications

Nearly all cases of blepharoconjunctivitis.

Benefits

Self-management of the condition and symptoms, but with negligible cost.

Harms

Negligible

Frequency/Dose/Duration

Daily eyelid and eyelash scrubbing with tepid water, eyelid cleansers, baby shampoo, and/or hypochlorous acid, and using a cotton tip applicator.

Indications for discontinuation

Resolution of the symptoms. Reduction in scrubbing frequency may be possible when the condition is under control.

Rationale

A comparative trial found an eyelid cleanser superior to baby shampoo for some metrics, although symptoms were improved with both symptoms (Sung et al., 2018). Another comparative trial also found efficacy of an eyelid cleanser, baby shampoo, and a tea-tree based facewash (Murphy et al., 2020). A comparative trial of hypochlorous acid found superiority to hyaluronic acid wipes (Mencucci et al., 2023). Another trial for dry eyes suggest lid hygiene is helpful for managing lipid-deficient dry eyes (Korb et al., 2015). A thermodynamic lipid device has also been reportedly successful for Meibomian gland dysfunction (Finis et al., 2014). Lid hygiene is not invasive, has few adverse effects, is low cost, has evidence suggesting efficacy, 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: Hygiene, eye hygiene, daily lid hygiene; eye diseases, blepharitis, eye disorder, eye abnormality, eye, eyes, blepharoconjunctivitis; 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 211 articles in PubMed, 61 in CINAHL, 511 in Cochrane Library, 17, 700 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 3 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ANTIBIOTICS FOR BLEPHAROCONJUNCTIVITIS

No Recommendation

There is no recommendation for topical antibiotics for treatment of anterior blepharitis.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Frequency/Dose/Duration

Per manufacturer's recommendation

Rationale

There are no quality trials of topical antibiotics for treatment of blepharitis. Some trials do not clearly specify anterior blepharitis, providing a potential confounder. Some trials appear to show potential efficacy for reductions in symptoms. A Cochrane review of oral antibiotics also found very low certainty evidence (Onghanseng et al., 2021). Topical antibiotics are not invasive, have few adverse effects, are low cost for short courses, but have no quality evidence of 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: Topical antibiotics; Tobramycin, Dexamethasone Drug Combination, Tobramycin, Dexamethasone, Loteprednol Etabonate, Loteprednol, Levofloxacin, eye diseases, blepharitis, eye disorder, eye abnormality, eye, eyes, blepharoconjunctivitis; 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 440 articles in PubMed, 143 in CINAHL, 38 in Cochrane Library, 21300 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 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 review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are

reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

CHEMICAL BURNS

Workplace chemical eye burns result most commonly from exposures to either alkaline agents (e.g., lime or sodium hydroxide) or acids, although they can occur with petrochemicals and other substances [278-284]. The specific chemical(s) involved, its concentration, quantity and duration of exposure are critical in determining extent of, and limiting the insults of, the injury. Additionally, it is recommended to screen for concurrent conjunctival/corneal foreign bodies and blunt trauma injury, including open globe injury, as they can occur simultaneously with chemical contamination and may change the management of the chemical injury. Rapid, initial management is likely the most critical aspect of the management and conveys subsequently improved prognosis when rapidly executed [281-287].

While there are no quality RCTs for use of antibiotics for chemical injuries, there should be a low threshold for their use, particularly in more severely injured patients.

See Prevention and Education recommendations.

TREATMENT RECOMMENDATIONS

IRRIGATION

Immediate treatment to irrigate the eye with copious water or other aqueous irrigating solutions is believed to be critical for improved, successful patient treatment [284, 286, 288]. Uncontrolled studies suggest better outcomes with longer duration of irrigation [287] that may include multiple liters in more severe injuries [289, 290]. It is also advised that the patient should avoid touching or rubbing the eye to prevent further skin and eye exposure(s). It is also quite important for the healthcare provider to wear protection during irrigation to prevent splashes and self-exposure(s). Use of topical anesthetics for assessment and irrigation is helpful, however management of the injury with topical anesthetics is not recommended.

COPIOUS EYE IRRIGATION FOR CHEMICAL EXPOSURE

Recommended

Copious irrigation is recommended for chemical eye exposures.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

All chemical eye exposures and injuries. Irrigation should begin immediately after eye exposure, and use the most immediately available solution (i.e., most commonly tap water),

rather than waiting for access to a buffered saline solution and/or for symptoms to develop. It is also recommended to begin irrigation promptly while others attempt to identify the specific chemical(s)/agent(s), concentration(s) and duration of exposure. Irrigation should also be used until Morgan lens, if indicated, is available for more severe injuries.

Benefits

Limiting extent of burn/injury, earlier relief of pain.

Harms

Negligible. Mild discomfort from solution and irrigation.

Frequency/Dose/Duration

Tap water is most commonly available and should be used if that is the most readily available solution, especially for first-line, in-plant settings that may begin at eye wash stations. Irrigation bottles with irrigating solutions are also useful typically as a second-line treatment at in-plant medical departments, clinical settings and distributed in some chemical laboratories and facilities.

Normal saline and lactated Ringer's solution are additional options for initial irrigation, but only if immediately available. For alkaline burns, there is low quality evidence suggesting superiority of buffered solutions and amphotere-containing solutions (Rihawi et al., 2008, Rihawi et al., 2006, Merle et al., 2005, Wiesner et al., 2019). Generally use topical anesthetic to anesthetize the eye when available, as it will assist in better tolerance of irrigation.

Patients are recommended to be positioned with the contaminated eye lower than the uncontaminated eye, and irrigant fluid should be applied so it flows from the inner canthus to the outer canthus.

During and after copious flushing there also should be careful examination for foreign material adherent to lashes, as this is adjacent to the eye, the skin is very thin, and these decontamination issues requires special care, consideration and techniques. Sweeping of the fornices is recommended to remove potentially retained material.

Although there are no RCTs showing clear evidence of efficacy, there are animal studies and some non-randomized human studies which suggest superiority of irrigation solutions that are buffered or contain amphoteres for treatment of ocular alkaline burns. If these are not immediately available, it is advised that the immediately available solution be used first (e.g., water or saline) while accessing the irrigation solution (Rihawi et al., 2008, Rihawi et al., 2006, Merle et al., 2005, Wiesner et al., 2019).

Total volume in more severe injuries is recommended to be at least multiple liters (Sharma N, 2018, Pokhrel PK, 2007). Monitoring with pH strips should be performed as irrigation occurs.

Indications for discontinuation

Only after extensive irrigation, usually at least 1-2 liters has been used to flush out the chemical. Neutralization of pH should be demonstrable for acid or alkaline exposures. The pH should be 7.0-7.2. The pH should be checked after discontinuing irrigation to assure that additional irrigation is not needed to maintain pH neutrality.

Rationale

There are naturally no quality studies identifying use compared with non-use of irrigation. There are experimental animal model studies of irrigating solutions for treatment. These animal studies suggest superiority of balanced salt solutions (e.g., normal saline, lactate Ringer's solution) over hypotonic solutions (such as tap water). Still, experience suggests earlier irrigation with the most readily available solution, including tap water, is the preferred initial strategy and is recommended. Once irrigation is underway with the first available solution, simultaneously or immediately and subsequently tailoring of further irrigation, with a balanced saline solution and potentially selective use of an irrigating system (e.g., "Morgan lens") may be considered.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Irrigation, Ocular Irrigation, Ophthalmic irrigation, Eye Irrigation, Therapeutic Irrigation; chemical burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 337 articles in PubMed, 45 in CINAHL, 0 in Cochrane Library, 17100 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EYE IRRIGATING SYSTEMS (MORGAN LENS) FOR CHEMICAL EXPOSURE

Sometimes Recommended

Irrigating systems (e.g., Morgan Lens) are selectively recommended for chemical eye exposures.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Frequency/Dose/Duration

Generally used only after initial treatment, flushing and decontamination (see Irrigation section) unless immediately available and placed while irrigation has commenced with traditional means. Generally use a balanced salt solution (e.g., normal saline (0.9%), lactated Ringer's solution). For most chemicals, 500 mL at fast rate (run-in 'open') has traditionally been recommended. However, there is some low quality evidence that includes animal models suggesting superiority of solutions containing buffers or amphoteres (Rihawi et al., 2008, Rihawi et al., 2006, Merle et al., 2005, Wiesner et al., 2019):

Use topical anesthetic to anesthetize the eye when available, as it will assist in better tolerance of the irrigating system.

Patients are recommended to be positioned with the contaminated eye lower than the uncontaminated eye, and irrigant fluid should be applied so it flows from the inner canthus to the outer canthus.

During and after copious flushing there also should be careful examination for foreign material adherent to lashes, as this is adjacent to the eye, the skin is very thin, and these decontamination issues requires special care, consideration and techniques. Sweeping of the fornices is also recommended to remove potentially retained material.

Total volume in more severe injuries is recommended to be at least multiple liters (Sharma N, 2018, Pokhrel PK, 2007). Monitoring with pH strips should be performed as irrigation occurs.

Reassess and consider additional fluid depending on chemical, concentration, dose, duration of contamination, severity and clinical effects. For alkali burns, 2 liters wide open is recommended, then 50mL/hr until pH in eye cul-de-sac is neutral. If buffered or amphotere-containing solution is unavailable, tap water may be substituted until those are available or transit occurs to definitive care from an in-plant setting.

Indications for discontinuation

Only after thorough irrigation of affected area. Neutralization of pH should be demonstrable for acid or alkaline exposures (pH 7.0-7.2).

Rationale

There are no quality studies comparing use with non-use of irrigating systems in patients. There is one RCT in volunteers showing tolerability although there were trends towards higher discomfort scores in the Morgan lens groups; however, the trial only reported 15-minute results and did not report eye damage and/or ongoing symptoms due to the device (Jones et al., 1998). One trial showed reduced symptoms and tolerability with lidocaine

(O'Malley GF, 2008). Irrigating systems, including Morgan lenses, are minimally invasive, have minimal adverse effects, are low cost, and are selectively recommended for chemical eye exposures, particularly involving larger volumes of chemicals and/or stronger agents.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Irrigation systems, irrigation, Morgan lens; chemical burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 373 articles in PubMed, 104 in CINAHL, 40 in Cochrane Library, 11, 700 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ARTIFICIAL TEARS OR LUBRICATION

ARTIFICIAL TEARS OR LUBRICATION FOR OCULAR CHEMICAL BURNS

Recommended

Artificial tears or lubricants are recommended for treatment of patients with chemical ocular burns.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Consideration of use after initial, definitive treatment with flushing/decontamination. Chemical ocular burns of sufficient size and pain, and particularly among those with inadequate tearing.

Benefits

May provide sufficient tears to reduce symptoms and potentially improve healing.

Harms

Undefined but likely negligible.

Frequency/Dose/Duration

Preservative-free artificial tears are recommended as they are generally associated with less eye irritation and faster eye healing (Schrage N, 2012, Sjö AD, 2025, Nasser L, 2018).

Indications for discontinuation

Resolution of symptoms.

Rationale

There are no quality trials of artificial tears for chemical ocular burns. Patients with more extensive burns tend to have greater subsequent need for artificial tears. Artificial tears are inexpensive, noninvasive, and have low adverse effects and are recommended particularly for those patients with inadequate tears and/or symptoms of dry eyes.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: lubricant eye drops, artificial tears, umbilical cord serum, autologous serum, amniotic membrane suspension; chemical burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 572 articles in PubMed, 72 in CINAHL, 26 in Cochrane Library, 13600 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EYE PATCHING

EYE PATCHING FOR CHEMICAL OCULAR BURNS

Recommended

Eye patching is selectively recommended for treatment of extensive, severe chemical ocular burns.

Strength of evidence Recommended, Insufficient Evidence (I)

Level of confidence Low

Indications

Patients with severe chemical eye injuries.

Rationale

There are no quality trials for patching eyes with extensive chemical burns. Extensive burns may involve significant discomfort and inadequate tearing. Patching with an ointment in place may facilitate comfort and potentially, healing and thus is selectively recommended for large chemical burns and/or involving stronger agents.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Eye patching; chemical burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 412 articles in PubMed, 7 in CINAHL, 15 in Cochrane Library, 17400 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EYE DROPS

NSAID DROPS FOR CHEMICAL OCULAR BURNS

Recommended

NSAID ophthalmic drops are recommended for treatment of chemical ocular burns.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients having sustained chemical ocular burns.

Benefits

Reduced pain, decreased inflammatory response.

Harms

Allergic reactions in susceptible patients, intolerance.

Frequency/Dose/Duration

As per manufacturer's recommendation.

Indications for discontinuation

With symptom improvement.

Rationale

There are no quality trials for treatment of chemical ocular burns with ophthalmic NSAID drops. NSAID drops are low cost, not invasive, associated with low risks are likely effective, and 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: NSAID eye drops, Anti-Inflammatory Agents, Non-Steroidal, Non-steroidal anti-inflammatory drugs, sodium hyaluronate, propranolol hydrochloride; chemical burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 826 articles in PubMed, 66 in CINAHL, 23 in Cochrane Library, 5750 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

GLUCOCORTICOSTEROID DROPS FOR CHEMICAL OCULAR BURNS

Recommended

Glucocorticosteroid ophthalmic drops are recommended for select treatment of chemical ocular burns.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients with chemical burns, particularly those which are more severely affected.

Benefits

Reduced inflammation and scarring.
Harms

Increased intraocular pressure, infection.

Rationale

There are no quality trials for treatment of chemical ocular burns with ophthalmic glucocorticoid drops. These medications are used to attempt to reduce the inflammatory process associated with healing chemical burns. These drops are low cost, not invasive, associated with low to moderate risks and are recommended for more severely affected patients. Animal studies are also supportive of a week of treatment (Donshik et al., 1978, Brent et al., 1991, Hoffart et al., 2010).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Gluocorticosteroid eye drops, Glucocorticoids, Corticosteroids; chemical burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 CINAHL, 0 in Cochrane Library, 0 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of

100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SURGICAL INTERVENTIONS

A minority of chemical exposures result in permanent defects, including scarring of the lens and blindness. These cases are generally amenable to surgical procedures, especially corneal transplantation for those with corneal defects and/or scarring involving the visual axis.

Amniotic membrane transplantation (AMT) has been used to treat chemical ocular burns [291-296].

AMNIOTIC MEMBRANE TRANSPLANTATION FOR CHEMICAL OCULAR BURNS

Sometimes Recommended

Amniotic membrane transplantation, potentially in conjunction with a specialized bandage contact lens, and including medical therapy is selectively recommended for treatment of moderately severe chemical ocular burns.

Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Low

Indications

Ocular burn Roper-Hall classification grades II-IV (Tamhane et al., 2005, Tandon et al., 2011).

Benefits

Patient comfort and decreased inflammation with potential for early re-epithelialization.

Harms

Potential allergic response to the membrane.

Frequency/Dose/Duration

Medical therapy to be administered at the same time is: topical 1% prednisolone acetate Q 6 hrs, ofloxacin Q 6 hrs, sodium ascorbate (10%), sodium citrate (10%), plus preservative-free lubricants every 2 hours, plus homatropine (2%) 1-2 times QD, and vitamin C 500 mg PO Q 6 hrs for 2 to 4 weeks (Tamhane et al., 2005).

Rationale

There are three moderate quality trials of amniotic membrane transplantation compared with medical therapy and two of those trials suggested earlier re-epithelialization (Tamhane et al., 2005, Tandon et al., 2011), although one does not (Eslani et al., 2019). An RCT comparing amniotic membrane transplantation with or without use of a specialized bandage contact lens for treatment of dry eye disease reported substantially better results in the group with lens use (Travé-Huarte et al., 2024). Amniotic membrane transplantation,

potentially also using with a specialized bandage contact lens is invasive, has some adverse effects, and is costly, but most data suggest efficacy; thus, it is selectively recommended for treatment of ocular burns and the common complication of dry eye disease.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Amniotic membrane transplantation, amniotic membrane grafting, AMT ; chemical burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 198 articles in PubMed, 30 in CINAHL, 53 in Cochrane Library, 8470 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 2 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

CORNEAL TRANSPLANTATION FOR BLINDNESS OR OTHER CORNEAL SCARRING/DEFECTS AFTER CHEMICAL EYE EXPOSURES

Recommended

Corneal transplantation is strongly recommended for restoration of vision due to blindness or other effects such as corneal scarring post chemical eye exposures.

Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Indications

Patients with uncorrectable visual deficits after ocular chemical burns have otherwise healed.

Benefits

Improved vision.

Rationale

There is strong evidence that corneal transplants are highly successful. Transplants are invasive, may have some complications, are high-cost, but are also potentially highly successful and are thus strongly recommended for those with uncorrectable and significant visual acuity deficits.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Corneal transplantation, corneal transplant, corneal grafting, Keratoplasty; chemical burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 2712 articles in PubMed, 255 in CINAHL, 203 in Cochrane Library, 6200 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 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 reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

FOREIGN BODIES, RUST RINGS, AND CORNEAL ABRASIONS

Foreign bodies and corneal abrasions are the most commonly reported occupational ophthalmological conditions [67, 99, 297]. In experienced hands, they are usually relatively simple to manage. However, complications such as infections and other adverse sequelae occasionally occur.

Symptoms of corneal abrasions, foreign bodies and rust rings both commonly include:

- A foreign body sensation.
- Acute onset of symptoms (usually)
- Pain. May be severe, especially if large foreign body or extensive abrasion(s).
- Tearing
- Redness
- Photophobia, especially if more severe
- Visual acuity usually preserved unless visual axis affected

Symptom onset is sudden and timed with a known event such as metalworking. Abrasions often involve rubbing the eye, with or without a prior foreign body sensation.

Red flags for potentially more serious injuries include [298, 299, 300, 301]:

- History of penetrating trauma or high impact metalworking without eye protection
- Suspected penetration of the globe
- Lacerated cornea
- Lacerated globe
- Ruptured globe
- Impaled globe
- Impaired extraocular eye movements
- Gradual onset of photophobia without an inciting event
- Systemic symptoms or diseases, especially rheumatological
- Purulence
- Abnormal visual acuity without objective foreign body and/or abrasion in the visual axis

Visual acuity should be assessed in all patients. It may be impaired, particularly if the visual axis is involved with the injury or the injury is extensive, e.g., with heavy tearing. This is followed by a careful history of the event(s), including duration of the condition. An eye history should be obtained that includes prior trauma and diseases. A history of systemic diseases should be sought. Prior treatment should be recorded.

An eye exam should ensue. Findings on inspection typically include redness, tearing and difficulty using the eye. Larger foreign bodies are visible on direct inspection. Unless large, abrasions are usually not visible without staining. Direct inspection may provide initial identification of larger foreign bodies. Magnification should identify foreign body(ies) and, if present, rust rings. Slit lamp examination is best. Fluorescein staining should be performed after the initial eye examination has occurred.

Prompt referral for definitive care is recommended for cases with penetrating wounds, lacerations, impaired ocular movements, new pupillary defects, signs of infection, loss of visual acuity (unless a minor abrasion is in the visual axis), and signs of iritis.

DIAGNOSTIC RECOMMENDATIONS

VISUAL ACUITY TESTING

Distance visual acuity screening is performed at the initial visit to document current visual acuity, guide clinical management, and as a baseline for follow-up visits. The LogMar charts are considered the current gold standard in visual acuity testing. Most tests are conducted at a distance of 20 feet away, however smaller letters may be used when the chart or card is less than 20 feet away [302]. Many other acuity tests have been used, including the Randot Stereoacuity test (RSA) [303], the Early Treatment Diabetic Retinopathy Study [304, 305], the Functional Acuity Contrast Test [306], and the Tritan Contrast Threshold test [307]. Near vision acuity is also sometimes assessed depending on various clinical factors, patient symptoms and job demands.

VISUAL ACUITY SCREENING WHEN EVALUATING EYE CONDITIONS

Recommended

Vision screening is recommended for evaluation of eye function, including foreign body and corneal abrasion injuries.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

There are no quality studies to directly address the utility of visual acuity testing. However, it is the primary screening test for all injured eye patients, serving as the main basis for evaluating visual acuity, and thus is recommended. Near vision may also be selectively evaluated, particularly depending on symptoms and job requirements.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: visual acuity screening; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 959 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 959 articles, 2 in CINAHL, 130 in Cochrane Library, 17100 in Google Scholar, and 0 from other sources. We considered for inclusion 4 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and - from other sources. Of the 4 articles considered for inclusion, 4 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SLIT LAMP AND FLUORESCEIN STAIN

SLIT LAMP AND FLUORESCEIN STAIN FOR EYE FOREIGN BODY AND CORNEAL ABRASION

Recommended

Slit lamp with fluorescein staining is recommended.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

There are no quality trials comparing use of slit lamp with and without fluorescein staining. Some foreign bodies may be observed without a microscope or slit lamp. This technique requires modest practitioner skill. SL examination is moderately expensive, has no adverse effects for diagnostic purposes, is highly effective, and therefore is recommended. In some circumstances depending on mechanism of injury, scope of injury and other factors, it may not be essential.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: slit lamp evaluation; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 959 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 959 articles, 2 in CINAHL, 130 in Cochrane Library, 17100 in Google Scholar, and 0 from other sources. We considered for inclusion 4 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 4 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

X-RAYS

Roentgenograms (x-rays) use x-ray beams to detect radiolucent objects, particularly metallic or calcified. They have been used to assess the eye's structural components and can be used to detect intraorbital foreign bodies (IOFBs), orbital and intraorbital fractures, orbital floor blow-outs and retinoblastomas [308, 309, 310, 311].

X-RAY FOR EVALUATION OF ORBITAL FRACTURE

Recommended

X-rays have been used for evaluation of potential fractures, and penetrating eye trauma, particularly if metallic (Modjtahedi et al., 2015).

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Trauma sufficient to produce orbital fracture(s).

Benefits

Detection of orbital fractures.

Harms

Mild radiation exposure.

Rationale

There are no quality studies of X-rays for the detection of orbital fracture, although they have been widely used. X-rays have no significant adverse effects and are low to moderate cost and are thus recommended for evaluation of potential orbital fracture. However, CT scans are generally considered the gold standard for assessing fractures.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Orbital fractures, Radiography, X-rays; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 170 articles in PubMed, 3 in CINAHL, 0 in Cochrane Library, 205 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

X-RAY FOR OCULAR FOREIGN BODIES

Recommended

X-rays have been used for evaluating the presence of ocular metallic bodies.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

There are two moderate-quality studies that included using x-rays for detection of intraocular foreign bodies. Clear superiority of one imaging method over another (e.g., CT, x-ray) has not been shown. There is some evidence that CT is superior to x-ray for evaluation of trauma (Pasman et al., 1995); and MRI is superior to x-ray or CT to determine foreign body composition if non-ferrous (Modjtahedi et al., 2015). X-rays have no significant adverse effects, are low to moderate cost, and are thus recommended for evaluation of intraocular foreign bodies (especially metallic).

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Radiography, X-rays; eye diseases, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 34574 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 34574 articles, 179 in CINAHL, 61 in Cochrane Library, 715 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

X-RAY FOR SIMPLE OCULAR ABRASIONS, RUST RINGS, AND NONPENETRATING FOREIGN BODIES

Not Recommended

X-rays are not recommended for routine evaluation of ocular abrasions, rust rings and foreign bodies.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

There are no quality studies comparing use of x-rays with evaluations without x-ray to ascertain differences in patient outcomes for simple abrasions, rust rings and/or foreign bodies. However, x-rays may be indicated for evaluation of penetrating trauma, such as to identify other metallic, intraocular bodies (see other recommendation). X-rays have no clear use for routine evaluation of foreign bodies that do not penetrate and thus 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: Orbital fractures, Radiography, X-rays; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 170 articles in PubMed, 3 in CINAHL, 0 in Cochrane Library, 205 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

COMPUTED TOMOGRAPHY

Computed tomography uses x-rays but provides more detailed images with greater resolution [312]. It is considered superior to MRI for imaging fractures [313]. Its purported uses include detecting intraorbital foreign bodies (IOFBs), evaluating ferrous foreign bodies, orbital fractures, orbital sepsis and traumatic optic neuropathy [314, 315].

COMPUTED TOMOGRAPHY (CT) FOR OCULAR FOREIGN BODIES

Sometimes Recommended

CT imaging is selectively indicated for evaluation of penetrating and/or evaluation of potentially retained intraocular foreign bodies.

Strength of evidence Recommended, Insufficient Evidence (I)

Level of confidence Moderate

Rationale

There are no quality studies comparing use of CT scans with evaluations without CT scans to ascertain differences in patient outcomes. One small comparative study reported superiority of helical CT scans to conventional scans in the pre-operative setting. CT scans have been suggested to be helpful for evaluating intraorbital foreign bodies (IOFBs) (Pinto et al., 2012, Bodanapally et al., 2014, Lakits et al., 1998) and thus are recommended for selective use. CT is generally preferentially considered over MRI for the evaluation of ocular foreign bodies (Song et al., 2025, Rong et al., 2019).

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Tomography, X-Ray Computed, Single Photon Emission Computed Tomography Computed Tomography, Multidetector Computed Tomography, CT Scan; eye diseases, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 5173 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 5173 articles, 198 in CINAHL, 194 in Cochrane Library, 593 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

COMPUTED TOMOGRAPHY (CT) FOR EYE INJURIES

Recommended

Computed tomography (CT) is recommended for eye injuries due to blunt trauma, penetrating globe injuries, and/or abrasions accompanied by concerns for orbital fractures and/or other complications unaddressed by radiographs.

Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Indications

Blunt trauma with concerns for orbital fracture and/or metallic or other foreign bodies.

Rationale

CT scans for blunt and/or penetrating trauma are supported by many studies and are considered the main imaging procedure for blunt trauma to rule out fractures, acute globe trauma (Bodanapally et al., 2014, Aljuhani et al., 2025, Foroughi et al., 2025, Gad et al., 2017, George, 2024, Kim et al., 2010, Yuan et al., 2014, Ren, 2022, Koca et al., 2025, Crowell et al., 2017, Chou et al., 2016, Karataş et al., 2025, Chen et al., 2024), as well as foreign bodies, and thus are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: computed tomography, CT scan; Blunt trauma injuries, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 5449 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 5449 articles, 65 in CINAHL, 24 in Cochrane Library, 7530 in Google Scholar, and 2 from other sources†. We considered for inclusion 0 from PubMed, 3 from CINAHL, 0 from Cochrane Library, 7 from Google Scholar, and 7 from other sources. Of the 17 articles considered for inclusion, 15 diagnostic studies and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) has been used especially for soft tissue imaging [316, 317, 318, 319, 320] that includes intraocular, non-ferrous foreign bodies [321, 322]. X-rays are needed to evaluate suspected intraocular foreign bodies prior to MRI in many patients.

MAGNETIC RESONANCE IMAGING (MRI) FOR EYE FOREIGN BODIES AND CORNEAL ABRASION

Not Recommended

MRI is not recommended for routine evaluation of eye foreign body or corneal abrasion, particularly if there is concern of ferrous-metallic object penetration of the globe. MRI may

be a reasonable option to evaluate intraocular foreign bodies when there is assurance that an intraocular foreign body is non-ferrous (Modjtahedi et al., 2015, Moisseiev et al., 2015). Absent metallic foreign bodies, there are concerns for other ocular/periorbital trauma or fracture with visual impairment.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

There are no quality studies comparing use of MRIs with evaluations without MRIs to ascertain differences in patients outcomes. MRI may be a reasonable option to evaluate intraocular foreign bodies if they are known to be non-ferrous (Moisseiev et al., 2015). MRIs have been shown to be helpful for evaluating soft tissues, including retinal imaging, evaluating staphyloma (Beenakker et al., 2015). Workers are usually unable to identify whether a potential metal foreign body is ferrous or not, providing further concerns about the use of MRI in that setting. When there is concern regarding detection of orbital fractures, CT is generally preferable (Rong et al., 2019, Song et al., 2025).

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; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 12729 articles in PubMed, 470 in CINAHL, 241 in Cochrane Library, 778 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 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 review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TREATMENT RECOMMENDATIONS

FOREIGN BODY AND RUST RING REMOVAL

Depending on size and degree of embedding, foreign bodies are commonly removed through irrigation, cotton swab, hypodermic needle tip, burr tool, and natural tears [323, 324, 325]. Magnets also have been successfully used for ferrous foreign body removals [326, 327]. Rust rings also occur and are generally easily removed [328, 329].

COPIOUS EYE IRRIGATION FOR SUPERFICIAL FOREIGN BODY REMOVAL

Recommended

Copious irrigation (e.g., approximately 200mL to 1L) is recommended for removal of superficial foreign body(ies) in some circumstances. The use of a Morgan Lens is not recommended for simple foreign bodies and may cause (additional) abrasions unless there is concern related to chemical or other substance that may result in rapid corneal injury through pH imbalance or other mechanism. Copious irrigation after removal of a foreign body (see below) is often included as an adjunct to attempt to assure removal of foreign body(ies).

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Foreign body sensation, especially with mechanism suspected to result in unembedded foreign body(ies), such as fiberglass, windblown debris. Also selectively used after foreign body removal, particularly if the foreign body fragments.

Benefits

Removal of foreign body or irritants.

Harms

Negligible when irrigated without an appliance. May have minor irritation.

Frequency/Dose/Duration

Irrigation with from approximately 200mL to 1L of either sterile saline or lactated Ringer's solution is recommended (Jones et al., 1998). Experimental evidence suggests solution choice is unimportant (Jones et al., 1998).

Indications for discontinuation

After completion. May repeat until symptoms resolved.

Rationale

There are no quality studies comparing irrigation with no irrigation for foreign bodies of the eye. Irrigation is low cost, minimally invasive, associated with negligible risks, is successful and 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: Therapeutic Irrigation, irrigation; foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 705 articles in PubMed, 70 in CINAHL, 450 in Cochrane Library, 4, 160 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

REMOVAL OF SUPERFICIAL EYE FOREIGN BODY WITH COTTON SWAB, NEEDLE, OR MAGNET

Recommended

The device used (e.g., needle, tool, magnet, swab) for foreign body removal is recommended to be based on expected foreign body composition, depth of embedding and clinician's experience. Copious irrigation after removal of a foreign body (see above) may also be included as an adjunct to attempt to assure removal of foreign body(ies) especially if fragmentation occurs on attempted removal and/or there are concern for more small foreign bodies elsewhere in the fornices. Use of slit-lamp examination is usually helpful, but is optional for simple removals, especially when the foreign body is visible without magnification and removal is easy (e.g., use of magnet). Slit-lamp is essential if prior removal attempts fail (Quirke et al., 2014).

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Foreign body visualized, and non-mobile.

Benefits

Removal of foreign body.

Harms

Negligible in experienced hands. Rare infections, although that risk may not be associated with the foreign body removal, and instead is more associated with embedded organic matter.

Indications for discontinuation

With resolution of issue.

Rationale

Foreign body removal has not been evaluated in quality comparative trials. Use of a magnetized tool tip is quite simple and may result in less corneal damage, but its use is limited to ferrous bodies. Quality data do not clearly define that a slit-lamp examination is required (Quirke et al., 2014), although for some removals it is essential. There is a low threshold for sweeping the fornices, especially for those with multiple foreign bodies. Foreign body removal is moderate cost, minimally invasive, associated with negligible risks, is highly successful and 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: Corneal Foreign Body Removal, Removal; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 2790 articles in PubMed, 310 in CINAHL, 234 in Cochrane Library, 1160 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

REMOVAL OF CORNEAL RUST RING

Recommended

Removal of a corneal rust ring, which can develop in as little as three to four hours after ferrous metal adheres to, or penetrates the cornea, is recommended (Mela et al., 2005, Mackiewicz et al., 2005, Xiang et al., 2005). Due to its insolubility in the corneal tissues, oxidation occurs and rust infiltrates the surrounding corneal tissue (Mela et al., 2005, Mackiewicz et al., 2005, Xiang et al., 2005). However, it is usually readily removed (Mackiewicz et al., 2005, Xiang et al., 2005).

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Presence of rust ring with or without foreign body. If foreign body visualized, it must be removed and by definition, use of a magnet for an initial tool to attempt to remove the foreign body is preferred. For rust ring removal, use of a burr under slit lamp examination is the preferable procedure (Brown et al., 1975). Use of a hypodermic needle may be adequate to successfully remove some tiny rust rings.

Benefits

Removal of rust ring. Improvement in visual acuity if rust ring is in the visual axis. Removal is thought to also reduce scarring.

Rationale

There is no trial comparing rust ring removal with non-removal. Rust ring removal has been evaluated in one moderate quality trial that compared manual rust ring removal with use of an electric drill and found the drill superior (Brown et al., 1975). A low quality trial found comparative results with an electric drill compared with a burr (Brown et al., 1975). Delayed and/or inadequate rust ring removal has been associated with worse ocular rehabilitation (Jayamanne et al., 1994). Rust ring removal is minimally invasive, associated with negligible risks, generally quite successful, moderately costly, 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: Removal, Removal of rust rings; foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 3114 articles in PubMed, 1159 in CINAHL, 1932 in Cochrane Library, 15, 000 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EYE PATCHING

Eye patching has been used as a treatment for corneal abrasion injuries related to foreign body or traumatic injury of the corneal epithelium [330-335]. Patching for 24 hours has been traditionally prescribed to purportedly reduce pain and a theory of promoting healing through reducing eyelid movement across the wound [333]; however, the evidence does not support patching.

EYE PATCHING FOR CORNEAL ABRASION

Not Recommended

Eye patching for simple corneal abrasions is moderately not recommended, including after removal of foreign bodies or rust rings.

Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Harms

Inability to use the eye, elimination of binocular vision, reduced depth perception.

Rationale

There are five moderate quality trials that compared the use of an eye patch with no patch for simple corneal abrasions (Kaiser, 1995, Arbour et al., 1997, Campanile et al., 1997, Le Sage et al., 2001, Menghini et al., 2013). There are no quality trials comparing patch to non-patching without cointerventions, as each of the trials utilized other treatments in addition to patching, including mydriatics, ophthalmic antibiotic drops or ointments, which may also have had some therapeutic effect. However, the trial results uniformly found no clinically significant differences demonstrated between the groups in healing times, pain control or adverse outcomes. The use of an eye patch did not demonstrate altered increased risk of infection in any of the trials. A meta-analysis also failed to find significant differences in pain scores (Yu et al., 2021). Use of an eye patch may be problematic for activities requiring binocular vision and good depth perception. Evidence is consistent that an eye patch does not provide faster healing or fewer complications, and therefore patching is not recommended for simple abrasions.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Eye patching, Occlusive Dressings; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 430 articles in PubMed, 7 in CINAHL, 18 in Cochrane Library, 397 in Google Scholar, and 0 from other sources. We considered for inclusion 1 from PubMed, 0 from CINAHL, 2 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 0 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

THERAPEUTIC CONTACT LENS

Therapeutic contact lens accompanied with non-preserved ofloxacin eye drops, also described as a contact bandage, have been used to treat corneal abrasions as a measure to purportedly aid in re-epithelialization of the corneal defect [(335)].

THERAPEUTIC CONTACT LENS FOR CORNEAL ABRASIONS

Not Recommended

Use of a therapeutic contact lens or contact bandage for corneal abrasions is not recommended.

Strength of evidence Not Recommended, Evidence (C)
Level of confidence Moderate

Rationale

There is one moderate-quality trial that compares use of patching with therapeutic contact lens and topical antibiotic for healing rates of simple corneal abrasion. There was no difference between the two groups (Hunting et al., 1999). Thus, there is no evidence of efficacy of the therapeutic contact lens and it is not recommended for these purposes.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Contact Lenses, therapeutic contact lenses, bandage contact lenses; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 1122 articles in PubMed, 165 in CINAHL, 3459 in Cochrane Library, 2, 500 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 articles considered for inclusion, 0 randomized trials and 1 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

THERAPEUTIC CONTACT LENS FOR RUST RINGS OR FOREIGN BODIES

Not Recommended

A therapeutic contact lens or contact bandage is not recommended for rust rings or foreign bodies.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There is one moderate-quality trial that compares use of patching with therapeutic contact lens and topical antibiotic for healing rates of simple corneal abrasion. There was no difference between the two groups (Hunting et al., 1999). Thus, there is no evidence of efficacy of the therapeutic contact lens and it is not recommended for these purposes.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: therapeutic contact lenses, Bandage contact lenses, Contact lenses; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 1009 articles in PubMed, 94 in CINAHL, 310 in Cochrane Library, 815 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MEDICATIONS

The use of ophthalmic antibiotic solutions or ointments have been prescribed following traumatic corneal abrasion. The incidence of bacterial keratitis following corneal abrasion is thought to be low, however there may be increased risk with injuries associated with vegetative or organic matter [86, 87, 88]. There also is a reportedly higher incidence of keratitis from foreign body injuries in the developing world than industrialized countries [91, 336].

Topical nonsteroidal anti-inflammatory medications (NSAIDs) function as local analgesics and are administered to provide relief from pain associated with corneal abrasions [85], postoperative pain from various surgical procedures [92] and pain associated with many other disorders. Topical antifungal medications, generally in ointment form, have been used to attempt to prevent (or treat) fungal keratitis that typically arises from corneal abrasions with unsanitary objects or sources [337].

Epidermal growth factor (EGF) reportedly accelerates the re-epithelialization process for traumatic corneal ulcers [338, 339]. EGF purportedly decreases epithelial defects, vascularization risks, infection, and rejection of graft. The encoded proteins act as a mitogenic factor that responds by initiating cellular growth. EGF may be found in the cell membranes of conjunctival epithelium, corneal epithelium and lens epithelium. Once EGF binds with the receptors, proliferation and differentiation of epidermal and cells occurs [339].

Mydriatic medications such as topical anticholinergic preparations have been used to provide analgesic relief from corneal abrasion and foreign body removal through dilation of the pupil. These medications are typically applied directly to the eye to assist with eye examinations or surgeries, and to treat cyclitis and iritis.

The use of artificial tears and lubricants is commonly used for eye irritation related to foreign body and corneal abrasion. Artificial tears or lubricants are often used to relieve eyes exhibiting dryness, or keratoconjunctivitis sicca, when the eyes are unable to produce adequate tears.

Topical opioids provide analgesic effects for severe ophthalmic pain on a short-term basis. Extended chronic use can result in adverse effects to the corneal tissues reportedly including alteration of lacrimation, corneal sensitivity loss, increased corneal permeability, disruption of corneal cell motility, swelling and corneal re-epithelialization inhibition [340]. See also Work-related Asthma Guideline.

Topical anesthetics are used during eye examinations and procedures to aide in hindering pain signals from nerve endings. Pain can be induced from the presence of foreign bodies, corneal abrasions and many other conditions [341].

Consultation with an ophthalmologist may be helpful when considering prescriptions for pregnant persons because the systemic absorption (either direct or after ingestion of lacrimal fluid) is estimated to be ~60-70%.

PROPHYLACTIC OPHTHALMIC ANTIBIOTICS FOR SIMPLE CORNEAL ABRASION, RUST RINGS, AND FOREIGN BODIES

No Recommendation

There is no recommendation for or against the use of prophylactic ophthalmic antibiotics for simple corneal abrasion, rust rings, and foreign bodies that do not involve vegetative matter.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Indications

None in the absence of vegetative matter (see below).

Harms

Potential for allergic reaction.

Rationale

There are no quality studies suggesting efficacy of prophylactic ophthalmic antibiotics for prevention of eye infections in the setting of minor ocular trauma and not involving vegetative matter; vegetative matter is thought to significantly increase risk of infections and the recommendation is different (see below). There is only one low quality study using antifungals for corneal abrasions which showed lack of efficacy between treatment groups. As there is no quality evidence, antibiotics are not invasive, have few adverse effects and are low cost, there is no recommendation for or against use of antibiotics in the absence of vegetative matter.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Prophylactic ophthalmic antibiotics, antibiotics, moxifloxacin, gatifloxacin, ciprofloxacin, ofloxacin; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 2787 articles in PubMed, 346 in CINAHL, 838 in Cochrane Library, 682 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 1 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 review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PROPHYLACTIC OPHTHALMIC ANTIBIOTICS FOR ORGANIC MATTER INJURIES

Recommended

Prophylactic ophthalmic antibiotics are recommended for abrasions associated with significant organic or vegetative matter.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Abrasions due to organic or vegetative matter, regardless of whether a foreign body removal procedure was required.

Benefits

Potential for reduced risk of infection.

Harms

Allergic reactions in susceptible patients, intolerance.

Frequency/Dose/Duration

Per manufacturer's recommendations.

Rationale

There are no quality trials comparing prophylactic antibiotic use with placebo or non-use in the setting of trauma involving organic matter. However, there is thought to be considerably higher risk of infection when vegetative matter is involved due to potential microbial load/dose, and this is thought to increase risk of infection. Prophylactic use is widely

practiced in this setting. Ophthalmic antibiotics are noninvasive with low risk for systemic effects, but do carry small risk of adverse events such as allergic reaction, eyelid itching and swelling, and conjunctivitis. Costs range from inexpensive to relatively high cost for new wide spectrum antibiotics. Eye injuries associated with plant or vegetative matter or organic matter likely have higher risk for bacterial or fungal infection and may warrant use of these medications, and thus they are recommended for this limited indication.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Prophylactic ophthalmic antibiotics, antibiotics, moxifloxacin, gatifloxacin, ciprofloxacin, ofloxacin; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 2789 articles in PubMed, 274 in CINAHL, 838 in Cochrane Library, 782 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

NSAID DROPS AFTER REMOVAL OF RUST RING OR EYE FOREIGN BODY

Recommended

NSAID ophthalmic drops are selectively recommended for large abrasions and/or after removal of a corneal rust ring or foreign body, particularly if larger sized.

Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Frequency/Dose/Duration

Per manufacturer's recommendations. Duration is until the abrasion is resolved.

Indications for discontinuation

When the condition and pain have resolved.

Rationale

There are six moderate-quality trials comparing NSAIDs with placebo or drug vehicle for analgesia of simple corneal abrasion (Alberti et al., 2001, Goyal et al., 2001, Jayamanne et al., 1997, Kaiser et al., 1997, Patrone et al., 1999, Szucs et al., 2000) A Cochrane review failed to find a large magnitude of benefit of 30% and/or 50% at 24 hours (Wakai et al., 2017), although that large a magnitude of expectations is beyond what NSAIDs provide for other painful conditions. Ophthalmic drops were evaluated in one moderate quality study after rust ring removal and found evidence of efficacy (Haynes et al., 1996). Each of the trials suggest efficacy in providing analgesia, with no significant increases in adverse events or reduction in healing times. NSAID drops have been shown to reduce pain, have low adverse effects, are low cost, 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: Anti-Inflammatory Agents, Non-Steroidal, NSAID Eye drops, Ketorolac, Diclofenac; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 465 articles in PubMed, 54 in CINAHL, 528 in Cochrane Library, 195 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 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 review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PROPHYLACTIC OPHTHALMIC ANTIFUNGALS

Not Recommended

The use of topical antifungal medications is not recommended for routine prophylaxis of simple corneal abrasions, rust rings and foreign bodies. They may be of benefit in select populations at risk for contaminated injuries, such as from plants or organic matter.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials of efficacy in a developed country. There is one moderate quality comparative trial comparing use of antibiotics and topical clotrimazole with antibiotics in a developing world tribal population (Srinivasan et al., 2006). There were no differences in healing rates. The study may be limited by power, generalizability from Southern India, potentially different foreign body source(s) and/or complications may have differed (Srinivasan et al., 2006). Topical prophylactic antifungal medications are noninvasive, have low risk for adverse events, low to moderate cost, and are not shown to be effective and thus are not recommended for routine use as prophylaxis for simple corneal abrasions.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: prophylactic ophthalmic antifungals, antifungal agents, antifungal, antifungals, natamycin, amphotericin, voriconazole, itraconazole, ketoconazole, fluconazole; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 606 articles in PubMed, 74 in CINAHL, 14 in Cochrane Library, 517 in Google Scholar, and 0 from other sources†.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EPIDERMAL GROWTH FACTOR (EGF) FOR CORNEAL ABRASIONS

Not Recommended

Epidermal growth factor (EGF) is not recommended in the treatment of corneal abrasion, although it may be indicated for treatment of severe injuries.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Not indicated for the treatment of corneal abrasions, rust rings and foreign bodies.

Rationale

There is one quality trial comparing the use of EGF with placebo suggesting faster healing times measured in hours rather than days (Pastor et al., 1992). Topical ophthalmic EGF is

not recommended for simple corneal abrasions which heal quickly, although it may be indicated for severe injuries.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Epidermal growth factor; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 2 in CINAHL, 4 in Cochrane Library, 5800 in Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EPIDERMAL GROWTH FACTOR (EGF) FOR RUST RINGS AND FOREIGN BODIES

Not Recommended

Epidermal growth factor (EGF) is not recommended in the treatment of most rust rings and foreign bodies. Selective use in severe injuries may be indicated.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Not indicated for the treatment of corneal abrasions, rust rings and foreign bodies.

Rationale

There is one quality trial comparing the use of EGF with placebo suggesting faster healing times measured in hours rather than days (Pastor et al., 1992). Topical ophthalmic EGF is not recommended for simple corneal abrasions, although it may be indicated for treatment of severe injuries.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Epidermal Growth

Factor, EGF; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 61 articles in PubMed, 3 in CINAHL, 0 in Cochrane Library, 5090 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MYDRIATIC MEDICATIONS FOR EYE INJURIES

Not Recommended

Mydriatic medications are not recommended for treatment of simple corneal abrasions, rust rings and foreign bodies.

Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

There is one high quality trial demonstrating no efficacy of mydriatic medication compared with synthetic teardrops for analgesia after corneal abrasion (Meek et al., 2010). Mydriatic medications are not invasive, but cause dilation of the pupil and potentially light sensitivity and decreased visual acuity that may be a safety concern for reading, driving, etc. They are low cost. The use of mydriatic medications for corneal abrasion is not recommended except in circumstances that require pupil dilation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Mydriatic Medications, Mydriatics, Homatropine Hydrobromide. Cyclopentolate, Tropicamide; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 531 articles in PubMed, 45 in CINAHL, 5 in Cochrane Library, 238 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ARTIFICIAL TEARS OR LUBRICATION FOR EYE INJURIES

Recommended

Artificial tears or lubricants are selectively recommended for treatment of patients with extensive corneal abrasions, rust rings, and foreign bodies, especially among those who do not tolerate ophthalmologic NSAIDs.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Corneal abrasions of sufficient size and pain that require adjunctive treatment. However, NSAIDs are more effective (Goyal et al., 2001, Szucs et al., 2000); thus, artificial tears should be reserved for those not tolerating ophthalmological NSAIDs.

Rationale

There are two quality trials comparing artificial tears to topical NSAIDs, demonstrating greater efficacy of the NSAID than artificial tears (Goyal et al., 2001, Szucs et al., 2000). There are no quality trials for artificial tears or lubrication vs. placebo. Artificial tears are inexpensive, noninvasive, and have low adverse effects. There is insufficient evidence for or against use of artificial tears, and other interventions may be more beneficial. However, these may be a low cost, low adverse effect option for those who do not tolerate NSAIDs yet require some additional minor treatment.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Artificial Tears, Lubricant Eye Drops, Ketorolac trometamol, diclofenac sodium; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 557 articles in PubMed, 61 in CINAHL, 22 in Cochrane Library, 3590 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 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.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TOPICAL ANESTHETICS FOR EYE INJURIES

No Recommendation

There is no recommendation for the use of topical anesthetics for short-term analgesia for corneal abrasion, rust rings, and foreign bodies outside of clinical settings.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One high-quality trial and two moderate-quality trials have demonstrated significant analgesic efficacy over the first 24-48 hours after injury (Shipman et al., 2021, Waldman et al., 2014, Ball et al., 2010), with one showing a 7-point pain rating difference and 87% lower hydrocodone tablets consumed (Shipman et al., 2021). A small pilot study with a high dropout rate reported lack of efficacy (Ting et al., 2009). A Cochrane review failed to find meaningful benefits (Sulewski et al., 2023), as did another meta-analysis (Yu et al., 2021). Prolonged use of topical anesthetics is controversial, with concerns for toxicity from overuse or complications from overtreatment of pain, such as retained foreign body. Some guidelines and evidence reviews have endorsed use of topical anesthetics for simple corneal abrasions (Green SM, 2024, Shipman et al., 2021). However, there are concerns that the RCTs are underpowered to detect serious adverse events including toxicity (Leslie L, 2025, Weiser P, 2024) and longstanding practice patterns against use of these agents, thus additional, sizable studies are needed and 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: Topical anesthetic, Topical anesthesia, Lidocaine, Tetracaine, Proparacaine; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 362 articles in PubMed, 32 in CINAHL, 351 in Cochrane Library, 703 in Google Scholar, and 0 from other

sources†. We considered for inclusion 1 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 3 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 2 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TOPICAL OPIOIDS FOR ANALGESIA AFTER EYE INJURY

Not Recommended

The use of topical fentanyl and opioids for analgesia of corneal abrasions, rust rings, and foreign bodies is not recommended.

Strength of evidence Not Recommended, Evidence (C)
Level of confidence Moderate

Harms

Decreased lacrimation, corneal sensitivity loss, increased corneal permeability, disruption of corneal cell motility, swelling and inhibition of corneal re-epithelialization.

Rationale

There is one quality trial comparing the use of topical fentanyl with no fentanyl that demonstrated no improved in analgesia at the dose tested (Zollner et al., 2008). There are no commercially available topical opioids approved for use in the eye in the U.S. These medications are not invasive, have reported adverse effects, and have no demonstrated efficacy and are thus 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: Opioid OR opiates OR morphine sulfate; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 550 articles in PubMed, 55 in CINAHL, 266 in Cochrane Library, 1, 270 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ANTIEMETICS

See the ACOEM Antiemetics Guideline.

INFECTIONS AND CORNEAL ULCERS

The patient evaluation should include assessment of temperature, visual acuity, observation, extraocular movements, type of discharge, corneal opacity, eyelid swelling, proptosis, shape and size of the pupil, and sensitivity to light [342]. Lymphadenopathy is more commonly associated with viral as compared to bacterial conjunctivitis [343].

Infections are among the differential diagnoses for a red eye (see Table 4). Eye infections may be acute, subacute or chronic. Infections of the conjunctive or cornea are generally accompanied by mattering of the eyelids on awakening as well as either an absence of or minimal pruritus [343, 344]. Thus, a symptom of mattering is somewhat helpful to narrow the differential diagnosis to be more likely an infectious etiology. Bilateral mattering is thought to be more likely bacterial [342]. However, mattering is not particularly helpful to distinguish the type of infection. Mattering also is a symptom of blepharitis (low level infection along the lid margins), as well as a few other conditions.

The diagnostic criteria for **viral conjunctivitis** are: (i) watery discharge (although it may also be mucopurulent), (ii) minimal or no purulent discharge, (iii) in an erythematous eye, (iv) with preserved visual acuity and (v) with no corneal opacities.

Diagnostic criteria for **corneal viral infections** (e.g., herpes simplex or zoster) are: (i) watery discharge, (ii) minimal or no purulent discharge, (iii) in an erythematous eye, (iv) with impaired visual acuity (or preserved visual acuity but impaired visual fields if the infected corneal area is out of the visual axis) and (v) with corneal opacities.

Diagnostic criteria for **bacterial and fungal eye infections** are: (i) the presence of purulent discharge [345, 346], (ii) in an erythematous eye [347, 348], (iii) with preserved visual acuity, (iv) lack of pruritus, (v) no history of conjunctivitis, and (vi) that may or may not be confirmed by culture [349, 350]. Bacterial and fungal Infections may be screened with gram stain, KOH (potassium hydroxide) preparation and confirmed with bacterial and fungal cultures. Gram stains and cultures are often not performed especially in milder cases where the condition may be self-limited and thus resolve with no or limited empiric treatment [342]. Cultures are necessary for cases with neonatal conjunctivitis, severe infections, recurrent infections, Neisserial infections, chlamydia infections, and cases that are difficulty to treat [342].

Particularly with acute infections, there usually is marked conjunctival injection. The main infectious etiologies in the differential diagnosis among immunocompetent individuals in the developed world are viral conjunctivitis, bacterial and fungal infection. In other parts of

the world or elsewhere among select populations, other etiologies include mycobacterium, parasites, and trachoma. Infections due to chlamydia trachomatis or Neisseria gonorrhea are beyond the scope of this guideline, yet for completeness are noted to require treatment with a systemic antibiotic plus an ophthalmologic antibiotic preparation.

Bacterial or fungal infections may also accompany and/or complicate corneal ulcers. Diagnostic criteria for bacterial or fungal ulcers are the same as those for infection with the added finding of corneal defect(s) or ulcer(s) on slit lamp examination.

The most important clinical assessment is whether the infection is vision-threatening or not. In general, vision threatening infections involve corneal ulcers and/or corneal infections.

Most eye infections in adults are diagnosed as viral conjunctivitis [351-359]. These infections are highly contagious [360, 361, 362, 363], with familial attack rates of up to 50% [364, 365]. Viral conjunctivitis normally does not require treatment other than instructions on careful handwashing, potentially isolating the patient/worker from others, avoiding touching the eye and any other object (contact precautions) [342]. Conjunctivitis caused by herpes simplex or herpes zoster may be resolved faster with treatments [245, 355-358, 366-368]. Herpetic and zoster corneal infections are considerably more complex than conjunctivitis caused by, e.g., adenovirus. Herpetic and zoster corneal infections may be vision-threatening and require prolonged treatment with antiviral medications.

Bacterial infections are the second most common cause [351-355, 358, 359]. Bacterial infections may be self-limited; thus, when mild, these infections may not require treatment [360], but they can also be more serious. Fungal infections are more serious and require treatment. One of the more serious conditions is an ulcer complicated by bacterial and fungal infection, which requires treatment and more vigilant follow-up care. Fungal infections typically take at least a month to resolve [369]. Contact-lens related infections are caused by bacterial, fungal, and Acanthamoeba infections and are beyond the scope of this guideline [370]. Simple infections are mostly treated by primary care, urgent care, and other non-ophthalmological and non-optometric specialists [361].

For presumptive viral conjunctivitis and mild bacterial conjunctivitis, there is no medication necessary. However, careful instructions about vigilant hand-eye hygiene is important to reduce risks of further spread for 10-14 days. There is consideration for work limitations for those with high contact with others, and particularly among those working with immunosuppressed individuals. For moderate to severe bacterial conjunctivitis, corneal infections, and ulcers, closer follow-up is required for progress and recovery, typically with an ophthalmologist.

SIGNS AND SYMPTOMS

Corneal ulcers are considered an ophthalmologic emergency, with prompt referral to an ophthalmologist. They may result in permanent visual impairment. They may be bacterial, viral, fungal, or parasitic in origin and may occur following corneal lacerations, abrasions, and intrusion of foreign bodies. They may result from poorly fitted or inadequately cleaned contact lenses. Patients with corneal ulcers present with complaints of changes in visual acuity, photophobia and/or eye pain, tearing, and a sensation that a foreign body is in the eye. The presence of corneal ulcers can be determined by direct visualization, but magnified viewing with fluorescein staining is needed to completely rule out their presence.

Symptoms usually begin gradually. Mattering of the eyelid(s) and a red eye on awakening is often the first sign of an eye infection. Common symptoms of corneal infections include: red/pink eye, tearing, purulence, crusty eyelids, mild pruritus, photophobia (if more severe), and potentially a mild foreign body or irritation sensation. Visual acuity is generally preserved, although some viral infections, especially herpes or zoster, may involve the visual axis and reduce visual acuity.

Symptoms of corneal infections commonly include the following:

- Red or pink eye
- Tearing
- Purulence
- Crusty eyelids, especially on awakening
- Mild pruritus is sometimes present
- Photophobia, especially if more severe
- Visual acuity is usually preserved unless visual axis affected (e.g., by corneal ulcer or corneal abrasion)
- Corneal ulcers typically include a foreign body sensation

Symptom onset is usually gradual. However, as onset is most often noticed on awakening with mattering of the eyelids, some patients may report this as sudden onset. Some infectious cases occur after acute onset of trauma to the cornea, e.g., corneal abrasion. Onset of corneal ulcers are similarly gradual, although the inciting event may have been an acute injury.

Other red flags for potentially more serious infections include:

- Reduced visual acuity
- Periocular swelling and inflammation
- History of penetrating trauma or high impact metalworking without eye protection
- Suspected penetration of the globe
- Impaired extraocular eye movements
- Photophobia
- Systemic symptoms or diseases, especially rheumatological
- Copious purulence

DIAGNOSTIC RECOMMENDATIONS

VIRAL SCREENING

Adenovirus screening has been performed in clinical settings to diagnose viral conjunctivitis [371] as most cases of viral conjunctivitis are caused by adenovirus [343].

ADENOVIRUS SCREENING FOR INFECTIOUS CONJUNCTIVITIS

Sometimes Recommended

Adenovirus screening is selectively recommended for evaluation of infectious conjunctivitis where there is diagnostic uncertainty and especially if there is a significant consideration for bacterial conjunctivitis. It is not recommended for routine evaluation of typical viral conjunctivitis cases, particularly in clinical locations without ready access to testing.

Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Rationale

One high-quality study showed 89% sensitivity and 94% specificity (Sambursky et al., 2006) and multiple other tests suggested at least some diagnostic accuracy (Johnson et al., 2021, Migita et al., 2019, Shorter et al., 2022, Kodama et al., 2020), although not all studies and tests suggest utility (Sachdev et al., 2018). The primary purposes of adenovirus screening are: 1) to indicate cases at high risk for epidemic spread of an adenovirus infection and 2) to rule out other infections and prevent excessive antibiotic usage for a condition that is usually self-limited. Yet, there are other viral causes; thus, it is an imperfect test. As most cases resolve readily without treatment, routine screening is not recommended, especially in locations without ready access to testing. Adenovirus screening is not invasive, has negligible adverse effects, is low cost, has demonstrated efficacy, and is thus indicated for selectively diagnosing viral conjunctivitis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Adenovirus screening; eye diseases, eye disorder, eye abnormality, eye, eyes; 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 144 articles in PubMed, 2 in CINAHL, 10 in Cochrane Library, 16, 000 in Google Scholar, and 0 from other sources†. We considered for inclusion 5 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 6 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

CULTURE AND SENSITIVITY

GRAM STAIN FOR EYE INFECTIONS

Sometimes Recommended

Gram stain is selectively recommended for evaluation of eye infections, especially for moderate to severe and/or poorly responding and/or recurrent cases.

Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Gram stain, potassium iodide (KOH) preparation, culture and sensitivity of eye infections are selectively recommended, especially for evaluation of eye infections where there is a moderate to severe infection (Lalitha et al., 2012, Lalitha et al., 2012).

Harms

Negligible. There is potential for misinterpretation if current antibiotic use produces a false negative test result.

Rationale

Gram stain, potassium iodide (KOH) preparation, culture and sensitivity of eye infections are selectively recommended, especially for evaluation of eye infections where there is a moderate to severe infection. These are also recommended if there is either poor clinical response to empiric treatment and/or a recurrent infection. The main purpose of this screening is to determine the most appropriate treatment.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Gram Stain; eye diseases, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 246 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 246 articles, 4 in CINAHL, 26 in Cochrane Library, 16, 400 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

POTASSIUM IODIDE (KOH) FOR EYE INFECTIONS

Sometimes Recommended

KOH preparation is selectively recommended for evaluation of eye infections, especially for moderate to severe and/or poorly responding and/or recurrent cases.

Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Gram stain, potassium iodide (KOH) preparations, calcofluor, Chicago Sky Blue 6B stain, trypan blue stain, polymerase chain reactions, culture and sensitivity, of eye infections of eye infections are selectively recommended, especially for evaluation of eye infections where there is a moderate to severe infection (Lalitha et al., 2012, Lalitha et al., 2012). These are also recommended if there is either poor clinical response to empiric treatment and/or a recurrent infection. The main purpose of this screening is to determine the most appropriate treatment.

Harms

Negligible. There is potential for misinterpretation if current antibiotic use produces a false-negative test result.

Rationale

Gram stain (Malik et al., 2018), potassium iodide (KOH) preparations (Assaf et al., 2025, Warnnissorn et al., 2024, Mallagundla et al., 2024, Rathi et al., 2017), calcofluor (Alekhya et al., 2020, Anwar et al., 2022, Bagga et al., 2022), Chicago Sky Blue 6B stain (Warnnissorn et al., 2024), trypan blue stain (Rathi et al., 2021), polymerase chain reactions (Behera et al., 2021), culture and sensitivity, of eye infections are selectively recommended, especially for evaluation of eye infections where there is a moderate to severe infection. Fungal infections can be difficult to diagnose and the performance of the various stains and preps in the US is reportedly not as robust as those in other countries (Bacorn et al., 2022). These are also recommended if there is either poor clinical response to empiric treatment and/or a recurrent infection. The main purpose of this screening is to determine the most appropriate treatment.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Potassium hydroxide, Potassium hydroxide preparation, KOH preparation, KOH test ; eye diseases, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 56 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 56 articles, 2 in CINAHL, 43 in Cochrane Library, 3710 in Google Scholar, and 0 from other sources†. We considered for inclusion 6 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 7 from Google Scholar, and 0 from other sources. Of the 13 articles considered for inclusion, 13 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

CULTURE AND SENSITIVITY OF EYE INFECTIONS

Sometimes Recommended

Culture and sensitivity of eye infections are selectively recommended, especially for moderate to severe and/or poorly responding and/or recurrent cases.

Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Gram stain, potassium iodide (KOH) preparation, culture and sensitivity of eye infections are selectively recommended, especially for evaluation of eye infections where there is a moderate to severe infection (Lalitha et al., 2012, Lalitha et al., 2012). These are also recommended if there is either poor clinical response to empiric treatment and/or a recurrent infection.

Harms

Negligible. There is potential for misinterpretation if current antibiotic use produces a false negative test result.

Rationale

Gram stain, potassium iodide (KOH) preparation, culture and sensitivity of eye infections are selectively recommended, especially for evaluation of eye infections where there is a moderate to severe infection. These are also recommended if there is either poor clinical response to empiric treatment and/or a recurrent infection. The main purpose of this screening is to determine the most appropriate treatment.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: Culture and Sensitivity, Eye Culture and Sensitivity; eye diseases, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 640 articles in PubMed using Most Recent tab, and we did a secondary search

in PubMed using Best Match tab to find and review 640 articles, 32737 in CINAHL, 90 in Cochrane Library, 17500 in Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

OTHER DIAGNOSTIC TESTING

Generally, other diagnostic testing is not needed for evaluating eye infections. Occasionally, there may be a need for other tests based on any other accompanying symptoms and/or injuries (e.g., sinus x-ray, sinus CT scan, CT of orbits, MRI of orbits).

TREATMENT RECOMMENDATIONS

ANTIBIOTICS

No antibiotic treatment is required for common causes of viral conjunctivitis [372]. Herpes simplex and herpes zoster corneal infections require antiviral treatment, but are beyond the scope of this guideline as they are not considered occupational conditions. In adults, the most common causes of bacterial conjunctivitis are *Streptococcus pneumoniae* (51%), *Pseudomonas* (23%), *Staphylococcus spp.,* and *Hemophilus influenzae* [373, 374]. Treatment of bacterial conjunctivitis shortens the clinical course [342, 375-378]. Yet, mild mucopurulent infections are not improved faster with antibiotics [379]. Ulcer severity is strongly correlated with outcome [380]. Fungal infections are generally more severe and require longer treatment times to resolve [381].

ANTIBIOTICS FOR BACTERIAL CONJUNCTIVITIS AND BACTERIAL INFECTIONS COMPLICATING CORNEAL ULCERS

Recommended

Antibiotics are recommended for select treatment of bacterial conjunctivitis and bacterial infections complicating corneal ulcers.

Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Moderate to severe bacterial conjunctivitis to shorten the clinical course. May not be necessary for mild cases, as mild mucopurulent infections are not improved faster with antibiotics. Cases of Neisseria require both topical and systemic treatment and are beyond the scope of this guideline. Bacterial infections complicating corneal ulcers also require

treatment with the additional indication of treatment until the corneal defect has also resolved. Baseline visual acuity is predictive of visual recovery (Srinivasan et al., 2014).

Frequency/Dose/Duration

There is quality evidence of comparable efficacy among all of the following ophthalmologic antibiotic preparations: ciprofloxacin 0.3%, gatifloxacin 0.3%, levofloxacin 0.5%, lomefloxacin 0.3%, moxifloxacin 0.5-1.0%, ofloxacin 0.3%, ofloxacin- benzalkonium chloride, tobramycin-cefazolin 1.33-1.5%/5-10%, cefazolin-amikacin, cefazolin-gentamicin, and thimerosal 0.005%. Thimerosal is not recommended due to a 5-fold rate of toxicity (Pavesio C, 1997). Tailoring the antibiotic selection to the estimated bacteria genus and specie as well as incorporating local antibiotic resistance profiles is advisable. Gram stain is not commonly performed but may assist in preliminary antibiotic tailoring, and further adjustments of the selected antibiotic may be necessary based on culture and sensitivity results, if obtained, as there is evidence suggesting antibiotic resistance correlates with worse outcomes (Lalitha et al., 2012). Length of treatment is for the duration of symptoms and for ulcers is typically for the duration of the ulcer until the corneal defect is resolved.

Antibiotic regimens used in the highest quality studies include:

- Amikacin/Cefazolin eye drops every 10 minutes during first 30 minutes of treatment and later decreased to hourly every 3 days (Kasetsuwan N et al., 2011)
- Ciprofloxacin 0.3% eye drops every 15 minutes for 1st 6 hours, 1 drop every hour 1st day, then hourly (Booranapong et al., 2004),
- Gatifloxacin 0.3% eye drops hourly (Parmar et al., 2006)
- Levofloxacin 0.5% eye drops every 10 minutes during first 30 minutes of treatment and later decreased to hourly every 3 days (Kasetsuwan N et al., 2011)
- Lomefloxacin ophthalmic solution 0.3% 1 drop every 15 minutes for 1st 6 hours, 1 drop every hour 1st day, then hourly the following days (Booranapong et al., 2004)
- Moxifloxacin 1 drop every hour for 48 hours, day 3 every hour by day and 2 hours by night, days 4 and 5, 1 drop every 2 hours and 4 by night, days 6 and 7, 1 drop every 4 hours and after every 6 hours (Constantinou et al., 2007)
- Ofloxacin 0.3% every ½ hr on study day 1, every hour on days 2 - 4, and every 2 hours on days 5 – 21 (Prajna et al., 2001)
- Ofloxacin 0.3% eye drops every 30 minutes for 6 hours, hourly on days 1-3, 2-hourly on days 4-5 and 4 hours until 1 week (Khokhar et al., 2000)
- Azithromycin 1% 1 drop twice daily for 3 days (Protzko et al., 2007, Abelson et al., 2008, Denis et al., 2008)
- Tobramycin 1.33% / Cefazolin 5% group received 1 drop every hour for 48 hours, day 3 every hour by day and 2 hours by night, days 4 and 5, 1 drop every 2 hours and 4 by night, days 6 and 7, 1 drop every 4 hours and after every 6 hours (Constantinou et al., 2007)
- Tobramycin/Cefazolin 1.5%/5% solution 0.3% 1 drop every 30 minutes for 6 hours, hourly on days 1-3, 2-hourly on days 4-5 and 4 hours until 1 week (Khokhar et al., 2000)

Rationale

There are many quality comparative trials evaluating treatment of bacterial infections with keratitis or complicating corneal ulcers. There are several placebo-controlled trials, all showing earlier clinical resolution with antibiotic treatment (Karpecki et al., 2009, Silverstein et al., 2011, Abelson et al., 2008, Hwang et al., 2003); a Cochrane review similarly concluded superiority to placebo (Chen et al., 2023, Liu et al., 2024). There is no moderate to high-quality evidence that any antibiotic is superior to another for treatment of these infections and all of the following have quality evidence of comparable efficacy: besifloxacin (Karpecki et al., 2009, Silverstein et al., 2011, McDonald et al., 2009, Tepedino et al., 2009)(DeCory et al., 2020), ciprofloxacin (Booranapong et al., 2004, Parmar et al., 2006, Prajna et al., 2001, Hyndiuk et al., 1996, Kosrirukvongs et al., 2000, Weyenberg et al., 2004), gatifloxacin (Parmar et al., 2006, Shah et al., 2010, Blair et al., 2011, Price et al., 2005, Yee et al., 2005)(Heller et al., 2014, Sharma et al., 2016), levofloxacin (Kasetsuwan N et al., 2011, Schwab et al., 2003), lomefloxacin (Booranapong et al., 2004, Erjongmanee et al., 2004, Gallenga et al., 1999), moxifloxacin (Constantinou et al., 2007, Shah et al., 2010, Price et al., 2005, Srinivasan et al., 2014, Sharma et al., 2013, Tauber et al., 2011)(Baiza-Durán et al., 2018, Janićijević et al., 2018), ofloxacin (Constantinou et al., 2007, Prajna et al., 2001, Khokhar et al., 2000, Schwab et al., 2003, O'Brien et al., 1995, Panda et al., 1999), ofloxacin-benzalkonium chloride (Pavesio C, 1997), tobramycin with or without dexamethasone (White et al., 2008, Chen et al., 2012, Comstock et al., 2017), tobramycin-cefazolin (Constantinou et al., 2007, Khokhar et al., 2000, Hyndiuk et al., 1996, Shah et al., 2010, O'Brien et al., 1995, Panda et al., 1999, Sharma et al., 2013), cefazolin-amikacin (Kasetsuwan N et al., 2011), cefazolin-gentamicin (Kosrirukvongs et al., 2000, Erjongmanee et al., 2004), azithromycin (Protzko et al., 2007, Abelson et al., 2008, Denis et al., 2008), pazufloxacin (Baiza-Durán et al., 2018), and thimerosal (Pavesio C, 1997). However, thimerosal is not recommended due to a 5-fold rate of adverse effects (Pavesio C, 1997). A Cochrane systematic review with network meta-analysis concluded there was moderate to very low certainty evidence that vancomycin + ceftazidime, moxifloxacin, cefazolin + tobramycin may be the most effective treatments for bacterial keratitis for corneal healing time, while ciprofloxacin was least effective (Song et al., 2025). One trial suggested a need for broad-spectrum antibiotics due to the probability of polymicrobial infections (DeCory et al., 2020). Topical ophthalmological antibiotic preparations are not invasive, have low adverse effects, are low cost, and are effective for treatment of moderate to severe bacterial eye infections and ulcers complicated by bacterial infections. 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: Antibiotics, Anti-bacterial agents, Erythromycin, Sulfacetamide, Fluoroquinolones; eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 636 articles in PubMed, 216 in CINAHL, 465 in Cochrane Library, 24, 200 in Google Scholar, and 14 from other sources†. We considered for inclusion 25 from PubMed, 2 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 12

from other sources. Of the 39 articles considered for inclusion, 26 randomized trials and 13 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ANTIBIOTICS FOR VIRAL CONJUNCTIVITIS

Not Recommended

Antibiotics are not recommended for routine treatment of viral conjunctivitis. They may be indicated if there are concerns for co-infections with bacteria.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There are no sizable, placebo-controlled RCTs. One moderate-quality study of fusidic acid found it ineffective for improving recovery time compared with placebo, while adverse effects were worse (Rietveld et al., 2005). One moderate-quality trial of chloramphenicol for treatment of viral conjunctivitis that showed no overall differences in response rates, although there was a modest shortening of moderate symptoms duration by 1.5 days with early treatment with chloramphenicol drops (Everitt et al., 2006). One trial of additive benefit of an oil to tobramycin/dexamethasone eye drops found modestly better results with the oil in combination (Cagini et al., 2020). Trials of comparable efficacy of various antibiotics in low- and moderate-quality studies suggest comparable (in)efficacy (Price et al., 2005, Said DG, 2014). Topical ophthalmological antibiotics are not invasive, have few adverse effects, are low cost, but do not have a sound rationale for use in viral conjunctivitis, are not shown to be clearly effective, and are thus generally not recommended. However, the threshold for treatment with antibiotics is fairly low as they have low rates of adverse effects. Additionally, in many clinical locations, it can be difficult to rapidly separate some viral from bacterial infections' thus, many cases are treated with antibiotics as a precaution. Severe infections or those thought to be bacterial are obvious candidates for treatment. Herpes simplex and herpes zoster corneal infections do require antiviral treatment but are beyond the scope of this guideline.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Anti-bacterial agent, antibiotics; eye diseases, eye disorder, eye abnormality, eye, eyes; 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 3483 articles in PubMed, 151 in CINAHL, 4 in Cochrane Library, 23, 700 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 1 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 reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ANTIFUNGALS

ANTIFUNGAL MEDICATIONS FOR FUNGAL CONJUNCTIVITIS AND FUNGAL INFECTIONS COMPLICATING CORNEAL ULCERS

Recommended

Antifungal medications are recommended for treatment of fungal conjunctivitis and fungal infections complicating corneal ulcers.

Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Frequency/Dose/Duration

There is quality evidence of comparable efficacy among most of the following ophthalmologic antibiotic preparations: econazole 2%, natamycin 5%, voriconazole 1%, and amphotericin B. Meta-analysis of multiple trials suggests natamycin is superior to voriconazole (FlorCruz et al., 2015); thus, voriconazole is not recommended. One trial suggested superiority of chlorhexidine gluconate compared with natamycin 5% (Rahman et al., 1997). One trial found superiority of Amphotericin B drops plus subconjunctival injections of fluconazole to topical treatment alone (Mahdy et al., 2010). Potassium iodide (KOH) is not always performed but may assist in preliminary antifungal regimen tailoring, and further adjustments in the medication(s) used may be necessary based on culture and sensitivity results. Length of treatment is until resolution of the ulcers, which varies widely and is commonly 4-6 weeks.

Antifungal regimens used in the highest quality studies include:

- Econazole 2% drops on hourly basis between 7 am to 9 pm (Prajna et al., 2003).

- Natamycin 5% every hour while awake until reepithelialization, then 4 times daily for at least 3 weeks (Prajna et al., 2012, Rahman et al., 1997, Prajna et al., 2003, Arora et al., 2011, Prajna et al., 2010).
- Amphotericin B 0.2 mg/ml Q2hrs for 21 days (Mahdy et al., 2010)
- Amphotericin B 0.2 mg/ml Q2hrs for 21 days plus subconjunctival injections of fluconazole 2mg/mL daily for 10 days (Mahdy et al., 2010)
- Chlorhexidine gluconate 0.2%, 1/2-hourly to 2-hourly for up to 5 days, then with reduced frequency, and all patients re-assessed at 21 days (Rahman et al., 1997).

Rationale

There are multiple quality comparative trials evaluating treatment of fungal infections with keratitis or complicating corneal ulcers. There are no placebo-controlled trials. There is limited quality evidence that one antifungal may be superior to another, as multiple trials suggest natamycin is superior to voriconazole (FlorCruz et al., 2015). A trial of additive benefit of oral voriconazole to topicals found a lack of efficacy (Prajna et al., 2016, Prajna et al., 2017). One moderate-quality trial found amphotericin B drops plus subconjunctival injections of fluconazole superior to topical treatment alone (Mahdy et al., 2010). There is also limited evidence the chlorhexidine gluconate may be superior to natamycin drops (Rahman et al., 1997). All of the following have been assessed in quality trials: Amphotericin B (Mahdy et al., 2010), econazole (Prajna et al., 2003), natamycin (Prajna et al., 2012, Rahman et al., 1997, Prajna et al., 2003, Arora et al., 2011, Prajna et al., 2010, Prajna et al., 2012), voriconazole (Prajna et al., 2012, Rahman et al., 1997, Prajna et al., 2003, Arora et al., 2011, Prajna et al., 2010, Prajna et al., 2012). Topical ophthalmological antifungal preparations are not invasive, have low adverse effects, are low cost, and are likely effective for treatment of fungal eye infections and ulcers complicated by fungal infections. Thus, they are recommended. Adjuvant antifungal injections in addition to topical treatment may be effective and may be best for severe cases, but evidence is currently insufficient to conclude an evidence-based recommendation (Mahdy et al., 2010).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Antifungal agents, antifungals; eye diseases, eye disorder, eye abnormality, eye, eyes; 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 650 articles in PubMed, 50 in CINAHL, 0 in Cochrane Library, 24, 400 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 6 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 7 articles considered for inclusion, 6 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles,

we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

NSAIDS

NONSTEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS) FOR VIRAL CONJUNCTIVITIS

Not Recommended

NSAIDs are not recommended for treatment of viral conjunctivitis.

Strength of evidence Not Recommended, Evidence (C)
Level of confidence High

Rationale

Two quality articles failed to find superiority of an NSAID to artificial tears (Lyra et al., 2014, Shiuey et al., 2000). Thus, there is no demonstrable efficacy. NSAIDs are not invasive, have low adverse effects especially for short-term use, are low cost, but are not effective and thus 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: Non-Steroidal Anti-Inflammatory Agents, Non-Steroidal Anti-Inflammatory Drugs, NSAIDs, Viral Conjunctivitis ; eye diseases, eye disorder, eye abnormality, eye, eyes; 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 643 articles in PubMed, 60 in CINAHL, 77 in Cochrane Library, 3520 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

GLUCOCORTICOSTEROIDS

ADJUVANT GLUCOCORTICOSTEROIDS FOR BACTERIAL CONJUNCTIVITIS AND BACTERIAL INFECTIONS COMPLICATING CORNEAL ULCERS

Not Recommended

Adjuvant glucocorticosteroids are not recommended for treatment of bacterial conjunctivitis and bacterial Infections complicating corneal ulcers.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Adjuvant glucocorticosteroid use for bacterial corneal ulcers has been widespread with a strong belief in efficacy at improving visual outcomes (See et al., 2012). There are quality trials evaluating adjuvant glucocorticosteroid use for treatment of bacterial keratitis after initial treatment with an antibiotic and failing to show significant differences in outcomes over intermediate to longer terms (Srinivasan et al., 2014, Srinivasan et al., 2012, Srinivasan et al., 2009, Srinivasan et al., 2012)(Carmichael TR, 1990). Another trial suggested delayed epithelialization with glucocorticosteroid compared with placebo (Srinivasan et al., 2009). A trial found povidone-iodine/dexamethasone ineffective compared with placebo (Ta et al., 2020). It has also been suggested steroids may not be helpful for nocardial infections (Srinivasan et al., 2014, Srinivasan et al., 2012, Srinivasan et al., 2009, Srinivasan et al., 2012, Lalitha et al., 2012). Topical ophthalmological preparations of glucocorticosteroids are not invasive, and are low cost. These medications do not have significant demonstrated efficacy (Srinivasan et al., 2014, Blair et al., 2011, Srinivasan et al., 2012, Srinivasan et al., 2009, Srinivasan et al., 2012), appear to have the adverse effect of delaying healing, and are thus not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Glucocorticoids, adjuvant glucocorticosteroids, glucocorticosteroids; eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 555 articles in PubMed, 176 in CINAHL, 15 in Cochrane Library, 711 in Google Scholar, and 1 from other sources†. We considered for inclusion 1 from PubMed, 0 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 4 articles considered for inclusion, 2 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we

review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

GLUCOCORTICOSTEROIDS FOR VIRAL CONJUNCTIVITIS

Sometimes Recommended

Povidone-iodine 0.6%/dexamethasone 0.1% drops are selectively recommended for treatment of viral conjunctivitis.

Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Moderate to severe cases of viral conjunctivitis.

Benefits

Earlier resolution of symptoms.
Harms

Increased intraocular pressure and theoretical potential for increased risk of infections. Patients who are being treated with topical corticosteroids should have additional monitoring. The dosage should be slowly tapered to the minimum effective dose. Follow-up examinations should be conducted regularly, with visits to include an interval history, measurement of visual acuity and IOP, and slit-lamp biomicroscopy.

Frequency/Dose/Duration

Povidone-iodine 0.6%/dexamethasone 0.1% drops, 4 times daily for 5 days (Pepose 2018).

Indications for discontinuation

Completion of a course or resolution.

Rationale

A trial of tacrolimus vs. dexamethasone reported evidence of superiority of tacrolimus (Bhargava et al., 2019). Two three-arm trials of povidone-iodine/dexamethasone vs. dexamethasone vs. lubricating drops reported superiority of the combination treatment (Kovalyuk et al., 2017, Pepose et al., 2018). Two trials of povidone-iodine/dexamethasone reported earlier resolution compared with lubricating drops (Pepose et al., 2019). A trial of tobramycin-dexamethasone vs. artificial tears found earlier recovery with the combination therapy, but comparable 7-day results (Shah et al., 2025). A trial of cyclosporine A vs. fluorometholone found modestly better short term results with the steroid, but much

higher recurrences (Gouider et al., 2021). There is one trial that had methodological issues including protocol deviation, which was interpreted as suggesting reduced symptoms (Wilkins et al., 2011). Glucocorticosteroid combined with povidone-iodine is not invasive, has low adverse effects, is low cost, has evidence of efficacy 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: glucocorticoids, glucocorticosteroids; eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 266 articles in PubMed, 186 in CINAHL, 2 in Cochrane Library, 10, 200 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 1 from CINAHL, 1 from Cochrane Library, 5 from Google Scholar, and 1 from other sources. Of the articles considered for inclusion, 7 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

KERATOCONJUNCTIVITIS

Vernal keratoconjunctivitis is a relatively rare, chronic, severe allergic inflammation of the ocular surface mediated by Th2-lymphocytes. Yet, 50% of patients do not have IgE mediated mechanisms [382]. It is considered the ocular manifestation of atopic dermatitis. It primarily begins in childhood [382, 383], thus is largely considered non-occupational. It is more common in the tropics than the northern climates [383]. Occasional cases can occur throughout the United States and Canada. It may be worsened by non-specific hyperreactivity due to wind, dust and sunlight [383].

The evaluation of patients with vernal keratoconjunctivitis is similar to other allergy investigations. Limited RCTs on treatments result in a relatively weak evidence base. By inference, treatments recommended for other allergic eye diseases are also recommended for vernal keratoconjunctivitis.

PTERYGIUM

Pterygium is an abnormal growth consisting of a triangular fold of tissue that advances progressively over the cornea, usually from the nasal side [384, 385, 386]. Localized conjunctival inflammation may be associated with pterygia [130, 384]. Most cases occur in tropical climates, dry climates, and amongst those who work outside with ultraviolet exposure. Most cases are cosmetic, although a minority may be symptomatic. However, surgical excision is indicated if the pterygium encroaches on the visual axis.

Topical NSAIDs function as local anesthetics and analgesics. Topical NSAIDS are administered to provide relief from inflammatory pain associated with inflamed pterygia, pingueculae [387], corneal abrasions [388], postoperative pain from various surgical procedures [389] and pain associated with many other disorders. Topical glucocorticosteroids have been used to provide relief from inflammatory pain associated with inflamed pterygia and pingueculae [387].

TREATMENT RECOMMENDATIONS

EYE DROPS

NSAID DROPS FOR INFLAMED PTERYGIA OR PINGUECULAE

Recommended

NSAID ophthalmic drops are recommended for inflamed pterygia or pingueculae and may be used postoperatively.

Strength of evidence Recommended, Evidence (C)
Level of confidence Moderate

Indications

Inflamed pterygia or pingueculae (Frucht-Pery et al., 1999) and/or post-operatively.

Benefits

Reduced pain, decreased inflammatory response.

Harms

Allergic reactions in susceptible patients, intolerance.

Frequency/Dose/Duration

Per manufacturer's recommendations. The one quality trial utilized indomethacin 0.1% drops 6 times daily for 3 days, then 4 times daily to complete 2 weeks (Frucht-Pery et al., 1999).

Indications for discontinuation

Symptom resolution, intolerance or adverse effects.

Rationale

There is one moderate-quality trial suggesting equal efficacy of NSAID drops compared with glucocorticoid drops for treatment of in flamed pterygia or pingueculae (Frucht-Pery et al., 1999). There also are multiple moderate quality trials comparing NSAIDs with placebo or drug vehicle for analgesia of simple corneal abrasion (Alberti et al., 2001, Goyal et al., 2001, Jayamanne et al., 1997, Kaiser et al., 1997, Patrone et al., 1999, Szucs et al., 2000). A low-quality trial reported comparable efficacy of ketorolac and dexamethasone (Çakmak et al., 2023). NSAID drops are low cost, not invasive, associated with low risks and 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: Anti-Inflammatory Agents, Non-Steroidal, NSAID, NSAID eye drops; Pterygium, pterygia, pingecula, pingueculae, infections, corneal ulcers, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 1184 articles in PubMed, 59 in CINAHL, 417 in Cochrane Library, 9, 660 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 articles considered for inclusion, 1 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

GLUCOCORTICOSTEROID DROPS FOR INFLAMED PTERYGIA OR PINGUECULAE

Recommended

Glucocorticosteroid ophthalmic drops are recommended for inflamed pterygia or pingueculae.

Strength of evidence Recommended, Evidence (C)
Level of confidence Moderate

Indications

Inflamed pterygia or pingueculae (Frucht-Pery et al., 1999). Generally preferable to use NSAID drops first as the adverse effects are generally lower.

Benefits

Reduced pain, decreased inflammatory response.

Frequency/Dose/Duration

Per manufacturer's recommendations. One moderate quality trial utilized 0.1% dexamethasone drops 6 times daily for 3 days, then 4 times daily to complete 2 weeks (Frucht-Pery et al., 1999).

Indications for discontinuation

Symptom resolution, intolerance, adverse effects or completion of a course.

Rationale

There is one moderate-quality trial suggesting equal efficacy of NSAID drops compared with glucocorticosteroid drops for treatment of in flamed pterygia or pingueculae (Frucht-Pery et al., 1999). A low-quality trial reported comparable efficacy of ketorolac and dexamethasone (Çakmak et al., 2023). Glucocorticosteroid drops are low cost, not invasive, associated with low risks for short course and are recommended, although NSAID drops are generally preferable due to the lower adverse effect profile.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: glucocorticosteroids, glucocorticoids; Pterygium, pterygia, pingecula, pingueculae, infections, corneal ulcers, eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 527 articles in PubMed, 175 in CINAHL, 0 in Cochrane Library, 26, 800 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EXCISION

Pterygia have been surgically removed using many different techniques and approaches [390].

PTERYGIUM EXCISION FOR PTERYGIA

Recommended

Pterygium excision is recommended for pterygia that are at, near and/or encroaching on the visual axis.

Strength of evidence Recommended, Evidence (C)
Level of confidence Moderate

Indications

Pterygia that are at, near and/or encroaching on the visual axis.

Benefits

Removal of a threat to vision and cosmesis.
Harms

Complications related to surgery including infection.

Rationale

Surgery has been used to remove pterygia. RCTs compare different techniques (Kucukerdonmez C, 2010, Kurian A, 2015, Wong VW, 2007, Al Fayez MF, 2002, Al Fayez MF, 2013, Ratnalingam V, 2010, Mourits MP, 2008, Jha et al., 2022, Karalezli A, 2008, Panda A, 1998, Tan DT, 1997, Cano-Parra J, 1995, Sati A, 2014, Sati et al., 2019, Chiu et al., 2017, Jiang J, 2008, Hall RC, 2009, Xu F, 2013, Chen Q, 2015, Chen et al., 2017, Lam DS, 1998, Zloto et al., 2017, Yu et al., 2021, Pan et al., 2018, Elwan, 2014, Young AL, 2009, Young AL, 2013, Cioba et al., 2023, Sodhi PK, 2005, Akinci A, 2007, Yeung SN, 2013, Kheirkhah A, 2011, Kheirkhah A, 2011, Kheirkhah A, 2012, Mastropasqua L, 1996, de Farias CC, 2014, Luanratanakorn P, 2006, Yan et al., 2019, Prat et al., 2018, Singh G, 1990, Singh PK, 2013, Koranyi G, 2004, Uy HS, 2005, Ari S, 2009, Mutlu FM, 1999, Almeida Junior GC, 2008, Cardillo JA, 1995, Akhter W, 2014, Donepudi et al., 2019, Choudhury S, 2014, Shahin MM, 2012, Manning CA, 1997, Frucht-Pery J, 2006). A systematic review suggested autografting is superior to amniotic membrane transplantation regarding recurrence rates (Clearfield et al., 2017). Surgical removal of pterygia is invasive has adverse effects, is costly, but is effective for removal of pterygia 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: Excision, Pterygium Surgery; Pterygium, pterygia, pingecula, pingueculae, infections, corneal ulcers, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 957 articles in PubMed, 148 in CINAHL, 378 in Cochrane Library, 8, 610 in Google Scholar, and 0 from other sources†. We considered for inclusion 24 from PubMed, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 26 articles considered for inclusion, 20 randomized trials and 6 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ANTIEMETICS

See the ACOEM Antiemetics Guideline.

PREVENTION OF RECURRENCE

Pterygia have been treated intraoperatively and postoperatively in an attempt to prevent recurrence and/or complications.

BEVACIZUMAB FOR PREVENTION OF PTERYGIA RECURRENCE

Recommended

Bevacizumab is recommended for pterygia that are near the visual axis and post-operatively.

Strength of evidence Recommended, Evidence (C)
Level of confidence Moderate

Indications

Pterygia that are to be removed with peri-operative administration to reduce risk of recurrence.

Benefits

Attempted to reduce angiogenesis and pterygial growth and/or recurrence.

Frequency/Dose/Duration

Trials with evidence of efficacy use bevacizumab that is administered as pre- and perioperative injection(s) for prevention of recurrence from surgical excision. It also has

been administered as topical bevacizumab (5 mg/mL) 4 times daily for 2 months (Ozgurhan et al., 2013, Christen et al., 2014).

Rationale

Two placebo-controlled RCTs suggest evidence of lack of efficacy of injected bevacizumab (Razeghinejad MR, 2014, Razeghinejad MR, 2010), and one topical application study is also negative (Karalezli A, 2014). However, multiple other non-injection controlled RCTs suggest efficacy (Sayadi et al., 2022, Elnahas et al., 2023, Ozgurhan et al., 2013, Nava-Castañeda A, 2014). Systematic reviews and meta-analyses also suggest efficacy of bevacizumab to reduce recurrences of pterygia (Zhang et al., 2021, Sun et al., 2018). Bevacizumab is minimally invasive when injected, has low adverse effects, has some evidence of efficacy, and thus is recommended to help prevent recurrence of pterygia.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Bevacizumab, Avastin; Pterygium, pterygia, pingecula, pingueculae, infections, corneal ulcers, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 1518 articles in PubMed, 41 in CINAHL, 15 in Cochrane Library, 28000 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 1 from CINAHL, 0 from Cochrane Library, 5 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 4 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

THERMAL BURNS

Thermal ocular burns occur in occupational environments, although relatively infrequently compared with chemical injuries.

Immediate treatment to irrigate the eye with copious water or other aqueous irrigating solutions is believed to be important for the outcomes of thermal eye injuries [284, 285, 288].

Ocular surface burns may be caused by intense ultraviolet exposures, most commonly welding while not wearing protective eye gear. They may also be incidental to being near a welder but without adequate eye protection. The presentation typically occurs one day after exposure with a red, painful irritated eye. A diffuse granular appearance of the cornea

is usually seen. The history and initial physical examination are highly characteristic. Slit lamp examination findings are characteristic of diffuse granular uptake generally with sparing of the upper and lower corneal margins where the eyelids protect the cornea.

Eye burn accidents occur mostly at work and can result from exposure to substances such as hot liquids, steam, liquid metals, or fireworks. Treatment can include immediate rinsing of the eye [391]. Another treatment is amniotic membrane transplantation (AMT) for acute ocular surface burns. A systematic review found lack of evidence to support the use of this treatment [153].

TREATMENT RECOMMENDATIONS

ARTIFICIAL TEARS OR LUBRICATION

ARTIFICIAL TEARS OR LUBRICATION FOR THERMAL OCULAR BURNS

Recommended

Artificial tears or lubricants are recommended for treatment of patients with thermal ocular burns.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies. Artificial tears may provide some comfort and lubrication for the eye and thus are recommended for treatment of ocular thermal burns.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Artificial tears; Thermal burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 68 in CINAHL, 8 in Cochrane Library, 17400 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

NSAID DROPS

NSAID EYE DROPS FOR WELDER'S FLASH

Recommended

NSAID ophthalmic drops are recommended for treatment of welder's flash.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There are no quality trials for treatment of welder's flash. NSAID drops are low cost, not invasive, associated with low risks and 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: Non-Steroidal Anti-inflammatory Agents, Non-Steroidal Anti-Inflammatory Drugs, NSAIDs, Welder's Flash, Arc Eye; eye diseases, eye disorder, eye abnormality, eye, eyes; 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 560 articles in PubMed, 41 in CINAHL, 48 in Cochrane Library, 1290 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

NSAID EYE DROPS FOR THERMAL OCULAR BURNS

Recommended

NSAID ophthalmic drops are recommended for treatment of thermal ocular burns.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Thermal ocular burns.

Benefits

Reduced pain, decreased inflammatory response.

Rationale

There are no quality trials for treatment of thermal ocular burns with ophthalmic NSAID drops. NSAID drops are low cost, not invasive, associated with low risks, 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: Anti-Inflammatory Agents, Non-Steroidal, Non-Steroidal Anti-Inflammatory Agents, NSAID; Thermal burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 534 articles in PubMed, 50 in CINAHL, 620 in Cochrane Library, 14, 400 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EYE PATCHING

EYE PATCHING FOR WELDER'S FLASH

Not Recommended

Eye patching for welder's flash is not recommended.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There are no quality trials of patching for treatment of welder's flash. However, eye patching has been shown to have no benefits for treatment of corneal abrasions and rust rings. Thus, patching is also not expected to be efficacious for welder's flash, and therefore patching is not recommended for welder's flash.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Teye patching, occlusion therapy, Welder's flash, photokeratitis, arc eye; eye diseases, eye disorder, eye abnormality, eye, eyes; 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 606 articles in PubMed, 13 in CINAHL, 1, 307 in Cochrane Library, 20, 900 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EYE PATCHING FOR THERMAL OCULAR BURNS

Recommended

Eye patching is selectively recommended for treatment of moderate to severe thermal ocular burns.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Moderate to severe thermal ocular burn that is sufficiently large to have limited vision and inadequate tearing.

Benefits

Comfort.

Harms

None.

Rationale

There are no quality studies. Eye patching to attempt to reduce symptoms may be a reasonable intervention for moderate to severely affected cases and so 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: Eye Patching, Eye Patch; Thermal burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 422 articles in PubMed, 14 in CINAHL, 15 in Cochrane Library, 17100 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

IRRIGATION

COPIOUS IRRIGATION FOR EYE THERMAL BURNS

Recommended

Copious irrigation is recommended for acute, thermal eye exposures and/or for those with potential for accompanying foreign bodies, such as ash or soot.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

All thermal eye exposures and injuries. It is recommended to begin irrigation immediately after eye exposure, rather than waiting for symptoms to develop.

Benefits

Limiting extent of burn/injury, earlier relief of pain.

Harms

Negligible. Mild discomfort from solution and irrigation.

Frequency/Dose/Duration

Tap water is most commonly available and should be used if that is the most readily available solution, especially for first line, in-plant settings. Irrigation bottles with irrigating solutions are also useful in in-plant medical departments, clinical settings and distributed in some facilities. Normal saline, lactated Ringer's solution are additional options for initial irrigation and are preferable to tap water, but only if immediately available. Substitute normal saline or lactated ringer's or other balanced saline solution for tap water when available. Generally use topical anesthetic to anesthetize the eye when available, as it will assist in better tolerance of irrigation.

Indications for discontinuation

Only after copious irrigation, usually at least 500mL has been used to flush out the eye.

Rationale

There are no quality studies identifying use compared with non-use of irrigation. There are experimental studies of irrigating solutions for treatment especially of animal models. These animal studies suggest superiority of balanced salt solutions (e.g., normal saline, lactate Ringer's solution) over hypotonic solutions (such as tap water). Still, experience suggests earlier irrigation with the most readily available solution, including tap water, is the preferred initial strategy and is recommended. Once irrigation is underway, tailoring of further irrigation, including possible use of an irrigating system (e.g., "Morgan lens") may be considered although is less necessary in thermal than in chemical injuries.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Irrigation, Eye Irrigation; Thermal burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 41 in CINAHL, 22 in Cochrane Library, 17200 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

IRRIGATING SYSTEMS (MORGAN LENS) FOR EYE THERMAL BURNS

Not Recommended

Irrigating systems (e.g., Morgan Lens) are not recommended for thermal eye exposures.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There are no quality studies comparing use with non-use of irrigating systems for thermal injuries. They are generally not thought to be necessary for most thermal injuries. Exceptions may include combinations of chemicals and thermal. (see above)

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Irrigating systems, morgan lenses; Thermal burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 82 articles in PubMed, 0 in CINAHL, 9 in Cochrane Library, 16400 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SURGICAL CONSIDERATIONS

AMNIOTIC MEMBRANE TRANSPLANTATION WITH MEDICAL THERAPY FOR THERMAL OCULAR BURNS

Recommended

Amniotic membrane transplantation in conjunction with medical therapy is selectively recommended for treatment of thermal ocular burns.

Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Thermal ocular burn Roper-Hall classification grades II-IV (Tamhane et al., 2005, Tandon et al., 2011).

Benefits

Faster re-epithelialization (healing) leading to improved vision.

Harms

Few reported.

Frequency/Dose/Duration

Medical therapy recommended to be administered at the same time is: topical 1% prednisolone acetate Q 6 hrs, ofloxacin Q 6 hrs, sodium ascorbate (10%), sodium citrate (10%), plus preservative-free lubricants every 2 hours, plus homatropine (2%) 1-2 times QD, and vitamin C 500 mg PO Q 6 hrs for 2 to 4 weeks (Tamhane et al., 2005).

Rationale

There are three moderate quality trials of amniotic membrane transplantation compared with medical therapy and both trials suggested earlier re-epithelialization (Tamhane et al., 2005, Tandon et al., 2011). However, the benefits have not been shown to extend to improved visual function. Amniotic membrane transplantation is invasive, has some adverse effects, is costly but has demonstrated efficacy and is selectively recommended for treatment of ocular burns. There also is some evidence of efficacy amniotic membrane transplantation with use of a specialized bandage contact lens for treatment of dry eye disease with reported substantially better results in the group with lens use (Travé-Huarte et al., 2024); thus, amniotic membrane transplantation, potentially also using with a specialized bandage contact lens, is selectively recommended for treatment of ocular burns and the common complication of dry eye disease.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: amniotic membrane transplantation with medical treatment; Thermal burns, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 38 articles in PubMed, 5 in CINAHL, 14 in Cochrane Library, 15,700 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

CORNEAL LACERATIONS

Corneal lacerations are deeper wounds than abrasions and include flap wounds. More extensive wounds may include injury to intraocular structures such as the lens. Many small intraocular foreign bodies, particularly metallic, do not require removal, and instead can be conservatively managed [392-394].

This guideline does not address penetrating eye injuries that require referral for highly individualized, definitive care [393, 395-409].

TREATMENT RECOMMENDATIONS

RETINOIC ACID FOR ADJUNCTIVE TREATMENT OF CORNEAL LACERATIONS

No Recommendation

There is no recommendation for retinoic acid for adjunctive treatment of corneal lacerations.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

Retinoic acid has been used for adjunctive treatment of corneal lacerations (Samarawickrama et al., 2015). However, there are no quality studies 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: retinoic acid, corneal laceration; eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 2 in CINAHL, 182 in Cochrane Library, 15, 000 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

CONTACT LENSES FOR CORNEAL LACERATIONS

Sometimes Recommended

Specialized contact lenses are recommended for selective treatment of corneal lacerations.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Specialized contact lenses are used to selectively treat corneal lacerations.

Benefits

Reduce symptoms and promote healing.

Rationale

Specialized bandage contact lenses have been used to attempt to provide better healing (Leibowitz, 1972, Zheng et al., 2015, Vora et al., 2013, Zagelbaum, 1997), and they may be used in conjunction with amniotic membranes to treat corneal lacerations (Alshammari et al., 2025). Specialized bandage contact lenses have some adverse effects, are costly, but have some studies suggesting efficacy for conditions such as dry eyes after chemical burns, and thus from inference, are recommended for selective treatment of corneal lacerations.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: contact lenses, bandage contact lenses; corneal lacerations, corneal tears, eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 121 articles in PubMed, 301 in CINAHL, 35 in Cochrane Library, 18,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 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 review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

STABILIZATION AND REFERRAL FOR PENETRATING TRAUMATIC INJURIES

Recommended

Stabilization of an intraocular foreign body without removal is recommended for cases of penetrating trauma and intraocular foreign bodies.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Penetrating trauma and intraocular foreign bodies are recommended to be initially treated with stabilization of the intraocular foreign body without removal to avoid further trauma, and prompt, emergent referral for definitive treatment. Many small intraocular foreign bodies, particularly metallic, do not require removal, and instead can be conservatively managed (Ho et al., 2004, Fulcher et al., 2002, Coleman et al., 1987).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: stabilization, referral; penetrating traumatic injuries, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 534 articles in PubMed, 50 in CINAHL, 620 in Cochrane Library, 17, 700 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

BLUNT TRAUMA AND TRAUMATIC HYPHEMA

Blunt trauma injures are highly diverse and include contusions, fractures, hyphema, retinal detachments, anterior chamber angle recession, ocular hypertension, and other complications [86, 410, 411]. As multiple other injuries are potentially present, a comprehensive evaluation of the patient and their neighboring tissues/organ systems is required. Orbital blowout fractures most commonly involve the medial wall followed by the orbital floor [412]. Associated nasal fractures have been reported in 16% [412].

Traumatic hyphema is susceptible to recurrent bleeding in approximately 10-40% of patients [413-419]. Prevention of re-bleeding is believed to be important to prevent worse outcomes and prednisone and aminocaproic acid have been utilized.

This guideline does not address those blunt trauma eye injuries that are complex, particularly those with pupillary defects, impairments and/or require definitive surgical care. Surgical approaches and techniques are diverse that are used for treating orbital fractures [420-430].

DIAGNOSTIC RECOMMENDATIONS

X-RAY FOR EVALUATION OF ORBITAL FRACTURE

Recommended

X-rays have been used for evaluation of potential fractures, and penetrating eye trauma, particularly if metallic (Modjtahedi et al., 2015).

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Trauma sufficient to produce orbital fracture(s).

Benefits

Detection of orbital fractures.

Harms

Mild radiation exposure.

Rationale

There are no quality studies of X-rays for the detection of orbital fracture, although they have been widely used. X-rays have no significant adverse effects and are low to moderate cost and are thus recommended for evaluation of potential orbital fracture. However, CT scans are generally considered the gold standard for assessing fractures.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Orbital fractures, Radiography, X-rays; Foreign bodies, rust rings, corneal injury, eye diseases, eye disorder, eye abnormality, eye, eyes; 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 170 articles in PubMed, 3 in CINAHL, 0 in Cochrane Library, 205 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

COMPUTED TOMOGRAPHY (CT) FOR EYE INJURIES

Recommended

Computed tomography (CT) is recommended for eye injuries due to blunt trauma, penetrating globe injuries, and/or abrasions accompanied by concerns for orbital fractures and/or other complications unaddressed by radiographs.

Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Indications

Blunt trauma with concerns for orbital fracture and/or metallic or other foreign bodies.

Rationale

CT scans for blunt and/or penetrating trauma are supported by many studies and are considered the main imaging procedure for blunt trauma to rule out fractures, acute globe trauma (Bodanapally et al., 2014, Aljuhani et al., 2025, Foroughi et al., 2025, Gad et al., 2017, George, 2024, Kim et al., 2010, Yuan et al., 2014, Ren, 2022, Koca et al., 2025, Crowell et al., 2017, Chou et al., 2016, Karataş et al., 2025, Chen et al., 2024), as well as foreign bodies, and thus are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar with date limits of 2018 to the present using the following terms: computed tomography, CT scan; Blunt trauma injuries, eye disorder, eye abnormality, eye, eyes; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 5449 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 5449 articles, 65 in CINAHL, 24 in Cochrane Library, 7530 in Google Scholar, and 2 from other sources†. We considered for inclusion 0 from PubMed, 3 from CINAHL, 0 from Cochrane Library, 7 from Google Scholar, and 7 from other sources. Of the 17 articles considered for inclusion, 15 diagnostic studies and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TREATMENT RECOMMENDATIONS

TOPICAL AMINOCAPROIC ACID FOR TRAUMATIC HYPHEMA

Recommended

Topical aminocaproic acid is selectively recommended for treatment of traumatic hyphema.

Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Non-penetrating traumatic hyphema.

Benefits

Improved visual acuity, reduced risk of corneal blood staining, glaucoma.
Harms

Negligible.

Frequency/Dose/Duration

Aminocaproic acid 30% in 2% carboxypolymethylene gel, 0.2mL applied in the inferior fornix Q6hrs for 5 days. Patients in the highest quality trial were also treated with 30º of head elevation, metal eye shield and moderate ambulation (Crouch et al., 1997, Crouch et al., 1976).

Indications for discontinuation

Completion of the treatment course.

Rationale

The highest quality trial compared controls with oral or topical aminocaproic acid and found markedly superior visual acuity results with either aminocaproic acid treatment arm (Crouch et al., 1997). Other studies have also suggested efficacy compared with placebo (Crouch et al., 1976, McGetrick et al., 1983, Kutner et al., 1987) with another underpowered study also trending towards efficacy (Pieramici et al., 2003). Another trial found comparable results between aminocaproic acid and prednisone (Farber et al., 1991), while another trial failed to find efficacy of glucocorticosteroid (Spoor et al., 1980). A Cochrane review found similar evidence of efficacy for prevention of recurrent bleeding, although it also found hyphema took longer to clear in those treated (Gharaibeh et al., 2019, Woreta et al., 2023). Topical aminocaproic acid is not invasive, has low adverse effects, is moderately costly, but is efficacious for preserving and/or recover visual acuity, and thus is 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: topical aminocaproic acid, aminocaproic acid; traumatic hyphema, hyphema, eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 0 in CINAHL, 1 in Cochrane Library, 306 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 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 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TRANEXAMIC ACID FOR TRAUMATIC HYPHEMA

Recommended

Tranexamic acid is recommended for treatment of traumatic hyphema (Rahmani et al., 1999).

Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Non-penetrating traumatic hyphema.

Benefits

Reduced risk of re-bleeding.

Harms

Negligible.

Frequency/Dose/Duration

Tranexamic acid 25mg/kg orally three times a day (Rahmani et al., 1999).

Indications for discontinuation

When visual acuity is restored.

Rationale

One moderate quality trial suggested efficacy of oral tranexamic acid for treatment of hyphema and further suggested superiority to steroid (Rahmani et al., 1999). A second, low-quality trial trended towards efficacy of tranexamic acid compared with prednisolone (Derakhshan et al., 2022). A Cochrane review also found tranexamic acid was associated with a reduced risk of recurrence (Woreta et al., 2023). Tranexamic acid is not invasive, has some adverse effects, is moderately costly, but is highly efficacious to preserve and/or recover visual acuity and thus is 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: Tranexamic acid, Lysteda, TXA; traumatic hyphema, hyphema, eye diseases, eye disorder, eye abnormality, eye, eyes; 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, 1 in CINAHL, 14 in Cochrane Library, 9750 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 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 reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

POSTOPERATIVE CONSIDERATIONS

INTRACANALICULAR DEVICES WITH GLUCOCORTICOSTEROIDS

Sometimes Recommended

Intracanalicular devices with glucocorticosteroids are selectively recommended for patients who need reduction of postoperative inflammation.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients with, or projected to have, significant inflammation after ocular surgery.

Benefits

Reduced eye inflammation after surgery (Walters et al., 2015, Tyson et al., 2019).

Indications for discontinuation

Resolution of postoperative timeframe and/or inflammation.

Rationale

There are quality studies suggesting efficacy to reduce symptoms of postoperative inflammation (Tyson et al., 2019, Tyson S, 2019, Walters et al., 2015, Walters et al., 2016, Donnenfeld et al., 2023, Nattis et al., 2023, Ibach et al., 2021, Sane, 2017). Systematic reviews also suggest efficacy (Bukhari ZM, 2025, Brooks CC, 2020). These inserts are minimally invasive, do not require removal, and thus are recommended for treatment (or anticipation) of significant postoperative inflammation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: intracanalicular devices, intracanalicular inserts; eye diseases, eye disorder, eye abnormality, eye, eyes; 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 13 articles in PubMed, 1 in CINAHL, 27 in Cochrane Library, 2, 730 in Google Scholar, and 1 from other sources†. We considered for inclusion 6 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 8 articles considered for inclusion, 8 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

FOLLOW-UP CARE

The frequency of follow-up visits is determined by the diagnosis, stage, and severity of the problem.

PHOTOKERATITIS

Photokeratitis (e.g., welder's flash) is generally readily treated and resolves in 1 or 2 days. It frequently requires no follow-up appointments or at most one appointment the next day.

TRAUMATIC INJURIES

Blunt trauma injuries that include orbital blowout fractures without red flags for immediate surgery are typically referred to ophthalmology and require close follow-up ranging from daily to approximately every 3 to 5 days to ascertain improvements and resolution of diplopia or other problems.

Traumatic hyphema also typically is referred to ophthalmology and also requires close follow-up that is generally determined by IOP on presentation. The larger the extent of the hyphema and the higher the IOP, the more frequently the follow-up is needed.

CORNEAL ULCERS

Corneal ulcers require follow-up initially every 1 to 2 days until the epithelium has healed and then every 1 to 6 months depending on the severity and frequency of the episode when multiple.

FOREIGN BODIES, RUST RINGS, AND CORNEAL ABRASIONS

After successful treatment for simple corneal abrasions or minor foreign bodies, follow-up may be on a daily basis until the problem has resolved. As healing is rapid and minor abrasions do not generally require follow-up, it is also acceptable to schedule follow-up for such cases as needed. The larger, deeper and more extensive the injury, the more likely follow-up will need to be scheduled.

There are no quality studies on the frequencies of following up patients with these injuries; thus, guidance is by expert consensus. Patients with minor abrasions may require no follow-up other than if symptoms persist and fail to resolve in one to two days. Patients with more extensive abrasions, abrasions from vegetative matter, large foreign body removals and/or large rust ring removals may require follow-ups every 1-3 days until healed. The primary purposes of frequent follow-up appointments are to assess healing, detect complications and address work limitations all of which may change quickly.

BURNS

For chemical burns, daily follow-up is generally required until the problem has resolved. For minor volumes of non-acidic, non-alkaline insults, it is acceptable to schedule follow-up as needed.

Thermal burns depend on the severity and involvement of other structures. Minor cases may require one follow-up appointment within a day or two. More severe cases may need follow-up every one to two days until the burns are resolved.

EYE INFECTIONS

There are no quality studies comparing the frequency and/or intensiveness of follow-up of patients with eye infections with or without ulcers. There are also no quality studies evaluating education in conjunction with care for these infections. In general, follow-up ranges from daily (e.g., bacterial ulcerative keratitis) to every few days for more severe infections and then less frequently until complete resolution. Follow-up intensity initially may also be more frequent for concerns about retained foreign bodies complicating the condition, as additional treatment may be required to remove foreign matter that is otherwise delaying recovery [431].

For bacterial or fungal infections, different frequencies of follow-up visits have been utilized in the randomized controlled clinical trials with most starting follow-up visits at least twice a week. Follow-up may be more or less frequently depending on the patient's age, severity of the infection, compliance with treatment, immunocompetency of the patient, and the clinical judgment as to the risk(s) of complications. Bacterial infections are expected to resolve in 1 to 2 weeks [342, 346]. Ulcers can take longer to heal and are recovery time is proportional to the size and depth of the ulcer.

Examples of specific follow-up visit frequencies include visits: (i) every 3 days [432, 433]; (ii) days 2, 4, 7, 14 and then longer if needed [434]; and (iii) days 2-3, 6-7, 11-12, 18-19 and 28 [435]. Fungal infections usually require longer follow-up due to longer healing times that have averaged 4-5 weeks in clinical trials [436].

ALLERGIC DISORDERS

Follow-up care is highly variable and based primarily on severity of the case and response(s) to treatment. In mild cases, infrequent follow-up is indicated. In others, work-up and

using handheld lasers [158] and commercial pilots [159, 160, 161], although most pilot exposures result in short term-impairments [162].

CATARACTS

A cataract is a lens opacity that obscures vision. Cataracts are typically subdivided according to their anatomic location (i.e., nuclear, cortical, posterior subcapsular) and severity (size and intensity) of visual impairments by various classification systems [163-174]. The different anatomic locations may occur simultaneously in one patient. Elderly individuals are most susceptible to nuclear cataracts, whereas younger patients are more susceptible to posterior subcapsular cataracts.

Age is a robust risk factor for cataracts [175-188], with National Health Interview Survey data suggesting that individuals older than 75 years have a 10-fold greater risk compared with young adults [189]. Low educational status is a risk for cataracts [189]. Genetic factors are reported risks [190, 191, 192, 193].

Age-related and cortical cataracts have been associated with increased carbohydrate intake and glycemic index [194]. Microvascular retinal changes associated with hypertension reportedly predict the risk of nuclear cataracts [195], as does hypertensive status [196]. Diabetes mellitus increases cataract risk by approximately 67-80% [175, 189, 196-199]. Oral hypoglycemic agents and insulin have been associated with 2-fold and 3.4-fold increased risks, respectively, which appear to be markers for diabetes rather than additional independent risks [192]. Use of glucocorticosteroids also increases risk [192, 200]. Penetrating trauma is also a strong risk for cataracts [201].

Smoking and alcohol have both reportedly increased risk of cataracts [202, 203]. Obesity has been found to increase the risk of age-related cataracts, particularly posterior subcapsular cataracts [192, 204]. Lipids have been associated with increased risk [197]. Statins have been found to reduce the risk of nuclear cataracts by 29% [197] and cataract extractions by 34% [205]. Kidney disease is a reported risk for cataracts [186].

Aspirin and thiazide diuretic use have been associated with reduced risk of cataracts [192]. Dietary lutein and zeaxanthin have been found to reduce the risk of cataracts [202, 206]. Dietary but not supplemental vitamin E has been associated with a reduced risk of age-related cataracts [207, 208], although reductions of 9-60% in cataract risk associated with multivitamin use have been reported [209, 210]. Glutathione S-transferases polymorphisms have been associated with cataracts [211]. Cataracts have been associated with subsequent age-related maculopathy [176], as well as elevated mortality [196, 212, 213].

Ultraviolet (UV) radiation, especially UVB, has been associated with cataracts [214-217]. This risk may be limited to cortical cataracts [218-220]. Steelworkers and other open hearth workers exposed to heat on the job may have an increased risk of cataracts [221-223]. Airline pilots and astronauts are reportedly at increased risk [224, 225]. A large cohort study suggested that all three types of cataracts were interestingly less common in rural residents than urban or suburban residents [226].

Cataracts may be associated with acute exposures to radiation of 2 Grays [227, 228]. Chronic cumulative exposures above 1 Gray are associated with cortical but not nuclear cataracts [229]. Healthcare workers exposed to ionizing radiation are also reportedly at increased risk of cataracts [230-233]. Work with trinitrotoluene has been associated with cataracts [234].

evaluation for concomitant asthma and consideration of exposure modification and/or removal from work is indicated. In others, immunotherapy is indicated, in which case treatments every 1-2 weeks for a period of many months to up to approximately 2 years may be indicated.

MONITORING/AUDITING CRITERIA

The clinician is recommended to assure:

1. Corneal abrasion patients undergo eye patching. Target <10% (i.e., less than 10% of corneal abrasion patients should be prescribed a patch).
2. Corneal abrasion patients undergo fluorescein staining. Target 100%
3. Patients with chemical eye splashes undergo copious irrigation. Target 100%

TABLE 1. TECHNIQUES TO IDENTIFY AND DEFINE OCULAR PATHOLOGY

Technique	Identify Physiologic Insult	Identify Anatomic Defect
History	+ + +	+
Physical examination, including visual acuity testing and fundoscopy	+ + + +	+ + + +
Fluorescein staining	0	+ + + +
Slit-lamp examination	0	+ + + +
Tonometry	+ + +	0
Imaging studies		
Plain-film radiography	0	+a
Ultrasonography	0	+ + + +b
CT scan	0	+ + + +a
MRI	0	+ + + +c

Note: Specificity and repetitiveness from 0 (absent) to (maximum).

[a]For evaluating suspected periorbital and other depressed fractures.

[b]For evaluating suspected retinal detachment, chamber dimensions, and intraocular foreign bodies.

[c]For evaluating foreign body and intracranial pathology. However, MRI is not indicated if a ferrous foreign body is suspected and has not been ruled out.

TABLE 2. SYMPTOMS OF RED EYE

Symptom	Acute Glaucoma	Acute Iridocyclitis	Keratitis	Bacterial Conjunctivitis	Viral Conjunctivitis	Allergic Conjunctivitis
Blurred vision	3	1-2	3	0	0	0
Pain	2-3	2	2	0	0	0
Photophobia	1	3	3	0	0	0
Colored halos	2	0	0	0	0	0
Exudation	0	0	0-3	3	2	1
Itching	0	0	0	0	0	2-3

TABLE 3. SIGNS OF RED EYE

Symptom	Referral Advisable if Present	Acute Glaucoma	Acute Iridocyclitis	Keratitis	Bacterial Conjunctivitis	Viral Conjunctivitis	Allergic Conjunctivitis
Ciliary Flush	Yes	1	2	3	0	0	0
Conjunctival Hyperemia	No	2	2	2	3	2	1
Corneal Opacification	Yes	3	0	1-3	0	0-1	0
Corneal Epithelial Disruption	Yes	0	0	1-3	0	0-1	0
Pupillary Abnormalities	Yes	Mid-dilated, nonreactive	Small; may be irregular	Normal or small	0	0	0
Shallow Anterior Chamber Depth	Yes	3	0	0	0	0	0
Elevated Intra-Ocular Pressure	Yes	3	-2 to +1	0	0	0	0
Proptosis	Yes	0	0	0	0	0	0
Discharge	No	0	0	Sometimes	2-3	2	1
Preauricular Lymph Node Enlargement	No	0	0	0	0	1	0

Note: The range of severity of the symptom is indicated by 0 (absent) to 3 (severe).

Modified from [239].

TABLE 4. SELECTED DIFFERENTIAL DIAGNOSIS OF RED EYE

Condition	Signs	Symptoms	Causes
Conjunctivitis			
Viral	Normal vision, normal pupil size and reaction to light, diffuse conjunctival injections (redness), preauricular lymphadenopathy, lymphoid follicle on the undersurface of the eyelid	Mild to no pain, diffuse hyperemia, occasional gritty discomfort with mild itching, watery to serous discharge, photophobia (uncommon), often unilateral at onset with second eye involved within 1-2 days, severe cases may cause subepithelial corneal opacities and pseudomembranes	Adenovirus (most common), enterovirus, coxsackievirus, VZV, Epstein-Barr virus, HSV, influenza
Herpes zoster ophthalmicus	Vesicular rash, keratitis, uveitis	Pain and tingling sensation precedes rash and conjunctivitis, typically unilateral with dermatomal involvement (periocular vesicles)	*Herpes zoster*
Bacterial (acute and chronic)	Eyelid edema, preserved visual acuity, conjunctival injection, normal pupil reaction, no corneal involvement	Mild to moderate pain with stinging sensation, red eye with foreign body sensation, mild to moderate purulent discharge, mucopurulent secretions with bilateral glued eyes upon awakening (best predictor)	Common pathogens in children: Streptococcus pneumoniae, nontypeable *Haemophilus influenzae* Common pathogen in adults: *Staphylococcus aureus* Other pathogens: *Staphylococcus* species, *Moraxella* species, *Neisseria gonorrhoeae*, gram-negative organisms (e.g., *Escherichia coli*), *Pseudomonas* species
Bacterial (hyperacute)	Chemosis with possible corneal involvement	Severe pain; copious, purulent discharge; diminished vision	*N. gonorrhoeae*
Chlamydial (including conjunctivitis)	Vision usually preserved, pupils reactive to light, conjunctival injections, no corneal involvement, preauricular lymph node swelling is sometimes present	Red, irritated eye; mucopurulent or purulent discharge; glued eyes upon awakening; blurred vision	*Chlamydia trachomatis* (serotypes D to K)
Allergic	Visual acuity preserved, pupils reactive to light, conjunctival injection, no corneal involvement, large cobblestone papillae under upper eyelid, chemosis	Bilateral eye involvement; painless tearing; intense itching; diffuse redness; stringy or ropy, watery discharge	Airborne pollens, dust mites, animal dander, feathers, other environmental antigens

Adapted from [437].

TABLE 5. COLOR VISION TESTING REQUIREMENTS

Mode of Transportation	Color Vision Requirement	Acceptable Tests / Evaluation Methods
Commercial Pilots (FAA)	Must demonstrate ability to perceive colors necessary for safe duties	• As of Jan 1, 2025: Only FAA-approved computerized tests are allowed for new initial applicants: City CAD, Rabin Cone Contrast Test (RCCT), or Waggoner CCVT. Existing pilots (medical certificate without color vision limitation as of Dec 31, 2024) are grandfathered—no new testing required. If upgrading class or removing limitation: must pass approved computerized test; otherwise only restricted ("Day VFR only") 3rd-class medical is issued. Legacy tests like Ishihara plates, lantern, etc., are no longer accepted for unrestricted certification after Dec 2024.
Commercial Drivers (CDL, FMCSA)	Must have ability to distinguish red, green, and amber(traffic signal colors)	• Color recognition is evaluated as part of the CDME physical, typically through the driver's ability to distinguish traffic signal colors. No specific standardized color vision test (e.g., Ishihara or lantern) is mandated.
Train Crew / Rail (e.g., Union Pacific safety-critical roles)	Require adequate color vision for safety-critical duties	• Color discriminatory requirements for engineers and conductors exceed other transportation modes due to many factors, including variations in non-standardized signal hues, day/night, varying backgrounds behind signals. Color vision screening typically involves identifying color deficiencies—specific test types are not specified by FRA. Possible use of clinical color vision tests (e.g., Ishihara, lanterns) as part of an individualized evaluation.
Maritime	Required to distinguish red, amber and green	• Required to detect and interpret signal lights, buoys and navigational aids. Pseudochromatic (e.g., Ishihara) plates or lantern tests, typically by a commercial screening device.
Other Occupations (e.g., electricians, OSHA-regulated roles)	OSHA does not mandate normal color vision.	• No specific testing required by government. This is determined and enforced by the employer based on job requirements.

TABLE 6. VISUAL ACUITY TESTING REQUIREMENTS

Mode and regulator	Visual-acuity requirement (distance/near/intermediate)	Field of vision	Accepted / typical test methods
Aviation – Pilots (First-class, FAA)	Distant: ≥ 20/20 each eye; Near: ≥ 20/40 at 16″ each eye; Intermediate (≥50 yr):≥ 20/40 at 32″ each eye.	"Normal" fields of vision.	Snellen-equivalent distance chart; near/intermediate at the specified working distances. FAA AME Guide permits commercial visual-acuity devices that are "acceptable substitutes
Aviation – Pilots (Second-class, FAA)	Distant: ≥ 20/20 each eye; Near: ≥ 20/40 at 16″ each eye; Intermediate (≥50 yr):≥ 20/40 at 32″ each eye.	"Normal" fields.	Same as above (Snellen-equivalent or approved devices
Aviation – Pilots (Third-class, FAA)	Distant: ≥ 20/40 each eye; Near: ≥ 20/40 at 16″ each eye.	Not explicitly numeric; no interfering pathology.	Same as above (Snellen-equivalent or approved devices
Highway – Commercial motor vehicle drivers (FMCSA/CDL)	Distant: ≥ 20/40 (Snellen) in each eye (with/without correction) and binocular ≥ 20/40; corrective lenses allowed.	≥ 70° in the horizontal meridian in each eye.	Standard distance acuity via Snellen or equivalent; field testing by confrontation/perimetry as part of the DOT medical. For drivers using the Alternative Vision Standard (2022), an OD/MD completes Form MCSA-5871 before the ME certifies.
Rail – Locomotive engineers and conductors (FRA)	Distant: ≥ 20/40 (Snellen) in each eye uncorrected or corrected to ≥20/40 and binocular ≥20/40.	≥ 70° each eye.	Snellen or equivalent under a railroad program that follows manufacturer instructions/ANSI; FRA allows retest and medical-examiner review if thresholds aren't met. (Color-signal tests are separate.)
Maritime – Deck (USCG)	Correctable to ≥ 20/40 in one eye; uncorrected ≥ 20/200 same eye. STCW endorsements: correctable ≥ 20/40 in both eyes; uncorrected ≥20/200 in both.	Not numerically specified in §10.305 (acuity focus); additional	Snellen or equivalent; common approved instruments include Titmus/OPTEC vision testers (used widely in USCG exams). If correction is required, mariner

		color standards exist separately.	must wear lenses and carry spares; waivers possible per §10.303.
Maritime – Engineering/Radio/Tankerman/MODU **(USCG)**	Correctable to ≥ 20/50 in one eye; uncorrected ≥ 20/200 same eye.	—	Same as above (Snellen or equivalent; Titmus/OPTEC acceptable; corrective-lenses/spares note; waiver policy).

APPENDIX 1: PICO QUESTIONS

1. What evidence exists for vision screening for preplacement examinations?
2. What evidence exists for vision screening for periodic surveillance examinations?
3. What evidence exists for vision screening during post-injury examinations?
4. What evidence exists for vision screening for postoperative examinations?
5. Is there evidence to perform color vision screening for preplacement examinations?
6. Is there evidence to perform color vision screening for periodic surveillance examinations?
7. What is the evidence for color vision screening for select post-injury examinations?
8. What is the evidence for color vision screening for select postoperative examinations?
9. Is there evidence for peripheral vision screening for preplacement examinations?
10. Is there evidence for peripheral vision screening for periodic surveillance examinations?
11. Is there evidence for peripheral vision screening for select post-injury examinations?
12. What evidence exists regarding depth perception screening for preplacement examinations?
13. What evidence exists for depth perception screening for periodic surveillance examinations?
14. Is there evidence for depth perception screening for select post-injury examinations?
15. Is there evidence for depth perception screening for select postoperative examinations?
16. Is there evidence for education regarding ocular injury prevention for workers?
17. Is there evidence for personal protective equipment (PPE) to prevent ocular injuries?
18. Is there evidence for using safety glasses in most work settings?
19. What evidence exists for use of safety goggles, face shields and/or splash guards in high risk jobs to prevent penetrating eye trauma or chemical splashes?
20. What evidence exists for screening of visual acuity when evaluating eye conditions?
21. Is there evidence to use a slit lamp with fluorescein stain when evaluating and diagnosing foreign bodies and/or corneal abrasions?
22. What evidence supports the use of x-ray for evaluating and diagnosing foreign bodies and/or orbital fractures?
23. Is there evidence to support use of x-ray for evaluating simple abrasions and rust rings?
24. What evidence exists for use of CT for the evaluation of ocular foreign bodies and possible orbital fractures?
25. Is there evidence to support the use of MRI for the diagnosis of foreign bodies and corneal abrasions?
26. Is there evidence for copious irrigation to remove superficial foreign bodies?
27. What is the evidence for using cotton swabs, needles or magnets to remove superficial foreign bodies?
28. What is the evidence for rust ring removal?
29. Is there evidence for the use of eye patches for corneal abrasions?
30. What evidence exists for prophylactic ophthalmic antibiotic use?
31. What is the evidence for using therapeutic contact lenses?
32. What evidence exists for epidermal growth factor?
33. What evidence exists for mydriatic medications?
34. Is there evidence to support the use of artificial tears or lubricants?
35. What evidence supports the use of topical anesthetics?
36. Is there evidence for use of topical opioids as analgesics?
37. Is there evidence for the use of topic aminocaproic acid for traumatic hyphema?
38. What is the evidence for use of tranexamic acid for traumatic hyphema?
39. Is there evidence for screening of adenovirus in select patients?
40. Is there evidence for routine screening of adenovirus?
41. What is the evidence for use of gram stain, potassium iodide (KOH) preparation and culture and sensitivity of eye infections in select patients?
42. What is the evidence for routine gram stain, potassium iodide (KOH) preparation and culture and sensitivity of eye infections?

43. Is there evidence for the use of antibiotics for bacterial conjunctivitis and/or bacterial infections complicating corneal ulcers?
44. What evidence exists for adjuvant glucocorticosteroids for bacterial conjunctivitis and/or bacterial infections complicating corneal ulcers?
45. What is the evidence for the use antibiotics for viral conjunctivitis?
46. Is there evidence to support the use of non-steroidal anti-inflammatory drugs (NSAIDS) for symptoms of viral conjunctivitis?
47. Is there evidence for use of glucocorticosteroids for symptoms of viral conjunctivitis?
48. What is the evidence for use of antifungal medications for fungal conjunctivitis and fungal infections complicating corneal ulcers?
49. Is there evidence for performing daily eye lid hygiene for blepharoconjunctivitis?
50. Is there evidence for using antibiotics for blepharoconjunctivitis?
51. What evidence exists for use of high molecular weight specific antigens for workers with or at risk for occupational asthma?
52. What evidence exists for the use of low molecular weight specific antigens for workers with or at risk for occupational asthma?
53. What is the evidence surrounding minimization of exposure risk for eye symptoms without asthma?
54. What is the evidence surrounding education to manage allergic eye conditions?
55. What evidence exists for antihistamine and/or mast cell stabilization medications for allergic eye conditions?
56. Is there evidence to use non-steroidal anti-inflammatory (NSAID) eye drops for allergic eye conditions?
57. What is the evidence for the use of glucocorticosteroids for eye allergies?
58. Is there evidence for copious irrigation for allergic eye conditions?
59. What is the evidence regarding irrigating systems such as the Morgan lens?
60. Is there evidence for use of artificial tears or other lubrication for allergic eye conditions?
61. What is the evidence surrounding use of non-steroidal anti-inflammatory (NSAID) drops for chemical ocular burns?
62. Is there evidence for the use of glucocorticoid drops for chemical ocular burns?
63. What is the evidence for eye patching for chemical ocular burns?
64. Is there evidence for using amniotic membrane transplantation for chemical ocular burns?
65. What is the evidence for corneal transplantation for blindness or other corneal scarring or defects after a chemical exposure to the eye?
66. Is there evidence for non-steroidal anti-inflammatory (NSAID) drops for Welder's Flash?
67. Is there evidence for eye patching for eye patching for Welder's Flash?
68. What is the evidence for copious irrigation after thermal eye exposures?
69. What evidence exists for irrigating systems such as the Morgan lens for thermal eye exposures?
70. What is the evidence for use of artificial tears or lubrication for thermal ocular burns?
71. What is the evidence for non-steroidal anti-inflammatory (NSAID) drops for thermal ocular burns?
72. Is there evidence for eye patching post thermal ocular burns?
73. What is the evidence for amniotic membrane therapy with medical management for chemical ocular burns?
74. What is the evidence for standalone amniotic membrane therapy for chemical ocular burns?
75. Is there evidence for the use of non-steroidal anti-inflammatory (NSAID) drops for inflamed pterygia or pingueculae?
76. Is there evidence for the use of glucocorticosteroids for inflamed pterygia or pingueculae?
77. What evidence exists for pterygium excision?
78. Is there evidence for use of bevacizumab for prevention of pterygia recurrence?

79. What is the evidence for the management of asthma (persistence of exposure)?
80. What is the evidence for the management of asthma (avoidance of exposure)?
81. What is the evidence for the management of sensitive-induced asthma (reduction of exposure to low molecular weight asthmagens)?
82. What evidence exists for the management of sensitive-induced asthma exposure to asthmagens?
83. Is there evidence for the management of irritant-induced asthma (reduction of exposure)?
84. Is there evidence for immunotherapy in the management of asthma?

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