How the eye works

- Front part collects light
- Light is refracted by two surfaces
  - Cornea
  - Lens
- Back part forms the image and sends it to the brain
Anterior segment
- Lids
- Conjunctiva/sclera
- Cornea
- Anterior chamber
- Iris
- Lens

Posterior segment
- Vitreous
- Optic disk
- Vessels
- Retina
- Macula
- Periphery
- Choroid

Light path
- Cornea
- Anterior chamber
- aqueous humor
- Pupil
- Lens
- Vitreous humor
- Retina

How the eye works
- The red eye
- Acute eye conditions
- Chronic vision loss
- Basic eye exam

Red eye
- Eyelids
- Blepharitis
- Stye / Chalazion
- Dacryocystitis
- Cornea
- Abrasion
- Bacterial keratitis
- Viral keratitis
- Conjunctiva
- Dry eye syndrome
- Allergic conjunctivitis
- Viral conjunctivitis
- Bacterial conjunctivitis
- Pingueculitis
- Pterygium
- Subconjunctival hemorrhage
- Episcleritis
- Scleritis
- Intraocular
- Acute glaucoma
- Uveitis / Iritis
- Endophthalmitis
- Orbit
- Pre-septal cellulitis
- Orbital cellulitis
- C-C fistula

The Red Eye
- Red
- Eyelid or eyeball?
- Why is eyeball red?
- Where is it red?
- Pain
- Foreign-body sensation?
- Improve with anesthetic?
- Blurred vision
Eyelids
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Intraocular
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Blepharitis
- Inflammation of eyelids

Presentation
- Red, thickened eyelids
- Crusting
- Gritty, burning

Treatment
- Warm compresses
- Antibiotic ointment

Stye / Chalazion
- Inflammation of lash follicle or oil gland
- Painful bump on eyelid

Treatment
- Warm compresses x 6 weeks
- May need excision/drainage

Dacryocystitis
- Inflammation of lacrimal sac
- Hot nodule next to nose
- Usually infection secondary to obstruction

Treatment
- Referral
- Systemic antibiotics
- I&D, Surgery

Cornea
- Abrasion
- Bacterial keratitis
- Viral keratitis

Conjunctiva
- Dry eye syndrome
- Allergic conjunctivitis
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Corneal Abrasion
- Disruption of corneal epithelium

- Extremely painful foreign-body sensation

- Fluorescein staining

- Antibiotic ointment
- +/- Pain meds
- No need to patch
**Bacterial keratitis**
- Infection of the cornea
- **Presentation**
  - Photophobia
  - Foreign-body sensation
  - Ciliary flush
- **Treat**
  - Quinolone drops (Cipro)
  - Referral

**Viral keratitis**
- Herpetic infection of cornea
  - Simplex or Zoster
- Dendritic or geographic epithelial defect
  - +/- skin findings
- Referral
- Antivirals
  - Topical or systemic

**Conjunctiva**
- Eyelids
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**Dry Eye Syndrome**
- Very, very common in NM
- Symptoms
  - Wind, smoke, reading, end of day
  - Waxing/waning vision
  - Blinking or resting eyes helps
  - Tearing
- Etiology
  - Inadequate tear production
  - Sjogren's Syndrome
  - Tear film instability
- Treatment
  - Lubricant eye drops (artificial tears)
  - Warm compresses
  - Flaxseed or fish oil

**Allergic conjunctivitis**
- Often seasonal
  - April and September
- Itchy
- Both eyes
- OTC: Ketotifen
  - Generic, Alaway,Zaditor
- RX:
  - Patanol
  - Cromolog

**Bacterial conjunctivitis**
- Rare and self-limited in adults
- Thick, yellowish discharge
- Treatment
  - Quinolone drops
- Refer if compromised host, significant vision loss, or no improvement in 3 days
**Viral conjunctivitis**
- Pink eye
- Adenovirus
- Discharge is clear or mucoid
- Discharge is highly contagious
- Contacts
  - Children
  - Other eye few days later
- Self-limited ~ 1 week
  - Hygiene – don’t rub
  - Quarantine
  - Refer only if worsens

**Pingueulitis**
- Pinguecula is abundant conjunctival tissue
- Nasal or temporal globe
- Very common
- Often unnoticed until surrounding tissues get inflamed
- Vision unaffected
- Treatment
  - OTC lubricant drops or vasoconstrictor

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**Subconjunctival Hemorrhage**
- Blood between conjunctiva and sclera
  - No vision changes
  - Trauma(rubbing), sneezing, spontaneous
  - No treatment

**Episcleritis**
- Focal inflammation of deep subconjunctival tissue
  - Mild pain/redness
  - Dilated vessels usually away from cornea
  - Self-limited
  - Lubricant eye drops

**Scleritis**
- Inflammation of sclera
  - Focal or diffuse
  - Deep, severe pain
  - Associated with collagen-vascular/auto-immune diseases
  - Referral
    - Systemic meds
Intraocular:
- Eyelids
  - Blepharitis
  - Stye / Chalazion
  - Dacryocystitis
- Cornea
  - Abrasion
  - Bacterial keratitis
  - Viral keratitis
  - Fungal keratitis
- Conjunctiva
  - Dry eye syndrome
  - Allergic conjunctivitis
  - Viral conjunctivitis
  - Bacterial conjunctivitis
  - Episcleritis
  - Scleritis
  - Pingueculitis
  - Pterygium
  - Subconjunctival hemorrhage
  - Episcleritis
  - Scleritis

Acute glaucoma:
- Sudden increase in intraocular pressure (IOP)
- Red, pain, blurred vision, mid-dilated pupil
- Nauseous
- Emergency – hours count
- This is why you need to know how to check IOP
- Immediate treatment and referral

Uveitis / Iritis:
- Inflammation inside eye
  - Uveitis (iris, ciliary body, choroid)
  - Photophobia
  - Ciliary flush (near limbus)
- Referral
  - Steroids
  - Work-up

Endophthalmitis:
- Infection inside eyeball
- Red, painful eye
- Hypopion
- Sources
  - Surgery
  - Trauma
  - Endogenous

Endogenous Endophthalmitis:
- Sources
  - Endocarditis, GI, urinary tract, indwelling catheters
  - If focal source, think bacterial
  - If compromised host, think fungal

Candidal endophthalmitis progression (from Kanski atlas)
- Risk of advancing to endophthalmitis if on anti-fungals is extremely low
Fungal Endophthalmitis Management
- Candidemia with eye or valve involvement receives a longer course of anti-fungals
- Anti-fungals
- Vitrectomy (especially if Aspergillus)
- Culture
- Amphi B
- Recommended if substantial vision loss

Orbit
- Eyelids
  - Blepharitis
  - Stye / Chalazion
  - Dacryopyostitis
- Cornea
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  - Bacterial keratitis
  - Viral keratitis
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Preseptal Cellulitis
- Peri-ocular skin infection
- Limited to the skin
- Systemic antibiotics
  - Cephalexin

Orbital Cellulitis
- Infection in the orbit
- Diplopia
- Admission
  - I-V antibiotics
  - Drain abscesses

Carotid-Cavernous sinus fistula
- A-V fistula
- Carotid-Cavernous sinus
- Orbital vascular congestion
- Chronic redness from corkscrew vessels
- Whooshing sound in head
- Referral
  - Observe
  - Self-limited
  - Embolization

The Red Eye
- Red
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Acute eye conditions

- How the eye works
- The red eye
- Acute eye conditions
- Chronic vision loss
- Basic eye exam

Chemical to eye

- Emergencies
  - Alkali burn
  - Acute angle closure glaucoma
  - Central retinal artery occlusion (CRAO)
  - Ruptured globe
- Urgencies
  - Lid lac (marginal or canalicular)
  - Retinal detachment
  - Papilledema

TAKE HOME MESSAGE

All chemical exposures need to be rinsed immediately with **AT LEAST 2L saline**

- More if suspect alkali
- Alkali eats through cornea (acid doesn’t)
- Must get pH under 8.0 (you’ll never get to 7.4)
Chemical to eye

- Severity of alkali burn is judged by:
  - corneal opacification
  - size of epithelial defect,
  - limbal ischemia/whitening
- Airbag deployment can release alkali – check pH

Acute glaucoma

- This is why you have to know how to check IOP
- Eye pain, redness, tearing, blurring (cloudy cornea), mid-fixed pupil, nausea

Acute glaucoma

- Refer immediately
- Give any available pressure-lowering meds (drops or diamox)
- If secondary to orbital swelling (hematoma, CC-fistula), perform lateral canthotomy/cantholysis
  - Cut lateral eye corner and inferotemporal ligament
  - We can easily repair it later if needed

Central retinal artery occlusion

- Acute, painless loss of vision
- Exam shows whitening of retina with cherry-red macula
- Refer immediately

Ruptured globe

- Corneal or scleral full-thickness laceration
- Eye loses pressure and contents shift
- Signs
  - Obvious laceration
  - Collapsed anterior chamber
  - Irregular pupil
  - Low pressure
  - Irregular contour on CT

Ruptured globe

- If diagnosed/suspected:
  - NPO
  - Shield (metal shield or paper cup over eye)
  - NOT A PRESSURE PATCH
  - Anti-emetics
  - CT to r/o retained foreign body
- Goal is to avoid pressure changes within the eye
- Surgical priority is to restore integrity of the globe
Acute eye conditions

- Emergencies
  - Alkali burn
  - Acute angle closure glaucoma
  - Central retinal artery occlusion (CRAO)
  - Ruptured globe
- Urgencies
  - Lid lac (marginal or canalicular)
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  - Papilledema

Eyelid lacerations

- Eyelid margin
  - Requires experienced closure to avoid notching

Eyelid lacerations

- Lacrimal canaliculus
  - Suspect if laceration involves eyelid margin between the lacrimal puncta and medial canthus
  - Requires OR, silicone stenting

Retinal detachment

- Retina separates from back of eye wall
- Symptoms are flashes, floaters, and curtain over part of vision
- Starts peripherally
- Requires surgery

TAKE HOME MESSAGE

Papilledema

- Optic disk edema secondary to increased intracranial pressure
- Not all disk edema is papilledema

Papilledema - findings

- Burred disk margins
- Obscured vessels
- Flame hemorrhages
- Bilateral
Acute eye conditions

- Flush all chemical exposures with at least 2L
- Acute glaucoma presents with nausea
- Papilledema is optic disk swelling secondary to increased intracranial pressure

How the eye works

- The red eye
- Acute eye conditions
- Chronic vision loss
- Basic eye exam

Chronic vision loss

- Cataract
- Diabetic Retinopathy
- Macular Degeneration
- Glaucoma

Cataract

- Clouding of the lens
- Usually age-related
- Causes glare problems and blurred vision
- Only treatment is surgery (replacement)

Diabetic retinopathy

- Vasculopathy
- Clinically, yellow and red spots
- Hemorrhages, aneurysms, edema, neovascularization, infarcts/ischemia

Diabetic retinopathy

- Two stages
- Non-proliferative
  - Red and yellow spots
- Proliferative
  - Neovascularization
  - Retina or iris
  - Serious complications
Macular Degeneration

- Age-related
- Degenerative process affecting retina, RPE, and choroid
- Yellow spots (drusen)
  - Lipoprotein deposits

Two stages

- Dry
  - Atrophic changes
- Wet
  - Choroidal neovascularization
  - Most of severe vision loss

Glaucoma

- Damage to optic nerve
  - Large cup-to-disk ratio
- Risk factors:
  - Increased intraocular pressure
    - Usual IOP 10-20 mm Hg
  - Age
  - Family history of glaucoma

Chronic visual loss

- Cataract - opacification of the natural lens
- Glaucoma - damage to the Optic Nerve
  - Progressive, Painless, Permanent, Preventable
- Diabetes in the eye is a retinal vascular disease
  - Non-proliferative and proliferative stages
- Macular Degeneration affects the central retina
  - Dry and wet stages
Eye Exam – components

- Visual acuity
- Visual fields
- Pupillary response
- Motility
- Intraocular pressure (IOP)
- Anterior segment
- Fundus examination

Function

Form

Visual acuity
- Measures central vision
- Force patient to miss at least half
  - They get credit for any line with at least half right
- Notation
  - Near (N) or Distance (D)
  - With (cc) or Without (sc) correction
  - Pinhole (PH)
- Must be reproducible

Visual fields
- Measures peripheral vision
- One eye at a time
- 1, 2, or 5 fingers in each quadrant while patient fixates on nose
- Notation: Visual fields full to confrontation (VFFTC OU)

Visual acuity

Visual fields

Pupils
- Abnormalities represent dysfunction of the pupil mechanics or the Optic nerve
  - *The Optic nerve is the important one*

Pupils

Afferent Pupillary Defect (APD)
- Swinging flashlight test
- Pupil *appears* to dilate in response to light
- Suggests Optic Nerve dysfunction

Afferent pupillary defect
Motility

- Both eyes open (have to hold lids)
- Six cardinal directions of gaze

\[
\begin{array}{c|c|c|c|c|c|c}
R & ED & MD & LE & SE & SR & LR\\
\hline
LR & SR & SO & IR & MR & LR & SO\\
\end{array}
\]

- Notation: Vergences full/conjugate

TAKE HOME MESSAGE

Intraocular pressure (IOP)

- Usual range 10-20 mm Hg
- You must know how to measure the eye pressure
- Can be measured with applanator or Tonopen

How to use the Tonopen

- Anesthetic drop
- New tip cover (always keep tip covered)
- Hold black button until beeps
- Ready to read when double black lines
- Hold lids if necessary
  - Against bone – don’t push on globe

How to use the Tonopen

- Tap perpendicular to center of cornea
  - Faint beep with each reading
- Long beep when readings satisfactory or times out
  - Should have <5% deviation (underscore on display)
- Will turn itself off

* If says CAL (needs calibration), hold pointing down for several seconds.
  When beeps “up”, point it up until it says “good”

Structure

Anterior segment is best examined with a slitlamp biomicroscope (slit lamp)
**Anterior segment**
- Lids
- Conjunctiva/sclera
- Cornea

**Anterior segment**
- Lids
- Conjunctiva/sclera
- Cornea
- Anterior chamber
- Iris
- Lens

**TAKE HOME MESSAGE**

**Anterior segment - Cornea**
- Fluorescein stains disrupted epithelium
- Use as LITTLE AS POSSIBLE

**Structure**
- Posterior segment best examined with an Ophthalmoscope

**Direct Ophthalmoscope**

**Technique - Dilation**
- Makes examination MUCH easier
- Red-top eydrops
  - Phenylephrine 2.5%
  - Stimulates iris dilator
  - Tropicamide 1%
  - Inhibits iris sphincter
- Last 4-6 hours
- Contraindication: need to follow pupil exam
Technique
- Dilate
- Examiner and patient at eye level
- Patient +/- examiner remove eyeglasses
- Patient fixates in distance with other eye
- Index finger on focusing wheel
- To examine right eye
  - Hold in right hand
  - Look with right eye

Technique
- Set dial well into the black/green
- Look through aperture
- Focus to get a clear red reflex
  - You will need to dial counterclockwise

Technique
- Focus to get a clear red reflex
  - You will need to dial counterclockwise
- Compare reflex in both eyes
  - Dimness or opacifications represent problems in the light path (the visual axis)

Technique
- Stand slightly lateral to patient
  - You'll be looking toward the optic nerve head
- Move in toward patient
- Identify a retinal vessel
- Dial counterclockwise to bring vessel into focus

Exam - funduscopic
Red reflex → Disk → Vessels → Background → Macula → Periphery

Now you are ready to concentrate on the exam – no more adjustments
Red Reflex → Vitreous → Disk → Vessels → Background → Macula → Periphery

- Disk (nerve head)
- Cup-to-disk ratio (CDR)
- Edema or pallor

Cup-to-disk ratio

- The cup is the central portion of the nerve, corresponding to the region where the nerve fibers dive deep to exit the eyeball.

Cup to disk ratio

- Normal CDR is < 0.5

Red Reflex → Vitreous → Disk → Vessels → Background → Macula → Periphery

- Cup-to-disk ratio (CDR)
  - >0.5 suggests optic nerve damage
- Edema
- Pallor

Vein:Artery diameter ratio should be 3:2
- A-V nicking
- Plaques/occlusions

Look for red or yellow spots

Red Reflex → Vitreous → Disk → Vessels → Background → Macula → Periphery
Red Reflex → Vitreous → Disk → Vessels → Background → Macula → Periphery

Look for red or yellow spots

- Red spots
  - Hemorrhages
  - Microhemorrhages (MH) or Dot-Blot Hemorrhages (DBH)
  - Aneurysms

- Yellow spots
  - Hard Exudates (HEx) - lipid deposits from leaking vessels
  - Cotton-wool spots (CWS) - infarction of nerve-fiber layer
  - Drusen - lipid deposits from poor metabolism (RPE dysfunction)

- Whitening
  - Commotio Retinae = retinal contusion

Macula is true center of posterior pole
- Central vision
- Temporal and a bit inferior to disk
- Identified by:
  - Slightly darker
  - Absence of blood vessels
  - Foveal Avascular Zone
  - Very light sensitive

Very difficult to see
- Nasal periphery sees the temporal visual field, inferior retina sees superior visual field, etc

Eye pain
- Ocular surface
  - Helped by anesthetic
  - Foreign-body sensation
- Intraocular
  - Photophobia
  - Ciliary flush
- Extraocular (orbit)
  - Pain with eye movements
  - Diplopia

If the patient has eye pain, use anesthetic drops
Note how much it helps
- Ocular surface pain is quite sensitive and responsive
- Intraocular or orbital pain will be minimally responsive

Take home points
- Visual acuity is measured by the smallest line with at least half correct
- An Afferent Pupillary Defect (APD) suggests Optic Nerve dysfunction
- Know how to check pressure
- Use as little fluorescein as possible
- Use anesthetic to exam painful eyes
REVIEW

How the eye works

- Front part collects light
- Back part forms the image and sends it to the brain

Light path
- Cornea
- Anterior chamber/aqueous humor
- Pupil
- Lens
- Vitreous humor
- Retina

The Red Eye
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Primary treatments

- For dry eyes, use artificial tears and warm compresses.
- For allergies, use ketotifen eyedrops.
- For antibiotic, use a quinolone (Cipro).
- For ointment, use erythromycin.
- Don't give topical steroids.

Acute eye conditions

- Emergencies
  - Alkali burn
  - Acute angle closure glaucoma
  - Central retinal artery occlusion (CRAO)
  - Ruptured globe
- Urgencies
  - Lid lac (marginal or canalicular)
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- Flush all chemical exposures with at least 2L.
- Acute glaucoma presents with nausea.
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Chronic vision loss

- Cataract
- Diabetic Retinopathy
- Macular Degeneration
- Glaucoma

Basic eye exam

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THANK YOU