

**Eye Diseases Made Simple**

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**Format**

- Describe the basic anatomy of the eye
- Identify the diseases of the eye
- Explain the medical therapies for diseases of the eye

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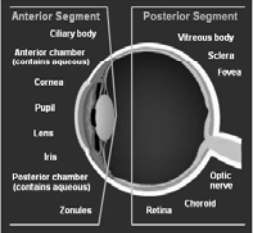
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**Segments**

- Anterior Segment
  - Front third of the eye that includes the structures in front of the vitreous humor: the cornea, iris, ciliary body, and lens.
  - Aqueous humor fills these spaces within the anterior segment and provides nutrients to the surrounding structures.
  - Serves to protect and also refractive mechanism
- Posterior Segment
  - Back two-thirds of the eye that includes the anterior hyaloid membrane and all of the optical structures behind it: the vitreous humor, retina, choroid, and optic nerve.
  - Serves as a receiving mechanism



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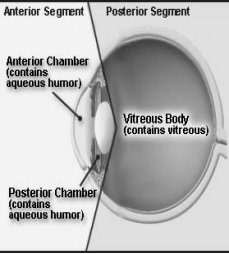
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## Chambers

- Within the anterior segment are two fluid-filled spaces:
  - **Anterior chamber** between the posterior surface of the cornea (i.e. the corneal endothelium) and the iris.
  - **Posterior chamber** between the iris and the front face of the vitreous.
- **Vitreous body (vitreous):**
  - Transparent, colourless, gelatinous mass that fills the space between the lens of the eye and the retina lining the back of the eye. It is produced by certain retinal cells. It contains very few cells (mostly phagocytes which remove unwanted cellular debris, as well as hyalocytes, which sequester the hyaluronic acid), no blood vessels, and 99.9% of its volume is water with salts, sugars, vitamins, a network of collagen type II fibers with the macropolysaccharide hyaluronic acid, and also a wide array of proteins in micro amounts.
  - Although the vitreous is in contact with the retina and helps to keep it in place by pressing it against the choroid, it does not adhere to the retina, except in three places: around the anterior border of the retina; in the macula; and at the optic nerve disc.
  - Unlike the fluid in the frontal parts of the eye (aqueous humor) which is continuously replenished, the gel in the vitreous chamber is stagnant. Therefore, if blood, cells or other byproducts of inflammation get into the vitreous, they will remain there unless removed surgically (floaters).
  - If the vitreous pulls away from the retina, it is known as a vitreous detachment, with age, the vitreous often liquefies and may collapse. This is more likely to occur, and occurs much earlier, in eyes that are highly myopic. It can also occur after injuries to the eye or inflammation in the eye (uveitis).




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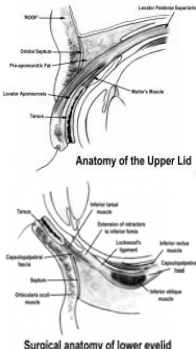
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## Eyelid Anatomy

- Thin fold of skin that covers and protects the eye. The levator palpebrae superioris muscle retracts the eyelid to "open" the eye.
- The eyelashes serve to heighten the protection of the eye from dust and foreign debris, as well as from perspiration.
- "Palpebral" (and "blepharo") means relating to the eyelids. Its key function is to regularly spread the tears and other secretion on the eye surface to keep it moist, since the cornea must be continuously moist. They keep the eyes from drying out when asleep.




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## Eyelid Diseases

- Ptosis
  - Drooping of the upper eyelid.
  - If severe enough and left untreated, can cause amblyopia or astigmatism. Important for this disorder to be treated in children at a young age.
  - R/O Horner's Syndrome, Chronic Progressive External Ophthalmoplegia, Trauma, Myasthenia Gravis, 3<sup>rd</sup> Nerve Palsy
  - **Treatment**
    - Surgical procedures include: Levator resection, Muller muscle resection, Frontalis sling operation
    - Non-surgical modalities like the use of "crutch" glasses or special Scleral contact lenses to support the eyelid may also be used.
    - Ptosis that is caused by a disease will improve if the disease is treated successfully



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## Eyelid Diseases

- **Hordeolum vs. Chalazia**
  - External **hordeolums** form on the outside of the lids and can be seen as small red bumps. It is an infection of the sebaceous glands of Zeis at the base of the eyelashes, or an infection of the apocrine sweat glands of Moll.
  - Internal **hordeolums** are infections of the meibomian sebaceous glands lining the inside of the eyelids. They also cause a red bump underneath the lid with only generalized redness and swelling visible on the outside.
  - Styes are similar to **chalazia** (meibomian gland lipogranuloma, is a cyst in the eyelid that is caused by inflammation of a blocked meibomian gland), but tend to be of smaller size and feel less painful and usually produce no lasting damage. **hordeolums** are characterized by an acute onset and usually short in duration compared to **chalazia** that are chronic and usually do not resolve without intervention.




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## Hordeolum/Chalazia Treatment

- **Hordeolum**
  - warm compress
  - Antibiotic ung
  - Oral antibiotic
  - Watch for preseptal/orbital cellulitis
  - Treat underlying blepharitis/meibomitis
- **Chalazia**
  - hot, wet flannel, and rub gently, until the heat has reached the cyst. It is rare that a chalazion will recur and they will usually be biopsied to rule out the possibility of a tumour.
  - Corticosteroids
  - Treat underlying blepharitis/meibomitis

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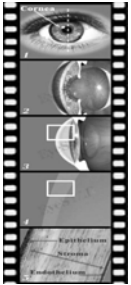
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## Corneal Anatomy

- Together with the lens, the cornea refracts light, accounting for approximately two-thirds of the eye's total optical power.
- refractive power of the cornea is approximately 43D
- focusing power is fixed.
- The cornea has unmyelinated nerve endings sensitive to touch, temperature and chemicals
- Because transparency is of prime importance the cornea does not have blood vessels; it receives nutrients via diffusion from the tear fluid at the outside and the aqueous humour at the inside and also from neurotrophins supplied by nerve fibres that innervate it.
- the cornea has a diameter of about 11.5 mm and a thickness of 0.5–0.6 mm in the center and 0.6–0.8 mm at the periphery.




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## Layers

- **Corneal epithelium:** a thin epithelial multicellular tissue layer of fast-growing and easily-regenerated cells, kept moist with tears. Irregularity or edema of the corneal epithelium disrupts the smoothness reducing visual acuity.
- **Bowman's layer:** a tough layer that protects the corneal stroma, consisting of a similar [irregularly-arranged collagen fibers]
- **Corneal stroma:** a thick, transparent middle layer, consisting of regularly-arranged collagen fibers
  - There are 2 theories of how transparency in the cornea comes about:
    - The lattice arrangements of the collagen fibrils in the stroma.
    - The spacing of the neighbouring collagen fibrils in the stroma must be < 200 nm for there to be transparency.
- **Descemet's membrane:** a thin acellular layer that serves as the modified basement membrane of the corneal endothelium, from which the cells are derived
- **Corneal endothelium:** a simple monolayer of mitochondria-rich cells responsible for regulating fluid and solute transport between the aqueous and corneal stromal compartments. Unlike the corneal epithelium the cells of the endothelium do not regenerate. Instead, they stretch to compensate for dead cells which reduces the overall cell density of the endothelium and has an impact on fluid regulation. If the endothelium can no longer maintain a proper fluid balance, stromal swelling due to excess fluids and subsequent loss of transparency will occur.

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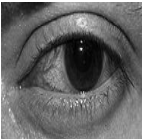
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## Keratitis

- **Amoebic keratitis.**
  - most serious corneal infection, usually affecting contact lens wearers
  - Acanthamoeba
    - Complete solution
- **Bacterial keratitis.**
  - injury
    - Staphylococcus aureus
  - contact lenses
    - Pseudomonas aeruginosa
- **Fungal keratitis**
  - Fusarium
    - ReNu with MoistureLoc contact lens solution
- **Viral keratitis**
- **Herpes simplex keratitis.**
- **Herpes zoster keratitis**
- **Exposure keratitis**
- **Photokeratitis** - keratitis due to intense ultraviolet radiation exposure
- **Ulcerative keratitis**
- **Contact lens acute red eye (CLARE)**
- **Severe allergic response** may lead to corneal inflammation and ulceration
- **Dry Eyes** - SPK




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## Treatment

- **Infectious keratitis**
  - antibacterial -steroid containing medications should not be used for bacterial infections
    - Quixin (levofloxacin)
    - Zymar (gatifloxacin)
    - Vigamox (moxifloxacin)
  - antifungal
  - antiviral
  - discontinue contact lens wear and discarding contaminated contact lenses and contact lens cases
- **Other keratitis**
  - Steroids
  - NSAIDS
  - Cyclosporine
  - Antihistamine/mast cell stabilizers

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## Conjunctiva Anatomy

- The conjunctiva is a clear mucous membrane consisting of cells and underlying basement membrane that covers the sclera (white part of the eye) and lines the inside of the eyelids. It is made of epithelial tissue
- Palpebral conjunctiva lines the eyelids
- Bulbar conjunctiva covers the eyeball, over the sclera. This region of the conjunctiva is bound tightly and moves with the eyeball movements

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## Conjunctivitis

- Redness (hyperaemia), irritation (chemosis) and watering (epiphora) of the eyes are symptoms common to all forms of conjunctivitis.
- Acute allergic conjunctivitis is typically itchy
- Viral conjunctivitis is often associated with an infection of the upper respiratory tract, a common cold, and/or a sore throat.
- Bacterial conjunctivitis: grittiness/irritation and a stringy, opaque, grey or yellowish mucopurulent discharge. Bacteria such as Chlamydia trachomatis or Moraxella can cause a non-exudative but persistent conjunctivitis without much redness.
- Irritant or toxic conjunctivitis is irritable or painful when the infected eye is pointed far down or far up. Discharge and itch are usually absent. This is the only group in which severe pain may occur.
- Inclusion conjunctivitis of the newborn caused by the bacteria Chlamydia trachomatis, and may lead to acute, purulent conjunctivitis, self-healing.




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## Treatment

- persons wash their hands frequently and practice optimum hygiene to prevent spreading it to others
- Allergic
  - artificial tears
  - non-steroidal anti-inflammatory medications and antihistamines
  - steroid drops
- Bacterial
  - antibiotic eye drops or ointments
- Viral
  - artificial tears.
  - corticosteroid
  - Antibiotic drops may also be used for treatment of complementary infections.
  - Patients are often advised to avoid touching their eyes or sharing towels and washcloths
  - usually resolves within 3 weeks
  - 5% Betadine
- Chemical
  - Conjunctivitis due to burns, toxic and chemical require careful wash-out with saline, especially beneath the lids.
  - topical steroids.
  - The more acute chemical injuries are medical emergencies, particularly alkali burns, which can lead to severe scarring, and intraocular damage. Fortunately, such injuries are uncommon.

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### **Sclera Anatomy**

- fibrous, protective, outer layer of the eye containing collagen and elastic fiber
- In children, it is thinner and shows some of the underlying pigment, appearing slightly blue.
- In the elderly, however, fatty deposits on the sclera can make it appear slightly yellow.
- continuous with the dura mater and the cornea, and maintains the shape of the globe, offering resistance to internal and external forces, and provides an attachment for the extraocular muscle insertions.
- The thickness of the sclera varies from 1mm at the posterior pole to 0.3 mm just behind the rectus muscle insertions.
- The sclera's blood vessels are mainly on the surface
- Along with the vessels of the conjunctiva, those of the sclera renders the inflamed eye bright red.

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### **Scleritis**

- diffuse scleritis (the most common), nodular scleritis, and necrotizing scleritis (the most severe)
- Redness sometimes changing to a purple hue
- Severe ocular pain (not in episcleritis) radiate to temple or jaw
- Photophobia and tearing
- Decrease in visual acuity
- R/O with phenylephrine

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### **Treatment**

- In very severe cases of necrotizing scleritis, surgery must be performed to repair damaged corneal tissue in the eye
- For less severe cases, nonsteroidal anti-inflammatory drugs, such as ibuprofen, are prescribed for pain relief.
- Scleritis oral medication containing corticosteroids and an eye solution.
- antibiotics are prescribed.
- chemotherapy (such as systemic immunosuppressive therapy with such drugs as cyclophosphamide or azathioprine) may be used to treat the disease.
- If not treated, scleritis can cause blindness.

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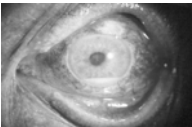
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## Uveal Anatomy

- The uvea lies between the corneosclera and the retina
- It is traditionally divided into 3 or 4 regions, from front to back, the iris, ciliary body, pars plana and choroid.
- anterior uvea (ie, iris and ciliary body)
- posterior uvea (ie, choroid)
- Symptoms if inflamed:
  - Redness
  - Blurred vision
  - photophobia
  - floaters
  - Pain
- Signs:
  - Cell
  - Flare
  - Hypopyon
  - Keratic precipitates
  - Iris nodules, choroiditis




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## Treatment

- The prognosis is generally good for those who receive prompt diagnosis and treatment, but serious complication (including cataracts, glaucoma, band keratopathy, retinal edema and permanent vision loss) may result if left untreated.
- glucocorticoid steroids, either as topical eye drops (prednisolone acetate) or oral therapy with prednisolone tablets. But before giving corticosteroids, rule out corneal ulcers by Florescence Dye test.
- topical cycloplegics, such as atropine or homatropine,
- Triamcinolone (Kenalog or Triescence)
- Antimetabolite medications, such as methotrexate are often used for recalcitrant or more aggressive cases of uveitis.

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## Lens Anatomy

- biconvex helps to refract light
- accommodation
- the refractive power of the lens in its natural environment is approximately 18 dioptres, roughly one-third of the eye's total power.



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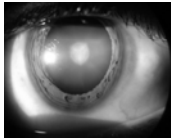
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## Cataracts

- long-term exposure to ultraviolet light
- exposure to radiation
- secondary effects of diseases such as diabetes, hypertension
- advanced age
- trauma (possibly much earlier); they are usually a result of denaturation of lens protein
- Genetic factors are often a cause of congenital cataracts and positive family history may also play a role in predisposing someone to cataracts at an earlier age.
- corticosteroids and Seroquel.
- There are various types of cataracts, e.g. nuclear, cortical, mature, and hypermature. Cataracts are also classified by their location, e.g. posterior (classically due to steroid use and anterior (common (senile) cataract related to aging).




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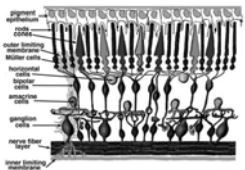
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## Retina Anatomy

- Inner limiting membrane - Müller cell footplates
- Nerve fiber layer
- Ganglion cell layer - Layer that contains nuclei of ganglion cells and gives rise to optic nerve fibers.
- Inner plexiform layer
- Inner nuclear layer contains bipolar cells
- Outer plexiform layer - In the macular region, this is known as the Fiber layer of Henle.
- Outer nuclear layer
- External limiting membrane - Layer that separates the inner segment portions of the photoreceptors from their cell nuclei.
- Photoreceptor layer - Rods / Cones
- Retinal pigment epithelium




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## Retinal Detachment

- Rhegmatogenous retinal detachment - due to a hole, tear, or break in the retina that allows fluid to pass from the vitreous space into the subretinal space between the sensory retina and the retinal pigment epithelium.
- Exudative, serous, or secondary retinal detachment - due to inflammation, injury or vascular abnormalities that results in fluid accumulating underneath the retina without the presence of a hole, tear, or break.
- Tractional retinal detachment - occurs when fibrovascular tissue, caused by an injury, inflammation or neovascularization, pulls the sensory retina from the retinal pigment epithelium.
- A retinal detachment is commonly preceded by a posterior vitreous detachment which gives rise to these symptoms:
  - flashes of light (photopsia) - very brief in the extreme peripheral (outside of center) part of vision
  - a sudden dramatic increase in the number of floaters

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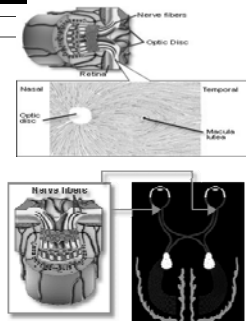
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## Optic Nerve Anatomy

- The optic nerve is composed of retinal ganglion cell axons and Portort cells. It leaves the orbit (eye) via the optic canal, running postero-medially towards the optic chiasm where there is a partial decussation (crossing) of fibers from the nasal visual fields of both eyes. Most of the axons of the optic nerve terminate in the lateral geniculate nucleus from where information is relayed to the visual cortex.
- From the lateral geniculate body, fibers of the optic radiation pass to the visual cortex in the occipital lobe of the brain.




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## Glaucoma

- Glaucoma refers to a group of diseases that affect the optic nerve and involves a loss of retinal ganglion cells in a characteristic pattern. It is a type of optic neuropathy. Raised intraocular pressure is a significant risk factor for developing glaucoma (above 22 mmHg). One person may develop nerve damage at a relatively low pressure, while another person may have high eye pressure for years and yet never develop damage. Untreated glaucoma leads to permanent damage of the optic nerve and resultant visual field loss, which can progress to blindness.
- Glaucoma can be divided roughly into two main categories, "open angle" and "closed angle" glaucoma. Angle closure can appear suddenly and is often painful. Visual loss can progress quickly but the discomfort often leads patients to seek medical attention before permanent damage occurs. Open angle, chronic glaucoma tends to progress more slowly and the patient may not notice that they have lost vision until the disease has progressed significantly.
- Glaucoma has been nicknamed the "sneak thief of sight" because the loss of vision normally occurs gradually over a long period of time and is often only recognized when the disease is quite advanced. Once lost, this damaged visual field can never be recovered. Worldwide, it is the second leading cause of blindness. Glaucoma affects 1 in 200 people aged fifty and younger, and 1 in 10 over the age of eighty.

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## Pathophysiology

- The major risk factor for most glaucomas and focus of treatment is increased intraocular pressure. production of liquid aqueous humor by the ciliary processes of the eye and its drainage through the trabecular meshwork. Aqueous humor flows from the ciliary processes into the posterior chamber, bounded posteriorly by the lens and the zonules of Zinn and anteriorly by the iris. It then flows through the pupil of the iris into the anterior chamber, bounded posteriorly by the iris and anteriorly by the cornea. From here the trabecular meshwork drains aqueous humor via Schlemm's canal into scleral plexuses and general blood circulation. In open angle glaucoma there is reduced flow through the trabecular meshwork; in angle closure glaucoma, the iris is pushed forward against the trabecular meshwork, blocking fluid from escaping.

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**Diagnosis**

- Testing for glaucoma should include measurements of the intraocular pressure via tonometry
- changes in size or shape of the eye
- anterior chamber angle examination or gonioscopy
- examination of the optic nerve to look for any visible damage to it, or change in the cup-to-disc ratio and also rim appearance and vascular change.
- A formal visual field test should be performed.
- The retinal nerve fiber layer can be assessed with imaging techniques such as optical coherence tomography (OCT), scanning laser polarimetry (GDx), and/or scanning laser ophthalmoscopy also known as Heidelberg Retina Tomography (HRT3).
- Owing to the sensitivity of all methods of tonometry to corneal thickness, methods such as Goldmann tonometry should be augmented with pachymetry to measure central corneal thickness (CCT). A thicker-than-average cornea can result in a pressure reading higher than the 'true' pressure, whereas a thinner-than-average cornea can produce a pressure reading lower than the 'true' pressure. Because pressure measurement error can be caused by more than just CCT (i.e. corneal hydration, elastic properties, etc.), it is impossible to 'adjust' pressure measurements based only on CCT measurements.
- The Frequency Doubling Illusion can also be used to detect glaucoma with the use of a Frequency Doubling Technology (FDT) perimeter.
- more attention given to sex, race, history of drugs use, refraction, inheritance and family history.

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**THANK YOU**

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