Occupational Eye Injuries

2009 Occupational Medicine Symposium
Southern California Permanente Medical Group
June 13, 2009

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Sources for Presentation

4. NIOSH Web Site: http://www.cdc.gov/niosh/eyesafe.html

Common Hazards

• Dust, concrete, and metal particles
• Falling or shifting debris, building materials, glass
• Smoke, noxious/poisonous gases
• Chemicals (acids, bases, fuels, solvents, lime, wet or dry cement powder)
• Welding light and electrical arc
• Thermal hazards and fires
Common Trauma

- Chemical splash or burn
- Corneal abrasions
- Corneal Foreign Body/Rust Ring
- Conjunctival Foreign Body
- Eyelid Laceration
- Hyphema
- Orbital Blow-Out Fracture
- Intraorbital Foreign Body
- Ruptured Globe and Penetrating Ocular Injury
- Welder’s flash-burn
- Facial contusion and black eye

First Aid for Eye Injuries

- Specks in the Eye
  - Do not rub the eye.
  - Use an eye wash, flush eye copiously.
  - See an ophthalmologist if speck does not wash out, pain or redness continues.

Chemical Splash or Burn

- Cuts, Punctures, Objects Stuck in the Eye
  - Do not wash out the eye.
  - Do not try to remove an object stuck in the eye.
  - Stabilize eye with a rigid shield without pressure such as with the bottom half of a paper cup.
  - Go directly to an Emergency Room.
First Aid for Eye Injuries

• Chemical Burns
  • Immediately flush eye with water. Open the eye as wide as possible. Continue flushing for at least 15 minutes. For caustic or basic solutions continue flushing while in route to physician’s office or emergency room.
  • If a contact lens is in the eye, begin flushing over the lens immediately. Flushing may dislodge the lens.
  • Again, see a physician at once.

• Blows to the Eye
  • Apply cold compress without pressure.
  • Crushed ice in a plastic bag can be taped to the forehead to rest gently on the injured eye.
  • See a doctor at once in cases of continued pain, reduced vision, blood in eye or discoloration which can mean internal eye damage.

Chemical Splash or Burn

alkali (e.g., lye, cement, plaster), acids, solvents, detergents, and irritants (e.g., mace)

• Emergent Treatment:
  • Immediately flush eyes with Saline or Ringer’s lactated solution for at least 30 minutes. If out in the field, then simply use non-sterile water if that is all that is available. For caustic or basic solutions continue flushing while in route to medical facility.
  • If a contact lens is in the eye, begin flushing over the lens immediately. Flushing may dislodge the lens.
  • Do not use acidic solutions to neutralize alkalies or vice versa (Hydrofluoric acid dilemma).
Chemical Splash or Burn

• Primary goals are:
  • Restore an intact epithelial layer of the ocular surface
  • Control the acute inflammatory process
  • Support the reparative process
  • Avoid complications

Chemical Splash or Burn
Acid vs. Alkali Burns

• As a general rule, most acid burns are mild and do not require the involved treatment for alkali burns.

Chemical Splash or Burn
Emergent Treatment

• Place an eyelid speculum (or simply try to hold open the eye as wide as possible) and topical anesthetic (e.g., proparacaine) in the eye prior to irrigation.

• Pull down the lower eyelid and evert the upper eyelid, if possible, to irrigate the fornices. Manual use of IV tubing connected to an irrigation solution facilitates the irrigation process.
Chemical Splash or Burn

- Use a cotton swab to remove any particulate matter that may be retained in the fornices. Soak the swab in ethylenediaminetetraacetic acid (EDTA) 1% if the causative agent contained calcium oxide (lime).
- Five minutes after ceasing irrigation (30 minutes of irrigation) to allow for equilibration, litmus paper should be touched to the inferior cul-de-sac. If the pH is not neutral (pH=7), irrigation should be continued until neutral pH is reached.

Chemical Splash or Burn

Hydrofluoric Acid Burns

- 0.03% Benzalkonium chloride as irrigant causes additional ocular damage and has no beneficial therapeutic effect.
- Pastes of 25 to 50% magnesium sulfate or magnesium oxide are too toxic.
- Isotonic calcium chloride, calcium gluconate or 0.2% benzethonium irrigation are too toxic and produce an additive effect with Hydrofluoric acid.
- 10% calcium chloride injected subconjunctivally is too toxic.
- Subconjunctival injection of isotonic magnesium chloride has no therapeutic effect.
- Immediate single irrigation with water or normal saline is the most effective therapy for ocular HF burns.

Chemical Burn

Image of chemical burn on the eye.
Corneal Alkali Burn

Mild to Moderate Burns
- Scattered superficial punctate keratitis (SPK)
- Focal epithelial loss to sloughing of the entire epithelium
- NO significant areas of perilimbal ischemia (no sign of interrupted blood flow through the conjunctival or episcleral vessels)
- Focal areas of conjunctival chemosis
- Hyperemia and/or hemorrhages
- Eyelid edema
- Mild AC reaction
- 1st and 2nd degree burns of the periocular skin

Moderate to Severe Burns
- Pronounced chemosis
- Perilimbal blanching
- Corneal edema and opacification
- Little-to-no view of the anterior chamber, iris or lens
- If visible, moderate-to-severe AC reaction
- Increased IOP
- 2nd and 3rd degree burns of the surrounding skin
- Local necrotic retinopathy as a direct penetration of alkali through the sclera
Alkali Burn

Perilimbal Blanching after Alkali Burn

Conjunctival Necrosis after an Alkali Burn
Early Sequelae of Alkali Burns

- Stromal Necrosis and perforation are seen in this cornea.
- Alkaline compounds are lipophilic and penetrate deeply into the corneal stroma.
- They cause saponification of fatty acids in cell membranes, which leads to rapid cell demise.

Late Sequelae of Alkali Burns

- Alkali Burn with a nonhealing epithelial defect resulting from ischemia

- Severe Alkali Burn after one year. Note complete scarring. They are poor candidates for transplants because of defective conjunctival and corneal stem cells.
Acid Burn (severe)

Chemical Splash or Burn
Treatment after Irrigation

• Probably admit to the hospital for close monitoring of IOP and corneal healing.

Corneal Abrasion

• Symptoms:
  • Pain, photophobia, foreign-body sensation, tearing, history of scratching the eye
• Critical Signs:
  • Epithelial staining defect with fluorescein
• Other Signs:
  • Conjunctival injection, swollen eyelid, mild anterior chamber reaction
• Work-up:
  • Slit-lamp examination
    • Use fluorescein
    • Measure size
    • Diagram
    • Check for an anterior-chamber reaction
  • Exert (double exert with large paper clip) eyelids to rule out foreign body
Corneal Abrasions

• Treatment:
  • Non-contact lens wearer
    - Cycloplegic (e.g., cyclopentolate 2%)  
    - Antibiotic ointment (e.g., erythromycin, bacitracin or ciprofloxacin, q2-4h) or antibiotic drops (e.g., polymyxinB/tobramycin/TMP/trimethoprim or a fluoroquinolone qid)
    - Pressure patch for 24 hours
    - Consider dissolving collagen lenses that have been pre-soaked in broad spectrum ophthalmic antibiotic solutions (discuss with ophthalmology and pharmacy departments on preparation).

• Contact lens wearer (think pseudomonas)
  - Cycloplegic (e.g., cyclopentolate 2%)  
  - Tobramycin or ciprofloxacin, q2-4h ointment or drops  
  - Topical nonsteroidal antiinflammatory drug drops (e.g., ketorolac, qid for 3d) for pain control
  - Debriding loose or hanging epithelium because it may inhibit healing
  - No CL wear.

Legal note: prescribing eye ointment without warning patient of blurry vision and not to drive constitutes lack of informed consent and opens the practitioner to liability to patient and any foreseeable injured party.

• No eye patch!
Corneal Foreign Bodies (FB)

- **Symptoms:**
  - Foreign-body sensation, tearing, blurred vision, photophobia, a hx. of a FB in the eye.

- **Critical Signs:**
  - FB, rust ring, or both

- **Other Signs:**
  - Conjunctival injection, eyelid edema, mild AC reaction and Superficial Punctate Keratitis (SPK).
  - Small infiltrate surrounding the corneal FB.
  - Linear, vertically oriented corneal scratches may indicate a FB under the upper eyelid.

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Corneal FB

- **History is crucial:**
  - Wearing safety goggles?
  - Did FB arise from metal striking metal (this may suggest an intraocular FB)?
  - Did the patient use a grinding wheel (this may suggest an intracocular FB)?

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Corneal FB

- **Document VA BEFORE any procedure is performed. Some experts suggest one to two gtts anesthetic to control blepharospasm and pain.**
  - Legal note: there have been claims that further damage was done by simply shining a flashlight into an injured eye. Mitigate such nuisance claims by always documenting VA first.
**Corneal FB Exam**

- Simply look at the eye
- Slit-lamp exam:
  - Locate & assess depth of FB
  - R/O:
    - Self-sealing lacerations
    - Iris tears
    - Lens opacities
    - AC shallowing
    - Asymmetrically low IOP in involved eye
  - Double evert* to look for additional FB's
  - Look for vertical linear abrasions
  - Observe conjunctiva for lacerations to R/O scleral laceration or perforation.

**Corneal FB Exam**

- Dilate the eye and examine vitreous & retina for possible intracocular FB
- Consider B-scan ultrasound, CT of orbit (axial & coronal views, 1-mm cuts)
- Consider ultrasonographic biomicroscopy (UBM) to exclude an intraocular or intraorbital FB
- Avoid MRI

**Corneal FB Treatment**

- Treatment:
  - Topical anesthetic (e.g., proparacaine)
  - Irrigation
  - FB spud
  - Fine forceps
  - Tuberculin syringe
  - Ophthalmic burr to remove rust ring. If deep and central rust ring, allow time for rust to migrate to the surface.
  - Measure resulting corneal abrasion and treat as "Corneal Abrasion"
Metal particles or slivers embedded in the eye

Iron FB in Cornea with an Early Rust Ring

Corneal Rust Ring
Deep Iron Corneal FB that was not Initially Removed - Striae indicate low pressure secondary to leaking aqueous - hence there is a perforation

Ophthalmic Burrs and Alger Brush

Heterochromia (darker irides) as a result of an intraocular iron FB.
Brown Deposits from retained iron FB.

Iron FB was in the angle and could only be appreciated by gonioscopy. This was a high velocity iron sliver with a self-sealing corneal wound.

Welder’s Flashburn

- Symptoms:
  - Moderate to severe ocular pain
  - Foreign-body sensation
  - Red eye
  - Tearing
  - Photophobia
  - Blurred vision
  - Symptoms are typically worse 6-12 hours AFTER the exposure
Welder’s Flashburn

• Critical sign:
  • Confluent SPK in an interpalpebral distribution seen with fluorescein staining

• Other signs:
  • Conjunctival injection
  • Mild-to-moderate eyelid edema
  • Mild-to-no corneal edema
  • Relatively miotic pupils that react sluggishly

Welder’s Flashburn

• Treatment:
  • Slit-lamp exam: use fluorescein stain
  • Evert eyelids to search for a foreign body
  • Cycloplegic
  • Antibiotic ointment (e.g., erythromycin)
  • Pressure patch for 24 hours
  • Oral pain medication

Welding Injury

• [Image of welding injury]
**SPK from Welding Injury**

![Image](image)

**Welding Injury**

- **Symptoms**
  - Moderate to severe ocular pain
  - FB sensation
  - Red eye
  - Tearing
  - Photophobia
  - Blurred vision
  - History of welding

- **Critical sign**
  - Superficial punctate keratitis (SPK) in an interpalpebral distribution seen with fluorescein staining

- **Additional signs**
  - Conjunctival injection
  - Mild to moderate eyelid edema
  - Mild to no corneal edema
  - Relatively miosis pupils that react sluggishly.
Welding Injury

Work-up
- Take work history (e.g., welding, sunlamp use, topical medication)

Treatment
- Cycloplegic (e.g., cyclopentolate 2%)
- Antibiotic ointment (e.g., erythromycin)
- Pressure patch for 24 hours (the more severely affected eye)
- Oral pain medication (e.g., acetaminophen)

Definitions

Penetration and Perforation

- Penetration – into but not through
- Perforation – into and through
Eyeball Laceration

- Ruptured globe:
  - Severe subconjunctival hemorrhage
  - Deep or shallow AC compared with the contralateral eye
  - Hyphema
  - Limitation of extraocular motility (greatest in the direction of rupture)
  - Intraocular contents may be outside of the globe (take pictures for legal documentation)

Eyeball Laceration

- Penetrating Injury:
  - Full-thickness scleral or corneal laceration
  - Signs of a ruptured globe
  - History of a sharp object entering the globe

Eyeball Laceration

- Other signs:
  - Low IOP
  - Irregular pupil
  - Iridodialysis
  - Cyclodialysis
  - Periorbital ecchymosis
  - Dislocated or subluxed lens
  - Commotio retinae
  - Choroidal rupture
  - Retinal breaks
  - Vitreous hemorrhage
  - Traumatic optic neuropathy
Eyeball Laceration

- Treatment as a first responder:
  - If patient is alert, tell them not to sneeze or cough
  - Place clean coffee cup over eye and tape
  - Transport to ER for ophthalmologist

Ruptured Globe

Ruptured Globe
Facial Contusion and Black Eye and possible Blow-out Fracture

• Symptoms:
  • Pain (especially on attempted vertical eye movement)
  • Local tenderness
  • Binocular double vision (the double vision disappears when one eye is covered)
  • Eyelid swelling after nose blowing
  • Recent history of trauma

• Critical signs:
  • Restricted eye movement (especially in upward and/or lateral gaze)
  • Subcutaneous or conjunctival emphysema
  • Hypesthesia in the distribution of the infraorbital nerve (ipsilateral cheek and upper lip)
  • Palpable step-off along the orbital rim
  • Point tenderness
  • Enophthalmos (may initially be masked by orbital edema)
Facial Contusion and Black Eye and possible Blow-out Fracture

- **Treatment:**
  - Nasal decongestants (Afrin nasal spray bid) for 10-14 days
  - Broad spectrum antibiotics (keflex) 250-500mg po qid for 10-14 days
  - Instruct the patient not to blow their nose
  - Icepacks to the orbit for the 1st 24-48 hours
  - Surgical repair at 7-14 days posttrauma if
    - persistent diplopia when looking straight ahead or attempting to read
    - Cosmetically unacceptable enophthalmos
    - Large fracture present

Blow-out Fracture

- **History:**
  - Type of injury
  - Exact time of injury
  - Exact time of visual loss, if any

- **Exam:**
  - Visual acuity and rule out ruptured globe as best as possible
  - Quantitate percent or millimeters and/or draw the extent of layering of RBC's and the presence of any clot.
  - If comfortable that there is no ruptured globe, obtain IOP.
  - In black patients, document history of sickle cell.

- Transport to ophthalmologist or hospital for:
  - B-scan ultrasound if retinal detachment can not be ruled out
  - CT scan (axial and coronal views) of the orbits and brain
  - Remember to shield eye in case there is a ruptured globe and instruct patient not to sneeze. Memorialize these instructions in your notes.

Hyphema

- **History:**
  - Type of injury
  - Exact time of injury
  - Exact time of visual loss, if any

- **Exam:**
  - Visual acuity and rule out ruptured globe as best as possible
  - Quantitate percent or millimeters and/or draw the extent of layering of RBC's and the presence of any clot.
  - If comfortable that there is no ruptured globe, obtain IOP.
  - In black patients, document history of sickle cell.

- Transport to ophthalmologist or hospital for:
  - B-scan ultrasound if retinal detachment can not be ruled out
  - CT scan (axial and coronal views) of the orbits and brain
  - Remember to shield eye in case there is a ruptured globe and instruct patient not to sneeze. Memorialize these instructions in your notes.
Chemosis in Lawn Maintenance Worker

Treatment for Allergic Conjunctivitis

- Eliminate the inciting agent
- Cool compresses several times a day
- Topical drops
  - Mild - artificial tears
  - Moderate - Vasoconstrictor/antihistamine qid (e.g., naphazoline/pheniramine) but used only for several days secondary to rebound vasodilation. Use ketotifen fumarate (Zaditor by Novartis) or epinastine HCL 0.05% (Estat by Allergan)
  - Severe - Mild topical steroid (e.g., Fluorometholone qid for 1-2 weeks)
- Antihistamine (e.g., diphenhydramine 25 mg po 3-4 times/day) in moderate to severe cases.
- Give informed consent

FB in Agrarian Workers Corn Husk
FB in Agrarian Workers
Grasshopper Leg

FB in Agrarian Workers
Tarantula Hairs

FB – Glass
Bloodborne pathogen exposure from blood or other body fluids or human remains

- Massive irrigation as with a chemical burn.
- Treat according to pathogen of exposure.

4 Points to Eye Safety

1. Have a safe work environment
   - Minimize hazards from falling or unstable debris.
   - Make sure that tools work and safety features (machine guards) are in place.
   - Ensure that workers, particularly volunteers, know how to use tools properly.
   - Keep bystanders out of the hazard area.
4 Points to Eye Safety

2. Evaluate your safety hazards
   • Know your primary hazards.
   • Recognize hazards from nearby workers, large machinery, and falling/shift ing debris.

3. Wear the proper eye and face protection
   • Select the Z87 eye protection for the hazard.
   • Make sure the eye protection is in good condition.
   • Make sure it fits properly and will stay in place.
   • Eye/face protection devices should not be relied upon to provide complete protection.

4. Prepare for eye injuries and first aid needs
   • Have an eyewash or sterile solutions on hand.
Types of Eye Protection

Usage certified eye protection. Look for the "Z87" mark on the lens or frames.

Types of Eye Protection

- **Safety Glasses - minimum required**
  - Use safety glasses for general working conditions where there may be minor dust, chips, or flying particles.
  - Use safety glasses with side protection such as side shields or wrap-around style.
  - Use safety glasses treated for anti-fog.
  - Use an eyewear retainer to keep the glasses tight to the face or hanging from the neck if not in use.

Non-prescription Safety Glasses with wrap-around side protection
Prescription Safety Glasses
with side shields

Goggles—better protection

Use goggles for higher impact protection,
greater dust, chemical splash, and welding
light protection.

- Goggles for splash or fine dust protection
  should have indirect venting. Use direct
  vented goggles for less fogging when
  working with large particles.
- Safety goggles designed after ski type goggles
  with high air flow minimize fogging while
  providing better particle and splash
  protection.

Goggles
Hybrid safety glasses/goggles—better protection

- Safety glasses with foam or rubber around lens provide better protection from dust and flying particles than conventional safety glasses with only side shields.
- Wrap-around safety glasses that convert to goggles with a soft plastic/rubber face seal may offer better peripheral vision than conventional goggles.
- For greater impact and face protection use a shield over safety glasses/goggles.

Face Shields—Additional Protection

- Use face shields for highest impact, full face protection for spraying, chipping, grinding, and critical chemical or bloodborne hazards.
- Face shields may be tinted or metal coated for heat and splatter protection.
- The curve of the face shield will direct particles or chemicals coming from the side into the eyes. Always wear safety glasses or goggles under a face shield.

Welding

- Exposure to welding light causes severe burns to the eye and surrounding tissue—“welder’s flash.”
- Lens for welding light protection must be marked with the “Shade Number” (1.5-14, 14 = darkest).
- Protect the eyes even when the helmet is lifted up.
- Protect the welder, welder’s helper, and bystanders.

Use the darkest shade possible
- Torch welding 1.5-3
- Torch brazing/cutting 3-6
- Gas welding 4-8
- Electric arc welding 10-14
- Use Z136 eye protection for laser light hazards (NOT Z87)
Welding

Respirators—Full face & Half-mask

• Full-face respirators provide the best general dust, chemical and smoke protection (respirators may not be Z87 compliant for impact protection).
• When half-face respirators are used, respirator must not interfere with the proper positioning of the eye protection.

Eye Safety for Prescription Lens Wearers

• Use polycarbonate or Trivex® lenses for the best impact protection in prescription safety glasses.
Prescription Safety Glasses

- Workers who wear prescription glasses should wear tight-fitting goggles over normal street wear glasses or contact lenses.
- Goggles should also be worn over prescription safety glasses in high dust environments.
- If worn alone, prescription safety glasses must have side shields.
- Prescription safety lenses with tempered glass or acrylic plastic lenses are not suitable for high impact. These types of safety glasses should not be used when working in debris areas unless covered by goggles or face shield.
- Respirators should be professionally fitted.

Prescription Safety Glasses

- Polycarbonate or Trivex® lenses should be used when working in high impact areas. New safety glasses with polycarbonate lenses should be hard-coated to reduce scratching. Contact lenses may present a significant corneal abrasion risk when working in dusty areas unless tight-fitting goggles or a full-face respirator are worn.
- Full-face respirators will not seal properly over street wear glasses or safety glasses. Prescription inserts compatible with a respirator should be used.