Brace for Impact!
Managing Ocular and Orbital Trauma

Andrew S. Morgenstern, OD, FAAO, FNAP

Assistant Professor, Uniformed Services University of the Health Sciences (USUHS)
Walter Reed National Military Medical Center
Bethesda, Maryland

1

2

COL. (ret) Francis La Piana, MD USA
James Karesh, MD FACS
Oculoplastic and Reconstructive Surgeons

3

Birth of Eye Protection
Vietnam War

4

Disclosures Dr. Morgenstern

- Director, AOA Evidence Based Optometry Committee Member, US Centers for Medicare & Medicaid Services Ophthalmologic Disease Management Clinical Subcommittee

5

Disclosures Dr. Morgenstern

- All information in this presentation is my opinion only based on peer reviewed information and was gained through the public domain.
- I have no financial interests regarding anything discussed in this presentation
- All information presented is the opinion of Andrew Morgenstern, OD FAAO and NOT the opinion of the US Government, Department of Defense, Department of Veterans Affairs, Army, Navy, Air Force, or any other US Government organization, US Government Contractor or Chenega HealthServices

6

Disclosure: Advisory Boards and Consultant

- Advisory Board, Boston University
- Advisory Board, Epion
- Advisory Board, LENZ Pharmaceuticals
- Advisory Board, Virtual Field
- Consultant, Chenega Health Services, LLC
- Consultant, Tarsus
- President, International Keratoconus Academy
- Trustee, New England College of Optometry

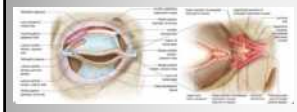
7

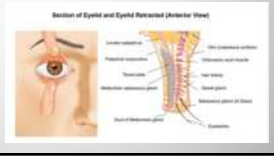
Anatomy

- Eyelid
- Orbit
- Globe
- Optic Nerve

8

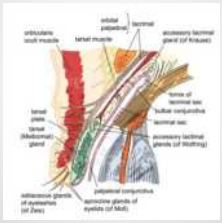
Eyelid Anatomy





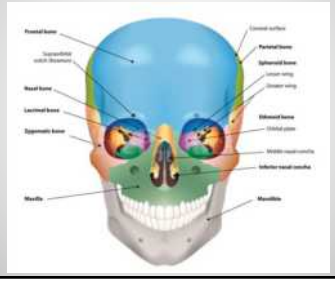
9

Eyelid Anatomy



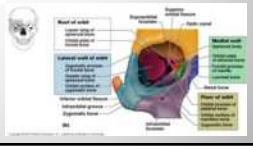
10

Orbit Anatomy



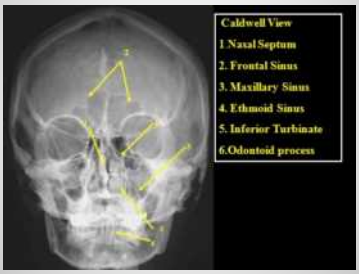
11

Orbit Anatomy



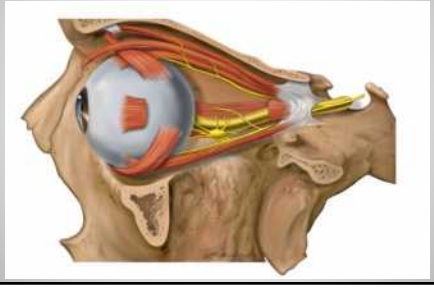
12

Orbit Anatomy



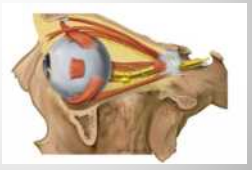
13

Globe



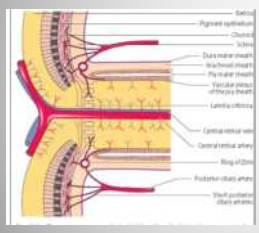
14

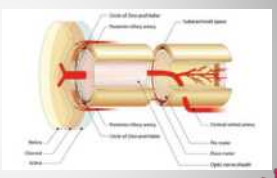
Globe



15

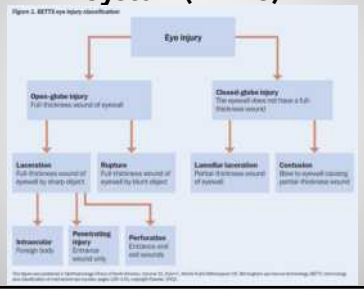
Optic Nerve





16

Birmingham Eye Trauma Terminology System (BETTS)



17

Open Globe Injury Classification

- Type
  1. Rupture
  2. Penetrating
  3. Intraocular
  4. Perforating
  5. Mixed
- Grade- visual acuity
  1. ≥20/40
  2. 20/50 to 20/100
  3. 19/100 to 5/200
  4. 4/200 to light perception
  5. No light perception
- Pupil
  - Positive-RAPD+ in affected eye
  - Negative-No RAPD in affected eye
- Zone
  - I- Isolated to cornea (Including the corneoscleral limbus
  - II- Corneoscleral limbus to a point 5mm posterior into the sclera
  - III- Posterior to anterior 5mm of sclera

18

Closed Globe Injury Classification

- Type
  1. Contusion
  2. Lamellar laceration
  3. Superficial foreign body
  4. Mixed
- Grade- visual acuity
  6. ≥20/40
  7. 20/50 to 20/100
  8. 19/100 to 5/200
  9. 4/200 to light perception
  10. No light perception
- Pupil
  - Positive-RAPD+ in affected eye
  - Negative-No RAPD in affected eye
- Zone
  I. External (limited to bulbar cj, sclera, cornea)
  II. Ant seg (structures internal to cornea including PC, pars plicata)
  III. Post seg- all structures post to PC)

19

What is the Most Important Detail to Record Immediately After an Eye Injury?

A. Level of Pain
B. Open vs. Closed Globe
C. Visual Acuity
D. Pupils and Motility

20

MILITARY MEDICINE, 183, 3/4:219, 2018

Simplified Method for Rapid Field Assessment of Visual Acuity by First Responders After Ocular Injury

CPT Nikhil J. Godbole, MC, USA; MAJ Erin S. Seefeldt, MC, USA*†; COL William R. Raymond, MC, USA, (Ret.)*; James W. Karesh, MD, FACS‡; Andrew Morgenstern, OD‡; Jo Ann Egan, BSN, MS‡; LTC Marcus H. Colyer, MC, USA§; COL Robert A. Mazzoli, MC, USA, (Ret.)*†‡*

ABSTRACT Objective: Initial visual acuity after ocular injury is an important measure, as it is an accurate predictor of final visual outcome and gives a rapid estimation of the overall severity of the injury, thereby aiding evacuation prioritization. We devised a simple method for rapidly assessing visual acuity in the field without having to rely on formal screening cards. Methods: Using common objects, icons, and text found in the injury zone – for example, common military name tapes, rank insignias, patches, emblems, and helmet camouflage bands, which will be known collectively as the Army Combat Optotypes (ACOs) – a Snellen-equivalent method of assessing visual acuity was devised and correlated to the ocular trauma score (OTS). Results: Ability to read the ACOs at 2, 3, and 5 ft correlates with acuities in the range from 20/20 to 20/400. Identification of ACOs with visual acuity of 20/50 and 20/200 approximates important inflection points of severity for the OTS. Conclusion: Accurately assessing visual acuity in the field after ocular injury provides essential information but does not require sophisticated screening equipment. Pertinent and accurate acuities can be rapidly estimated using commonly available text or graphical icons such as standard name tapes, patches, and rank insignias.

21

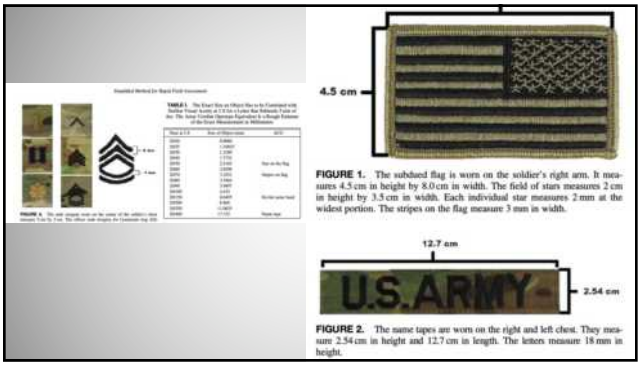


FIGURE 1. The subdued flag is worn on the soldier's right arm. It measures 4.5 cm in height by 8.0 cm in width. The field of stars measures 2 cm in height by 3.5 cm in width. Each individual star measures 2 mm at the widest portion. The stripes on the flag measure 3 mm in width.

FIGURE 2. The name tapes are worn on the right and left chest. They measure 2.54 cm in height and 12.7 cm in length. The letters measure 18 mm in height.

22

23

Which of the following are True Ocular Emergencies??

- Retinal Detachment
- Central Retinal Artery Occlusion
- Acid/Alkali Chemical Injury
- Acute Angle Glaucoma
- Partial Thickness Globe Injury
- Open Globe Injury
- Hollenhorst Plaque
- Orbital Floor Fracture
- Orbital Sinus Fracture

24

True Ocular Emergencies

- Central retinal artery occlusion
- Alkali/Acid injury
- Orbital compartment syndrome
- Acute angle closure glaucoma

25

Orbital Compartment Syndrome

- An acute increase in the compressive forces within the closed orbital cavity from either
  - A decrease in the orbital size without any compensating decrease in the orbital contents, OR
  - An increase in the orbital contents without and compensating increase in the size of the orbit
- Reduction in orbital perfusion caused by an increase in intraorbital compressive forces
- Irreversible ischemic injury to the optic nerve and retina resulting in loss of vision.

26

Treatment
Orbital Compartment Syndrome

- Canthotomy/Cantholysis
- Cut Lateral Canthal Ligament

27

How to do a Lateral Canthotomy

28

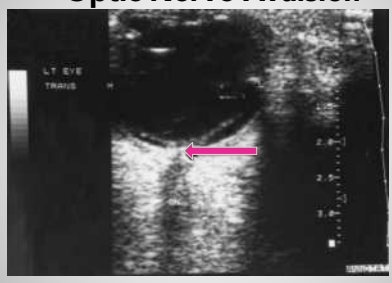
Optic Nerve Avulsion
Complete

29

Optic Nerve Avulsion
Partial

30

Optic Nerve Avulsion



Hypolucency posterior to the optic nerve head

31

Emergent Ocular Injuries

- Central retinal artery occlusion
- Alkali/Acid injury
- Orbital compartment syndrome
- Acute angle closure glaucoma

32

Urgent

- Hyphema (in certain situations such as sickle cell disease/trait)
- Severe periocular lacerations
- Orbital fracture with muscle entrapment
- Traumatic optic neuropathy
- Corneal foreign bodies

33

Non-Urgent

- Corneal abrasions
- Periocular lacerations
- Most hyphemas
- Most orbital fractures
- Most retinal detachments

34

Intraocular Sequlae of Blunt Trauma
7 Rings of Anterior Segment tissue
LTC. Won I. Kim, MD USA (1 Eye Kim, really)

- Iris sphincter → sphincter tears (traumatic mydriasis)
- Iris base → iridodialysis
- Ciliary body face → angle recession
- Ciliary body attachment to scleral spur → cyclodialysis
- Trabecular meshwork → meshwork tears
- Zonules → lens subluxation/Traumatic cataract
- Ora serrata → retinal dialysis

35

Emergency! Now What do I do??

- Primary survey
  - ABCs: stabilization of life-threatening injuries
  - Life, Limb, SIGHT and Safety
- Secondary survey
  - Includes ocular exam

36

Acute Ocular Trauma Exam

- Visual acuity
  - Snellen, CF, HM, LP, NLP
- Motility
- External
- Penlight exam
  - pupils, anterior segment

37

Acute Ocular Trauma Exam – In Office

- Assessment of ocular injuries
- Irrigate if chemical exposure
- Protect eye with shield
- Avoid further injury
- Minimize increase in IOP
  - Positioning, splinting, pain control, antiemetics

38

Primary Survey – In Office

- Mechanism of injury
  - Sharp, blunt, chemical exposure, dirt
  - Time of injury
- Subjective visual acuity (before and after)
- Visual/ocular symptoms
  - Pain, double vision, photophobia
- Last meal

39

Primary Survey – In Office

- Medications
- Allergies
- Medical conditions, including:
  - Cardiovascular/pulmonary disease
  - Sickle cell disease or trait
  - Bleeding disorders
- Immunization status (esp. tetanus)

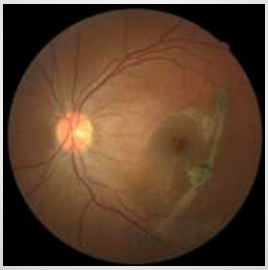
40

Primary Survey – In Office

- Visual acuity
- Corrective lenses (including contacts)
- Medications
- Known ocular pathology
- Previous ocular surgeries/injuries
  - Includes laser vision correction (LASIK/PRK)

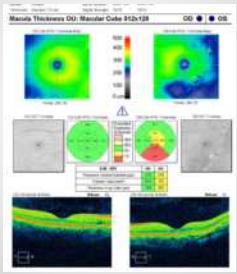
41

Choroidal Rupture



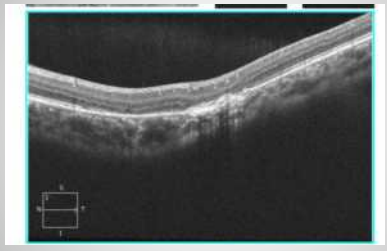
42

OCT Images – Choroidal Rupture (CR)



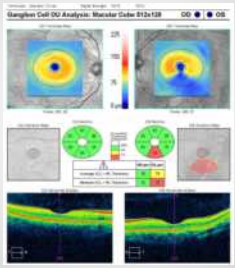
43

High-resolution images through CR

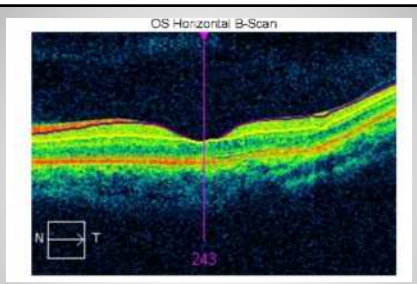


44

Evidence of inner retinal damage with CR



45

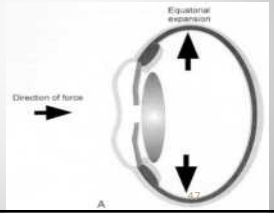


Visual field testing was offered but the patient refused further investigations

46

Choroidal Rupture

- Choroidal rupture
  - Tears in choroid, Bruch membrane, and RPE
  - More common w/ contra-coup



47

Choroidal Rupture

- Choroidal rupture
  - Tears in choroid, Bruch membrane, and RPE
  - Curvilinear lesions concentric w/ disc
  - May be as risk for CNVM
  - Monitor w/ home Amsler

48

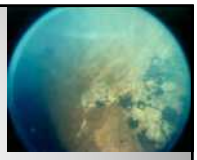
Choroidal Rupture Involving Macula

Baseball injury
20/40

49

49

Sclopeteria

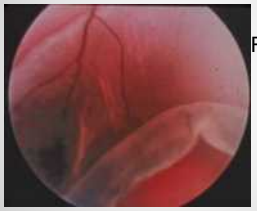


- Traumatic Chorioretinal Rupture
  - Coup injury
  - Associate with high-velocity objects (including BB's)
  - Appears as loss of segment of retina and choroid
  - RD unlikely as overlying vitreous is intact

50

50

Avulsion of the vitreous base



Retinal Dialysis

51

51

Avulsion of the vitreous base

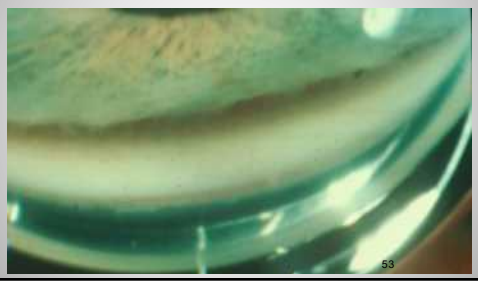
- Retinal break
- Retinal detachment
- Traumatic macular hole

- DDx.: Photothermal injury from visible radiation

52

52

Angle Recession (note torn processes)



53

53

Iridodialysis

54

54

Iridodialysis

55

55

Ocular Toxicity

- Acute
  - Retina (Photic [solar] Retinopathy,Maculopathy)

•Sungazing, Unprotected eclipse viewing
•Operating microscope over-exposure
•Symptoms and signs
  •History of exposure
  •Decreased vision
  •Central scotoma

56

56

Total Solar Eclipse 08APR2024

57

57

58

58

Laser Injury and F/U

Leo Semes, OD

59

59

20-Year-Old Male

- Laser injury to face with both eyes potentially involved

(Micra laser with a legend amplifier, 800nm, generally set at 2.5 watts, mode lock pulse laser)

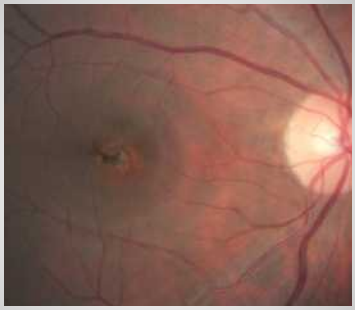
- Persistent after-image; no further VA reduction subjectively
- VA 20/20 in each eye

60

60

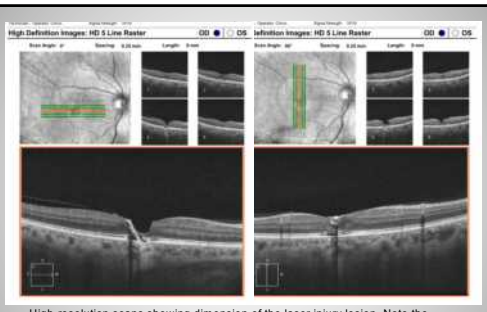
(Left) Right macula with pigmentary disruption.
(Right) Left macula is uninvolved

61



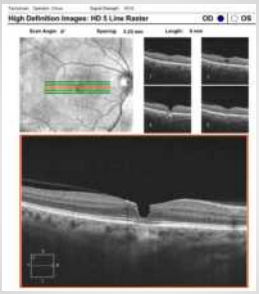
Close up of right macula. Note proliferative pigmentary response

62



High-resolution scans showing dimension of the laser injury lesion. Note the disorganization of the outer retina corresponding to other clinical findings.

63



Another cross-section through the right macula showing thickened inner retina and demonstrating vitreo-macular adherence. The outer retina is disturbed, as well.

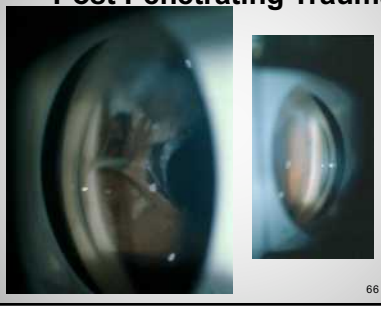
64

Post Penetrating Trauma

65

65

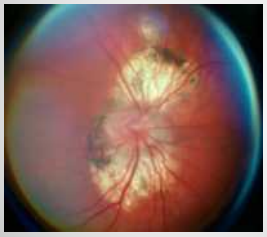
Post Penetrating Trauma



66

66

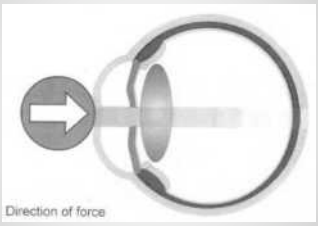
Post Penetrating Trauma



67

67

Blunt Ocular Trauma

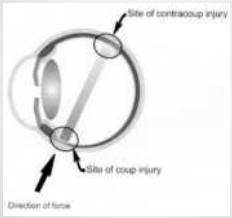


Schematic of coup injury to the anterior segment

68

68

Mechanisms of injury – blunt trauma

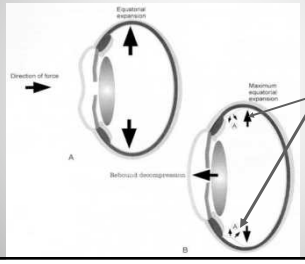


Schematic of coup and contacoup injury [posterior segment

69

69

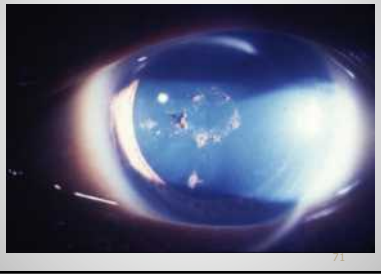
Mechanisms of injury – blunt trauma



70

70

Vossius Ring



71

71

Lens dislocation

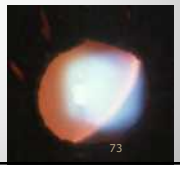
- Secondary to tissue shearing
- Zonules torn
- If refraction vastly different from current data, consider lens dislocation; dilation; U/S
- IOP
- Usually associated with severe trauma
- May be associated with attendant pathology
  - Vitreous herniation into AC
  - Elevated IOP

72

72

Traumatic Lens injury

- May be from force and/or penetration
- Clinical signs
  - Iris transillumination (red reflex through undilated and dilated pupil)
  - Ruptured lens capsule

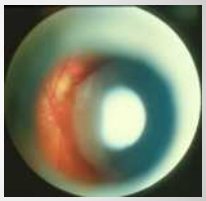


73

73

Traumatic Lens injury

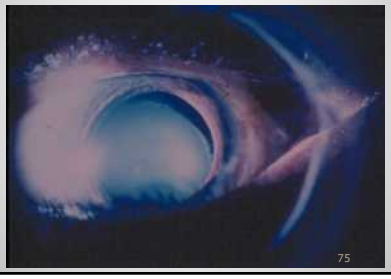
- May be from force and/or penetration
- Clinical signs
  - Dislocated lens
  - Variation in refractive correction



74

74

Traumatic Lens injury - Dislocated lens



75

75

Vitreous hemorrhage

- Can occur secondary to
  - Iridodialysis
  - Ciliary body trauma
  - Retinal vessel tear/avulsion
  - Choroidal rupture with retinal breakthrough
- Management
  - Follow closely (consider U/S)
  - Be aware of other pathology
    - RD, erythroclastic glaucoma, e.g., reasons for vitrectomy

76

76

Commotio retina

- "Berlin's edema" (1873)
  - Whitening of deep retina; not true edema
  - Usually seen opposite site of impact [macula]
  - Epitome of blunt trauma
- Usually resolves quickly 24-72 hours
- Can lead to pigment disturbances
- Visual / VF loss may occur

77

77

Imaging of the Skull, Orbit and Eye

- CT
  - Bone
- MRI
  - Soft Tissue
- X Ray
- Ultrasound
- OCT

78

78

Suspected Eye Injury
Never, Never, Never, Never!

- NEVER place a patch on the eye
- NEVER apply pressure to the eye
- NEVER instill solutions or ointments into a suspected open globe
- NEVER remove foreign bodies protruding from the eye or orbit

79

80