



## **Initial Evaluation and Treatment of Traumatic Ophthalmologic Emergencies**

Traumatic injury to the eye can range from subtle to dramatically obvious. The lecturer will provide the tools necessary to make appropriate treatment and evaluation decisions when faced with a patient with potential ophthalmologic trauma. Criteria for emergent consultation will be reviewed.

- Describe the anatomy of the eye and orbit and the neurologic pathways important to vision.
- Identify subtle findings of ophthalmologic trauma.
- Describe an appropriate workup for suspected ophthalmologic trauma.
- Identify problems requiring emergent admission or consultation.

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### **FACULTY**

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## EYE TRAUMA - "PREVENT IT IF YOU CAN!"

### Educational Objectives

1. To understand the basic anatomy of the eye, orbit, and neurologic pathways important to vision/pupillary reflexes.
2. To know the materials and medications that should be available for the assessment of eye injured patients in the Emergency Department.
3. To know the basic historical and physical examination information necessary in eye injured patients.
4. To have pattern recognition for both subtle and gross surface, blunt, and penetrating injuries of the eye. "Once seen, never forgotten".
5. To understand selected therapies, including timing of consultation and emergent admission, for patients with eye trauma.

### I. Selected Anatomy

- A. Orbit - made of seven bones: frontal, sphenoid, maxilla, palatine, zygoma, lacrimal, ethmoid. Floor and medial aspect are only 0.5 - 1.0 mm thick. Orbital trauma-everything but globe.
- B. Cornea: six layers including tears. 0.5 mm thick at center. Injuries beneath Bowman's membrane heal with scar. Surface repairs 2-3 square mm in 24 hours.
- C. Limbus (Scleral - Iris junction) area of "angle recession" injury. Hydraulic forces damage Canals of Schlemm (aqueous humor drainage). Heal with scar - late glaucoma. Difficult to visualize without gonioscopy.
- D. Uveal tract: iris, ciliary body, choroid. Pigmented layer. may visualize in rupture, perforation. Ocular trauma-specific to globe.
- E. Retina - Neuronal layer first, then rods/cones. Ophthalmic artery supplies. Any damage/obstruction turns retina white. Retina firmly attached at optic nerve/ora serrata. May separate from choroid at Retinal Pigmented Epithelium (RPE), Bruch's membrane is basement membrane, site of retinal detachment.
- F. Optic nerve - Optic tract with 3 layers. Blood can dissect into pre-retinal area. through lamina cribosa, via subarchnoid space. Optic n. can be contused in blunt trauma.
- G. Neuro-ophthalmology - Oculomotor nerve essential in motor control. Edinger-Westphal nucleus controls autonomic function through ciliary ganglion. Source of direct and consensual reflexes.
- H. External Inferior orbital nerve. tear duct system (upper and lower lids) are at risk.

## II. Materials/Medications for Eye Exam in Emergency Department

### A. Materials

1. Eye charts - Snellen, close visual
2. Blank/pinhole eye occluder
3. Eye pads/shield
4. Lid elevator (**Desmarres** retractor)
5. Spud/burr
6. Fluorescein Strips/U-V light
7. Light/magnifying sources
8. Schiotz or other tonometer

### B. Medications: "Is it necessary to dilate an eye in the ED?"

1. Mydriatics (only): 2.5% phenylephrine - dilates in 15-30 minutes, lasts 2-3 hours: Avoid higher concentrations. 1% hydroxyamphetamine - dilates in 10-15 minutes, lasts 1-2 hours.
2. Mydriatic/Cycloplegics (red tops): Homatropine probably best in ED. dilates in 30 minutes, duration up to 2-3 days. Dependent on iris pigmentation. **light=longer. Scopolamine/Atropine** last over one **week and** have no place in ED.
3. Myotics (green tops): .5-4% **Pilocarpine**, a parasympathomimetic. constricts in 20-30 minutes, duration 4-6 hours. Can be used in **Ddx** of "blown" pupil. Peripheral blockage/injury will not constrict. Central source (III N compression will constrict).
4. Anesthetics: Proparacaine **HCl** 0.5%. Lasts 1-2 hours. consider protective patching. May be used in evaluation as relief of pain suggests surface **injury**. Avoid **Tetracaine**.
5. Antibiotics: Sulfa or **bacitracin-polymyxin B** (Polysporin) usually sufficient. ointments in potential penetration. Must question exactly **what** is being treated. since many complications viral or **fungal**.
6. Steroids- mentioned to stress **NEVER** to use without ophthalmologic consultation
7. Antifungal - topical may be combined **with** systemic. Use after consultation. Examples: Idoxuridine 0.1% - H. Simplex, Trifluridine 1% - Adenovirus, H. Simplex.

## III. History/Physical Examination

### A. History

1. Usually pain, redness, loss of vision, trauma.
2. In actual or suspected trauma, stress time since injury, forces and materials involved with high suspicion of "penetration potential", chronology including treatment.
3. Cover pre-injury eye background: glasses/contacts, medication, previous injury.

## B. Physical Examination

1. Early and accurate visual acuity testing an absolute necessity.
2. Altered acuity approach: a. uncorrected refractive error. b. **opacification** of **light-transition** media. c. alteration of light receiving/impulse transmitting neural structures. (See III C)
3. External exam: consistent to avoid lapses  
Orbital bones, infra-orbital n., lids and margins, globe position/ condition. **corneal** clarity/light reflex, anterior chamber clarity/depth, iris structure and function. pupillary reflexes, ocular motility, direct ophthalmoscopy, visual fields.
4. **Marcus-Gunn** pupillary reflex (swinging light test)  
important to detect lesions of prechiasmal afferents (retina, optic nerve). When normal eye illuminated, see direct and consensual constriction, then swing light over to injured eye and see dilation, This is last component of altered visual acuity assessment.

## C. Altered visual acuity - examine 4 areas'

1. Visual acuity
2. Assess refractive component of visual acuity
3. View transparency of visual axis
4. Assess Marcus-Gun pupil (prechiasmal afferent status)
  - a. Relative afferent pupillary defect (**RAPD**)
    - Present: Retinal **retachment**, papilledema, optic nerve contusion
    - Absent: Migraine headache. muscular degeneration, cortical blindness

## D. Adjuncts to examination

1. Fluorescein strips and U-V light
2. Schiottz **tonometer**

## IV. Triage

### A. Emergent

1. Caustic contamination
2. No visual perception
3. Progressive visual decrease
4. Abnormal globe shape or position
5. Cloudy cornea or anterior chamber

### B. Urgent

1. Foreign body complaint but eye grossly normal, except some infection and tearing
2. Significant pain without visual changes or other problems.
3. Cannot fully look at eye due to blepharospasm, but no other reason to make emergent.

## V. Imaging

- A. Plain film/tomography - Orbital views, **Caldwell/Waters** (relate to level of mastoid air cells). **Caldwell** - best ethmoids. central. Waters - infraorbital rim. Lateral/soft-tissue globe. Tomography indicated in abnormal plain film with questionable interpretation, or normal plain with clinical suspicion.
- B. Ultrasound - posterior globe, foreign body search ( to .5 mm)
- C. CT - orbit. retro-orbit, especially hemorrhage.
- D. **MRI** improved clarity, orbital, globe, retro-orbit. Currently the imaging of choice in most eye problems.

## VI. Selected injuries

### A . Periorbit/Orbit

- 1. Lid lacerations - awareness of “grey” line
- 2. Medial **canthus** - complex repairs with tear duct drainage
- 3. Ocular muscle injury - **levator palpebral** repair
- 4. Orbital rim fracture may occur with or without blow-out fracture - detail mechanism of injury. check for entrapment **rectus** muscles and status infraorbital nerve May see periorbital emphysema. Medial blowouts involve ethmoids. Both rim fracture and blow out fracture require consult and eventual repair. Many consultants will wait 7-14 days to let edema subside.
- 5. May CT if diagnosis uncertain.
- 6. TX with nasal decongestants. broad spectrum oral antibiotics. steroids usually not indicated.

### B. Surface wounds

- 1. Abrasion - Antibiotic optional, because of 2<sup>o</sup> iritis consider **mydriatic/cycloplegics** if abrasion greater **than 30-40%** of cornea surface, analgesia. Follow-up in 24-48 hours, unless increased pain. Patch generally not necessary. may slow healing. Certainly not contraindicated. Avoid contacts. If use, arrange close follow-up. Any **corneal** infiltrate is immediately consulted.
- 2. Foreign body - **removal**, search for “penetration potential”, cycloplegics if 2<sup>o</sup> iritis or extensive surface injury. follow-up as abrasion. If rust ring. can wait 24-48 hours for softening, but may not remove easily. Cover with topical antibiotics. F.B. complicated by missed other F.B., **corneal** perforation, infection, **stromal** scarring beneath **Bowman’s** membrane.
- 3. Chemical burns - TRUE EMERGENCY requiring irrigation ( at least 1 L) before visual acuity testing. Must sweep gross **particulates** and irrigate fomices. Consider Morgan lens after first 1-2 L. Check IOP. **Alkali>>acids/solvents** in terms of worse prognosis. If any clouding of cornea. chemosis - talk with consultant. Usually treated with Cycloplegic, antibiotic, topical steroid



4. Radiant burns anesthetic is diagnostic. Causes a superficial **punctate keratitis (SPK)**. Also seen in dry eye. topical drug toxicity. contact lens. associated with conjunctivitis. Patch for 12-24 hours usually sufficient. Don't wear contacts - artificial tears may decrease symptoms and be used instead of patch. If severe consult, topical antibiotics.
5. Super Glue or equivalent - slow removal, focus on separating lids. Don't trim lashes. Will result in abrasion, may be deep. Consult. close follow-up.

### C. Blunt Trauma - Globe

Potential for many simultaneous injuries. combined with surface and/or penetrating. Prefer anatomic approach. Vast majority of findings are referred to Ophth for limited treatment and follow-up. Role of EM is anticipation and discovery.

1. Cornea - whitish opacity represents deep injury. Lacerations repaired in O.R.
2. **Conjunctiva/Sclera** - contusion and subconjunctival hemorrhage, SC hemorrhage may take 3-4 weeks to resolve. Rare-rupture. usually posteriorly.
3. Anterior chamber - shallow chamber seen in **corneal** perforation. deep seen with lens dislocation or **scleral** rupture. Hyphema often from "angle recession." injury to iris. Hyphema complications include glaucoma. **corneal** staining. re-bleed. Imaging necessary if suspect posterior globe problem. or **fundus** can't be examined. Treat with upright position. eye shield. and consult. Hospitalize children and elderly. Usually **cycloplegic** used, **occasionally** Amicar.
4. Iris - may have transient spasm (traumatic mydriosis), tear. angle recession injury. **disinsertion** from **ciliary** body, iritis.
5. Lens - direct injury results in **opacification**, may sublux or dislocate. "Trembling" iris (iridonesis) may tip-off lens dislocation.
6. Vitreous - bleed from retinal, ciliary body, or choroidal vessels most common. Conservative therapy, with evaluation of **retro-bleed** area by imaging. Late **sequelae** of scarring and retinal detachment.
7. Retina
  - a. Hemorrhage - preretinal. retinal. subretinal. Most serious problems around **macula**, must be examined.
  - b. Edema (**commotio** retinae) -often contracoup injury. complications most serious in macular area. May look like retinal detachment, branch retinal artery occlusion. No treatment, usually clears.
  - c. Retinal break/tear with early or late detachment. Important long term **follow-up**.
8. Optic Nerve
  - a. Traumatic optic neuropathy - positive M-G pupil, decreased visual acuity. Early-disk is hyperemic. late - white, **Eval - CT/MRI**. Tx - steroids
  - b. Papilledema - from CNS or **retro-orbital** injury. A vascular obstruction results. Look at venous vessels as well as disk. Generally, not subtle.
  - c. **Avulsion** - rare. but dramatic. Retina attached at disc, goes with it.
9. Vascular injury
  - a. Arterial (ischemia) - may be branches only. ischemic retina **turns white**

- b. **Venous** (hemorrhage) - in trauma. usually assoc. with CNS injury

D. Penetrating Trauma - Globe

- 1 **Corneal** laceration - consultation. Conjunctival laceration - <1 cm may heal without repair. Consult. Seidel's test (fluorescein dilution) does not rule out.
2. **Intra-ocular** - 20% occur without eye pain. Substances vary in reactivity within the eye. Severe problems caused by iron, copper, nickel, organic material. Treat with cover. avoid pressure/ointments, early eye referral. Some consultants add antibiotics. Evaluate with CT, MRI

E. Intra-orbital

1. Penetrating trauma - high suspicion, Dx may be delayed. May be surprisingly asymptomatic. Wood/organic matter - poorly tolerated. Stone. glass, steel. plastic may be well tolerated. High CNS infection/orbital cellulitis potential. Consider "penetration potential". Evaluate with CT, MRI. Tx - Admission, tetanus. antibiotics.
2. Retro-orbital hematoma - lateral **canthectomy/cantholysis** may be necessary to relieve proptosis and decrease IOP. also aortic glaucoma Tx. Suspect in chemosis, congested **conjunctiva**, increased IOP. May look like orbital cellulitis. ruptured globe. carotid-cavernous sinus **fistula**. Need CT/MRI of orbit. Early consult.
3. **Enucleation** - Early **removal**, glass eye replacement

REFERENCES

1. Management of Ocular Injuries: **Paton** and Goldberg's, By Deutsch TA. Feller DB.. Philadelphia, W.B. Saunders, 1985. (The second edition **of the** 1976 classic. well done, a **must** read book on the subject).
2. Ophthalmology for Medical Students & Primary Care Physicians, 6th edition. American Academy of Ophthalmology, 655 Beach, Suite 300, San Francisco, CA 94109-1336. 1993. (An excellent primer on the eye evaluation, contains color photos of eye lesions, excellent references.
3. ACEP Ophthalmology Study Guide (Well done in conjunction with Ophthalmology, useful information but weak in trauma).
4. The Wills Eye Manual, 2nd Ed., **Cullom** and Chang, Philadelphia, J.B. Lippincott, 1994.(**Best** overall text for ED. No photos, and you need to know what you want).
5. CD - Atlas of Ophthalmology, Ford and Marsh. St. Louis. Mosby 1998. \$285.00 (New from England. Have your department or library buy it).

## TWENTY-TWO UNFORGETTABLE OPHTHALMIC FACTS

Borrowed from Drs. Roland and Clark  
(Previous Eye Topic presenters at ACEP)

1. Never give Ophthaine as an outpatient treatment.
2. 1% **Paredine** is the drug of choice for emergency dilation of the pupils. It is easily reversible with 1% **Pilocarpine**.
3. Neosporin - the most sensitizing topical antibiotic to the eye.
4. Use sulfa or chloromycetin eye drops for routine conjunctivitis.
5. Have patient wear glasses when taking visual acuity.
6. With severe trauma, immediate treatment consists of placing the patient in a supine position with eye shields over the injured eye.
7. Do not use steroids unless consult and patient will see an ophthalmologist within 36 hours.
8. A topical anesthetic will differentiate superficial (**corneal**) from deep origin eye pain.
9. Arc Welder's flash - use 1 drop of ophthaine, ointment and cycloplegic and many patch both eyes.
10. Subconjunctival hemorrhage - be sure to rule out a foreign body.
11. A semi-diagnostic test for iritis is 1 drop of 1% Mydracyl should relieve about 50% of the pain in about 10 minutes. Also light shined in unaffected eye causing pain in other one.
12. When at a loss about what to do with a patient with a conceivable severe eye injury. place them on their back, put patches gently over eyes and let them rest.
13. A retinal tear or dislocated intra-ocular lens would be treated as #12.
14. A lid laceration that goes through the lid margin or **canaliculus** should be repaired by an ophthalmologist.
15. With any black eye -don't forget a blow-out fracture.
16. If you even think of an intraocular foreign body, get a **soft** tissue x-ray of the globe.
17. There are only two true emergencies involving the eye:
  1. Central retinal artery occlusion
  2. Chemical burn
18. Optic neuritis looks very similar to papilledema but the former is:
  - a. Unilateral
  - b. Associated with a moderate to marked decrease in vision
  - c. Has a large central scotoma
  - d. Has minimal retinal hemorrhages or venous congestion,
19. If the visual acuity is 20/25 or better with glasses in both eyes and the pupils are equal and react to light and accommodation and the **fundus** looks ok, there is probably nothing serious going on.
20. Light sensitivity is a non-specific symptom of virtually any ocular irritation.
21. Most superficial ocular infections, **corneal** abrasions. and mild trauma will clear no matter what topical treatment you use
22. Do not use ointment if:
  - a. There is any chance of penetrating trauma (the ointment may get into the anterior chamber)
  - b. When **fundus** examination is required in the next several hours (ointment will mechanically obscure the view).