CORNEA AND SCLERA

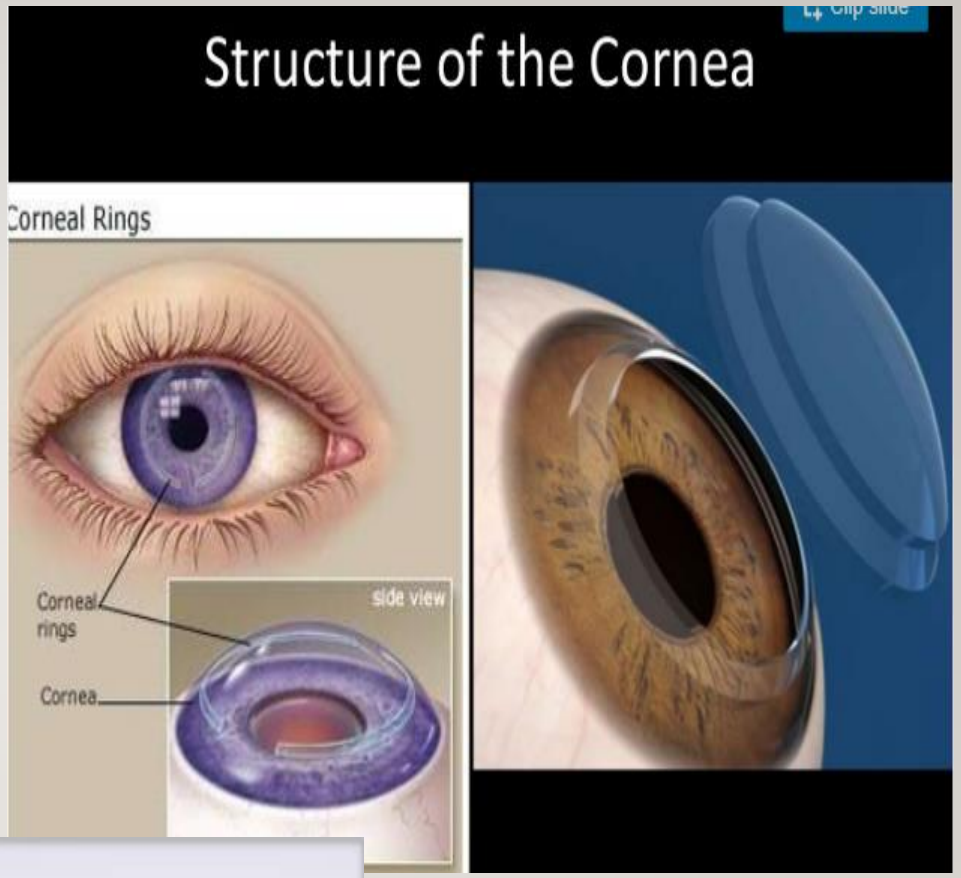
CORNEA ANATOMY

HIDAIA RASHID

RUND ADAILA

Cornea is a transparent, avascular, watchglass like structure.

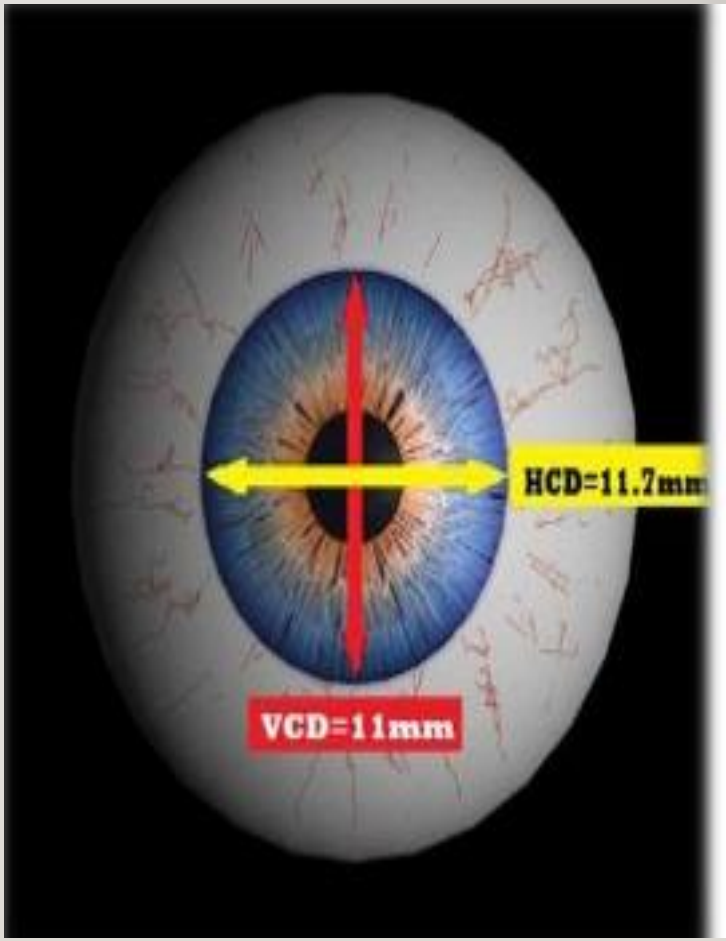
It forms anterior 1/6 of the outer fibrous coat of eyeball.



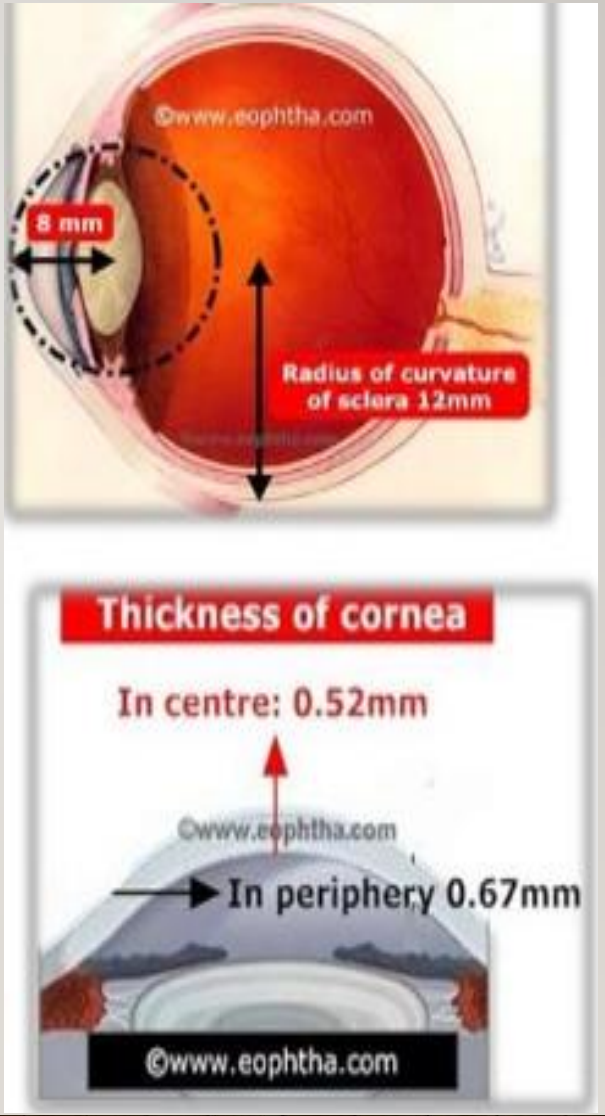
Dimensions:

Anterior surface is convex and elliptical.

Posterior surface is concave and circular with diameter of 11.5mm

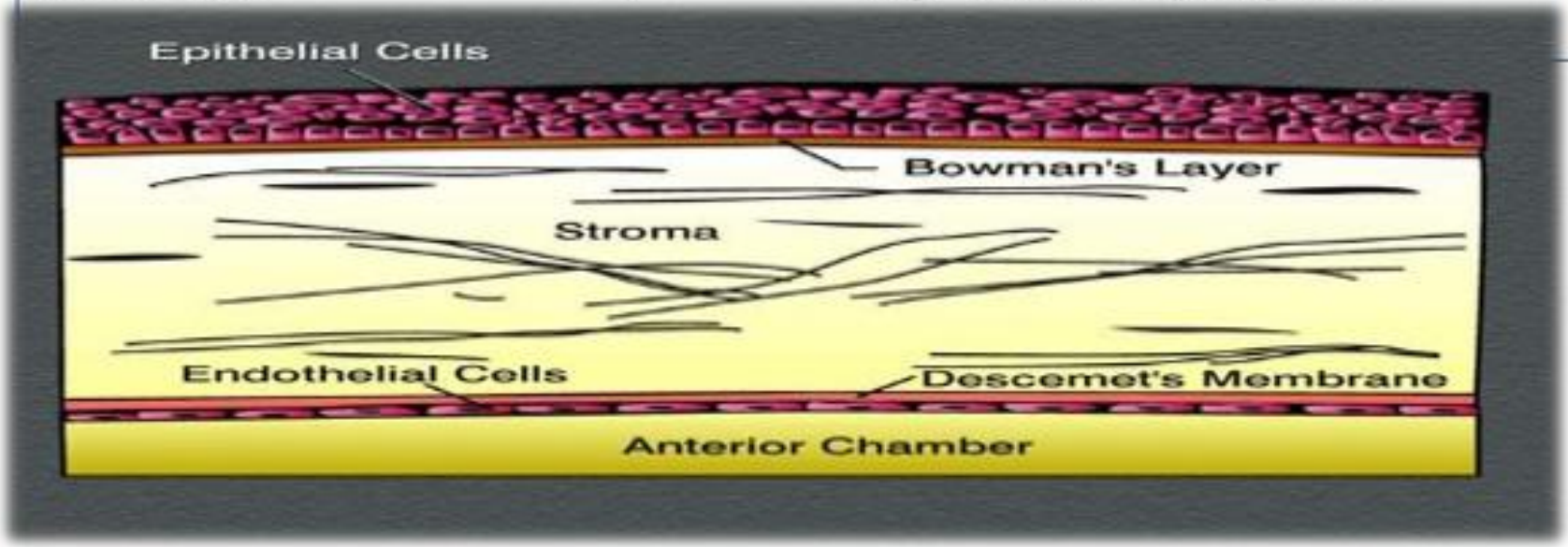


- Thickness in center is 0.5mm and in periphery is 1mm.
- Radius of curvature of anterior surface is 7.8mm and posterior surface is 6.5mm.
- Refractive Power of cornea is 43D (net). *most powerful refractive surface of the eye- at the center*
- Refractive index is 1.33.



Cornea is composed of Five Layers.

Layers	Thickness (in μm)	Composition
Epithelium	50	Stratified Squamous Epithelium
Bowman's Membrane	8-14	Compact layer of collagen fibres
Stroma	500(0.5mm)	Orderly arrangement of collagen lamellae with keratocytes
Descemet's Membrane	10-12	Consists of collagen & glycoprotein
Endothelium	5	single layer of simple squamous



- **First type :** non-keratinized, replaced every 7 days.
- **Secound type :** acellular, not regeneratable.
- **Third type :** regeneratable. (proteoglycan, macrophages, lymphocytes)
- **Fourth type :** By endothelium. Ends at limbus - Schwalbe's line.

LAYERS OF EPITHELIUM

Layers of Epithelium	Description	Mitoticactivity
Basal Cell	Single layer of columnar cells found adjacent to basal layer	+
Wing Cell	2-3 layers of polyhedral cells	–
Surface Cell	3 layers of flattened epithelial cells with microvilli in contact with the tear film.	–

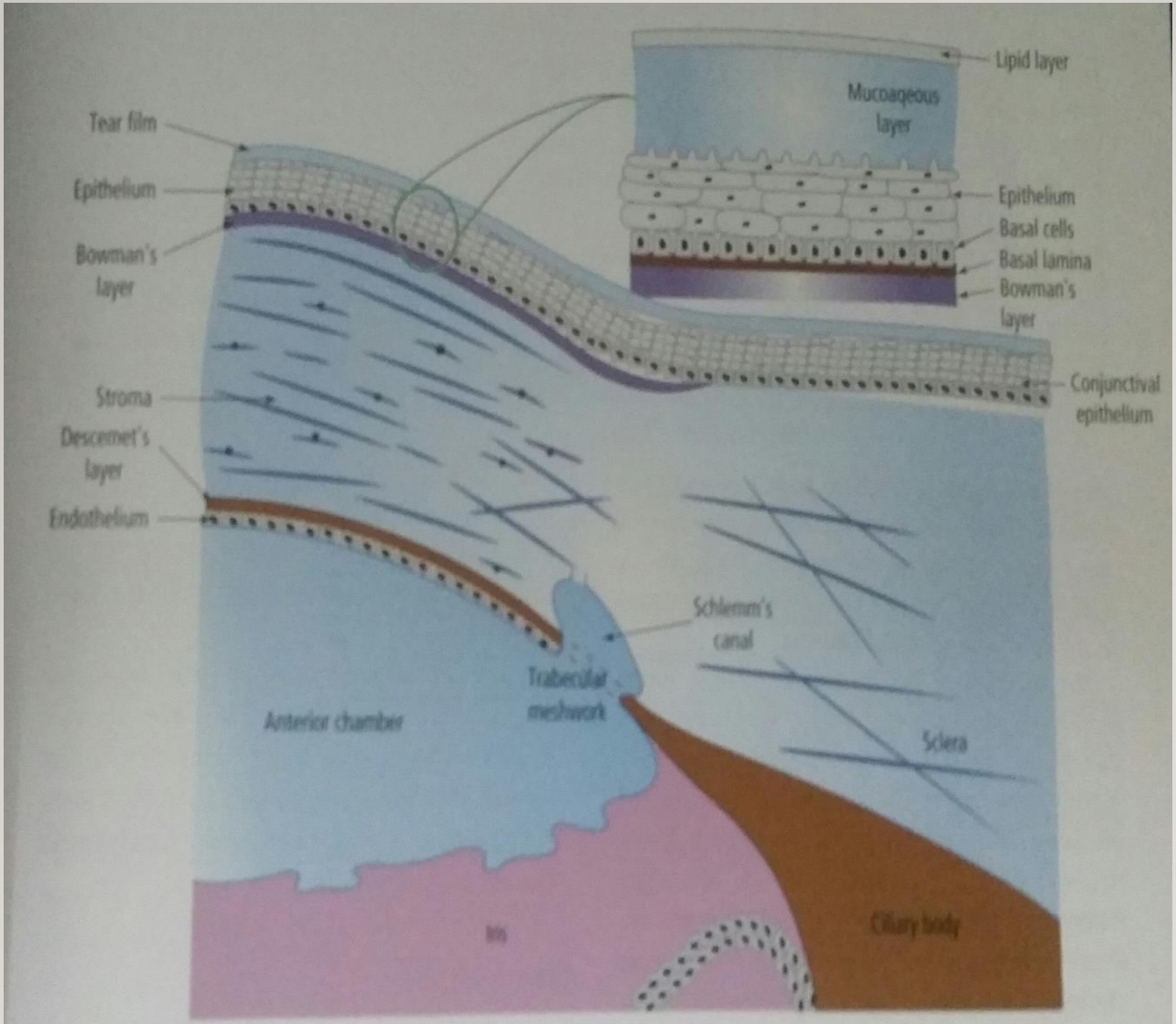


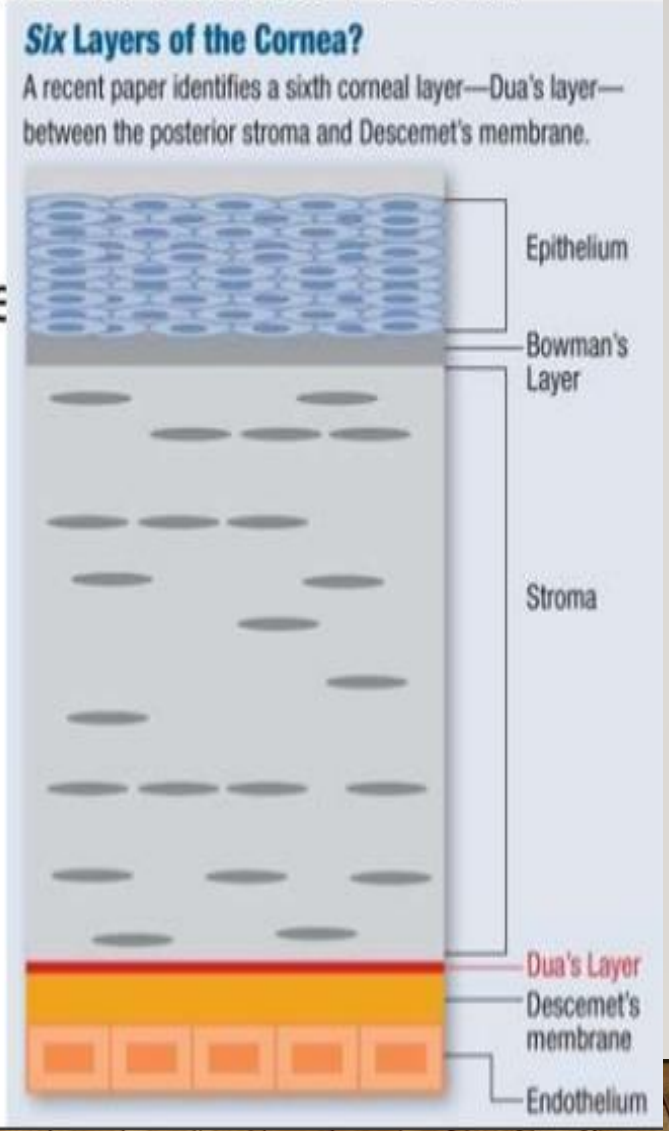
Figure 1.10 The structure of the cornea and precorneal tear film (schematic, not to scale – the stroma accounts for 90% of the corneal thickness).

Transparency

- Regularity of stromal structures: Fibers of regular diameter, arranged in lattice, interfibrilar distance less than a wavelength of light.

New Layer Discovered-DUA'S LAYER

- In a paper published in 2013, the existence of Dua's layer was suggested by Harminder Singh Dua *et al.*



Implications of findings of Dua's layer

The layer may help surgeons improve outcomes for patients undergoing corneal
grafts and transplants.

During surgery, tiny air bubbles are injected into the corneal stroma in what is known as the "big bubble technique".

Sometimes the bubble bursts, damaging the patient's eye.

If the air bubble is injected under Duals layer instead of above it, the layer's strength could reduce the risk of tearing

*Difference:

Damage to the epithelial layer, is repaired by cell spreading and proliferation.

Endothelial damage, is repaired by cell spreading alone, with a loss of cell density.

A point is reached when loss of its barrier and pumping functions leads to over- hydration (oedema), disruption of the regular packing of its stromal collagen and corneal clouding

BLOOD SUPPLY:

- Avascular.
- Anterior ciliary vessels.

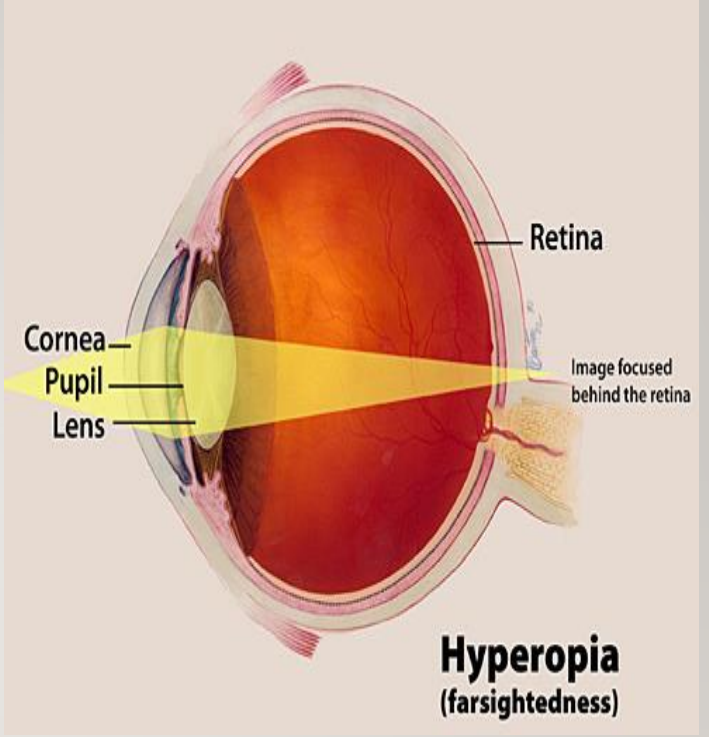
(ophthalmic, the limbal region) *helps in corneal metabolism and wound repair by providing nourishment.

No lymphatics.

The aqueous supplies oxygen to posterior stroma while the anterior one receives it from the ambient air.

Physiology

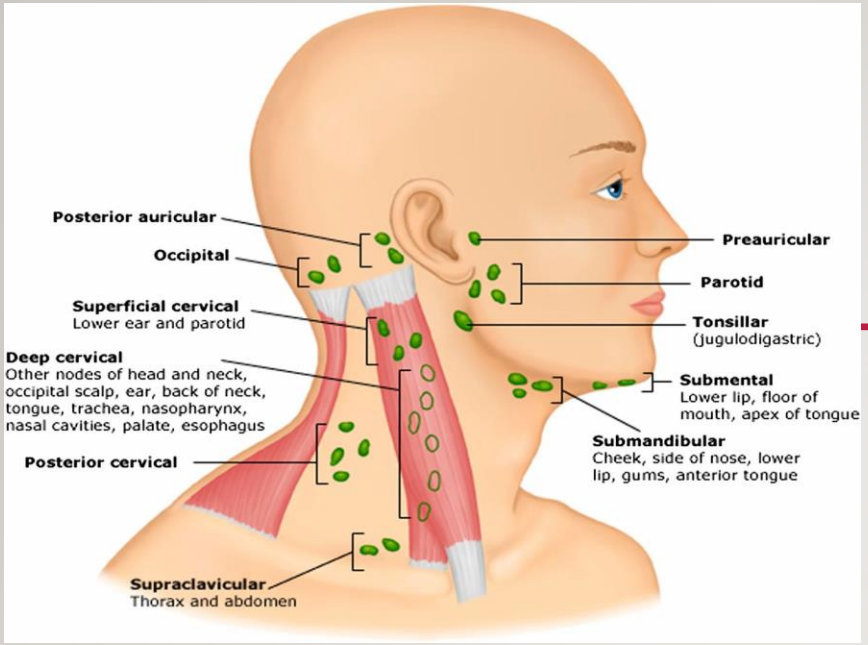
- Refracts and focuses the light onto retina with the lens.
- Protection of intraocular contents.
- Absorption of drugs.

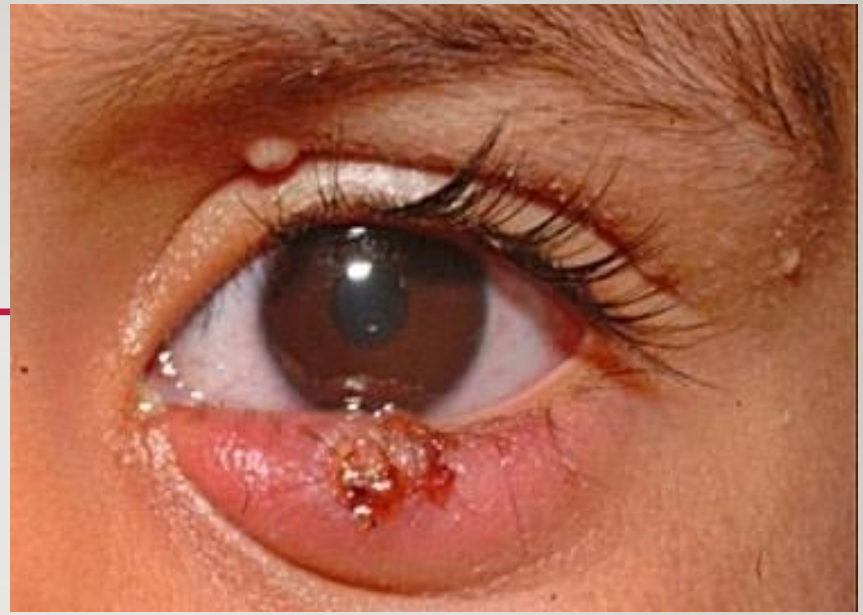


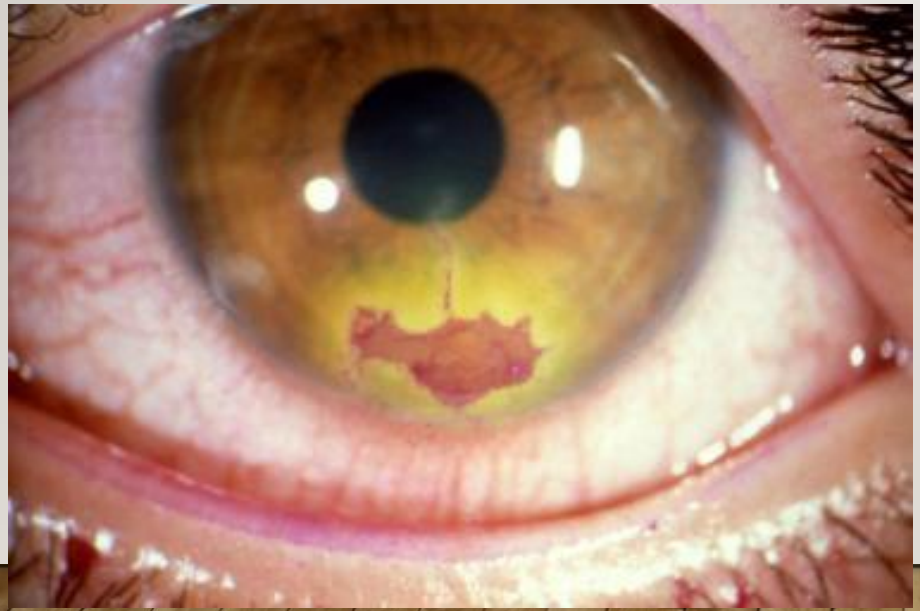
CORNEAL DISEASES

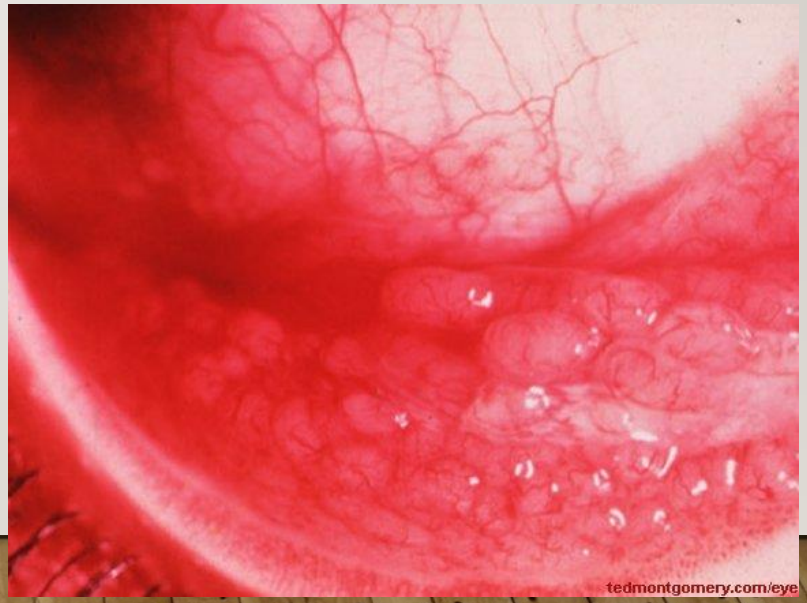
INFECTIVE CORNEAL LESIONS

- **Herpes simplex keratitis:**
- Type 1 herpes simplex virus (HSV1) is a common imp. cause of ocular disease.
- Type 2 (HSV2) can cause genital disease may cause keratitis and infantile chorioretinitis .
- Primary infection with (HSV1) aquired early in life by close contact such as kissing, it can be asymptomatic or with :
- -fever
- -vesicular lid lesion
- -follicular conjuctivitis
- -preauricular lymphadenopathy


Posterior auricular
Occipital
Superficial cervical
Lower ear and parotid
Deep cervical
Other nodes of head and neck, occipital scalp, ear, back of neck, tongue, trachea, nasopharynx, nasal cavities, palate, esophagus
Posterior cervical
Supraclavicular
Thorax and abdomen
Preauricular
Parotid
Tonsillar
(Jugulodigastric)
Submental
Lower lip, floor of mouth, apex of tongue
Submandibular
Cheek, side of nose, lower lip, gums, anterior tongue



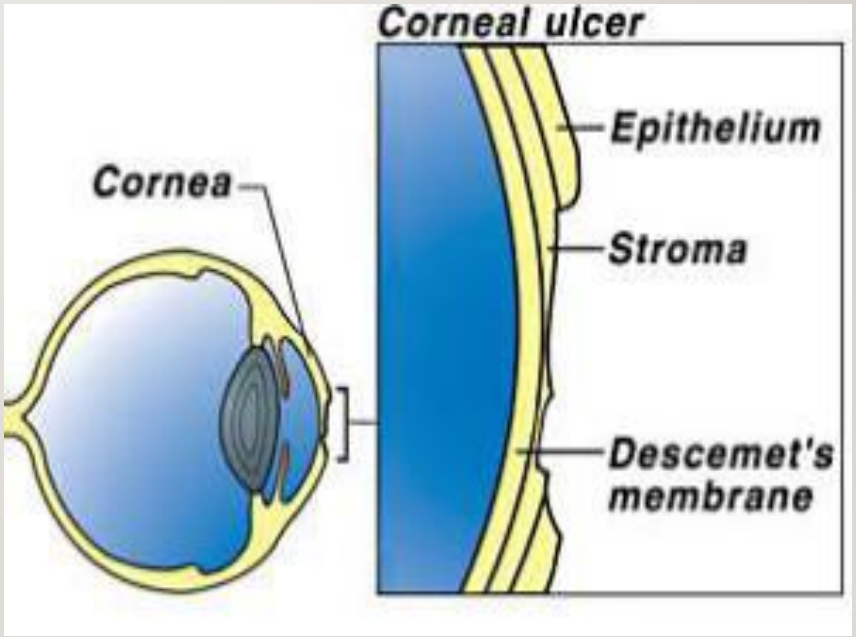



tedmontgomery.com/eye

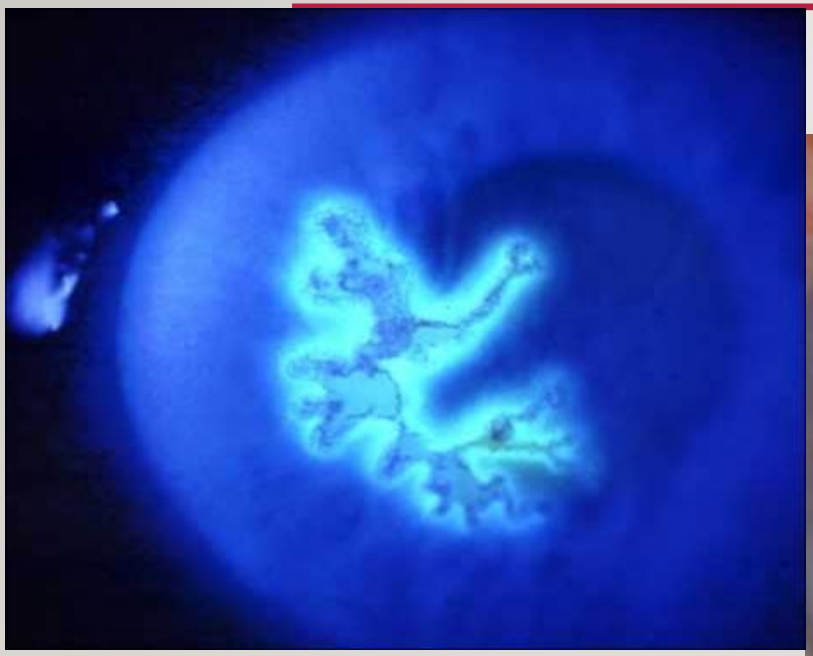
- The primary infection is followed by resolution and latency of the virus in the trigeminal ganglion , while the period of reactivation of the latent virus is "recurrent infection" in which the virus travels centrifugally to nerve terminals in the corneal epithelium to cause an epithelial keratitis.

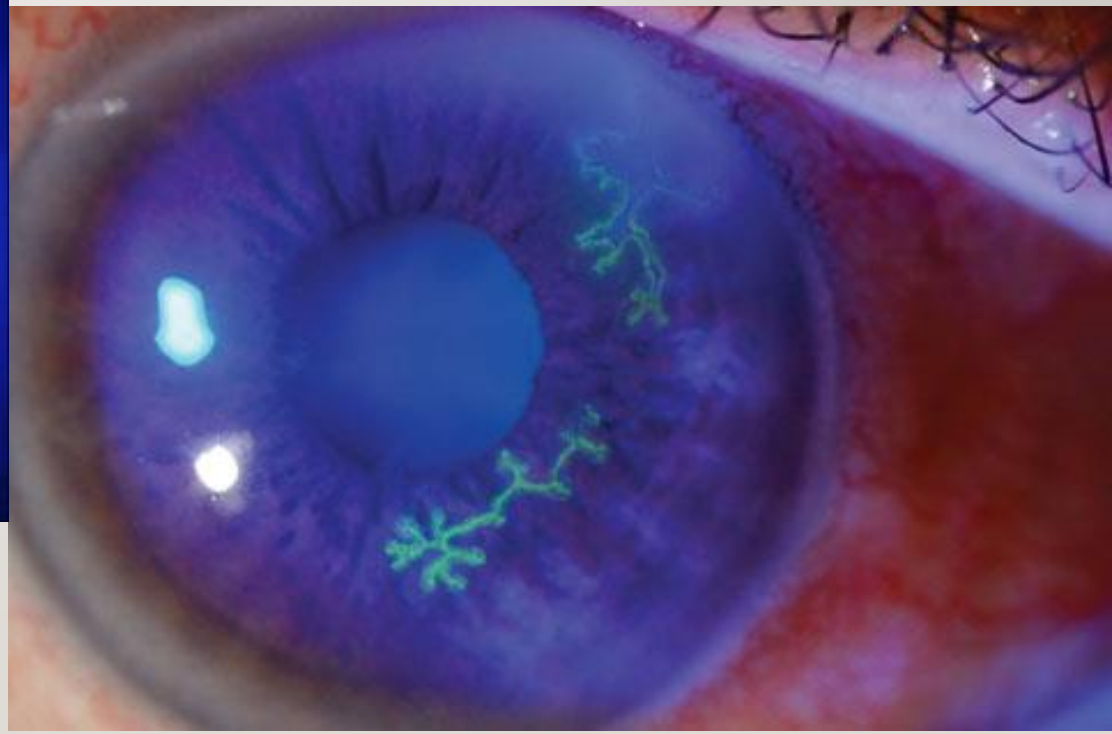
- The pathognomonic appearance is dendritic ulcer which is a linear , branching , epithelial ulcers

- **Corneal ulcer**, or **ulcerative keratitis**, is an inflammatory or more seriously, infective condition of the cornea involving disruption of its epithelial layer with involvement of the corneal stroma.



DENDRITIC ULCER

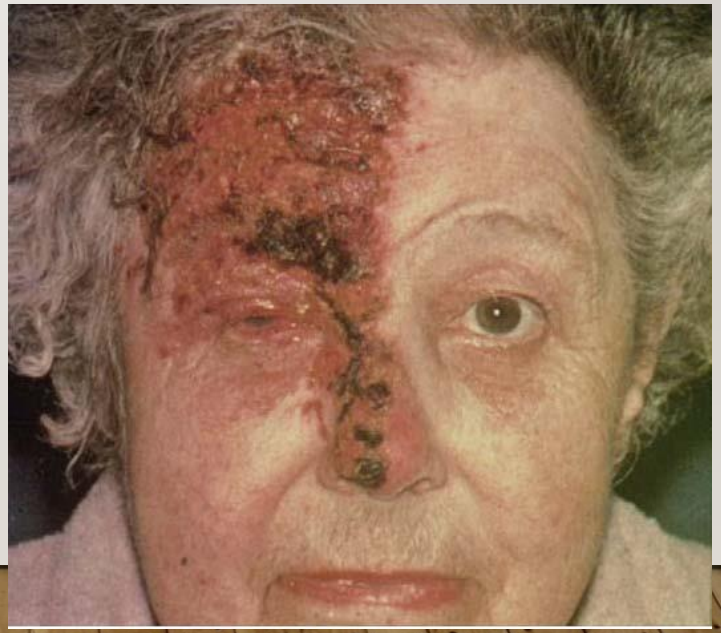




- May heal without scar or progress to a stromal keratitis and iflammatory infiltration with perminant scar ,corneal grafting can be done .
- **Treatment:**
- Aciclovir
- Ganciclovir
- Vidarabine
- triflurothymidine

HERPES ZOSTER OPHTHALMICUS

- Varicella zoster.
- Ophthalmic division of trigeminal nerve.
- Pain and vesicles in the distribution of the ophthalmic nerve.
- Ocular problems if nasociliary branch of the nerve is involved.
- **Signs**:
  - Lid swelling
  - Keratitis
  - Iritis
  - Secondary glaucoma



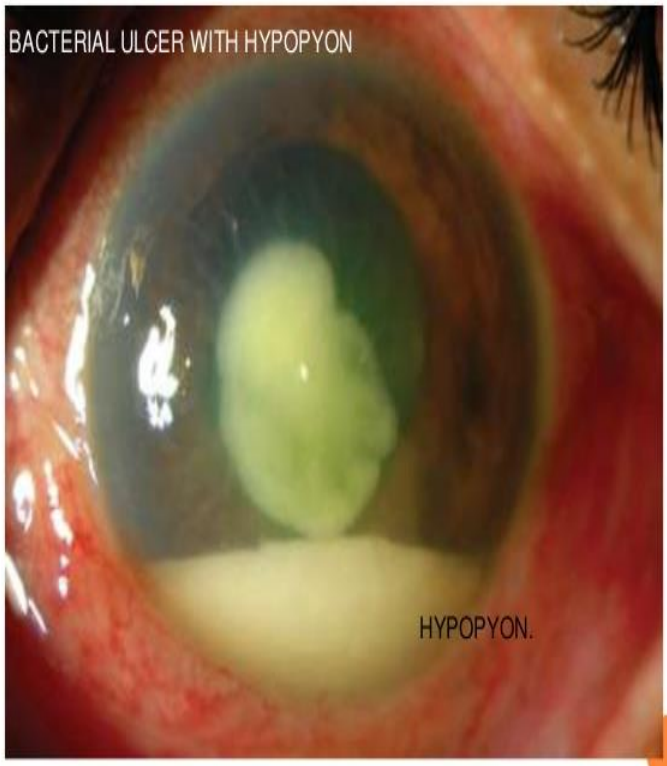
- **Treatment:**
  - Oral antiviral treatment for post infective neuralgia .
  - Antibacterials to prevent secondary infection .
  - Prognosis is improved with antivirals .

BACTERIAL KERATITIS

- Staph.epidermidis ,staph.aureus , strep.pneumonia , coliform , pseudomonas , haemophilus.
- **Factors prevent infection of cornea and conjuctiva**:
  - Blinking
  - Flow of tears
  - The corneal epithelium
  - Mucus trapping foreign bodies
- **Predisposing factors:**
  - Keratoconjunctivitis sicca
  - Contact lens wear
  - A break in the corneal epithelium

SIGNS AND SYMPTOMS

- Pain
- Purulent discharge
- Ciliary injection
- Visual loss
- Hypopyon
- White corneal opacity

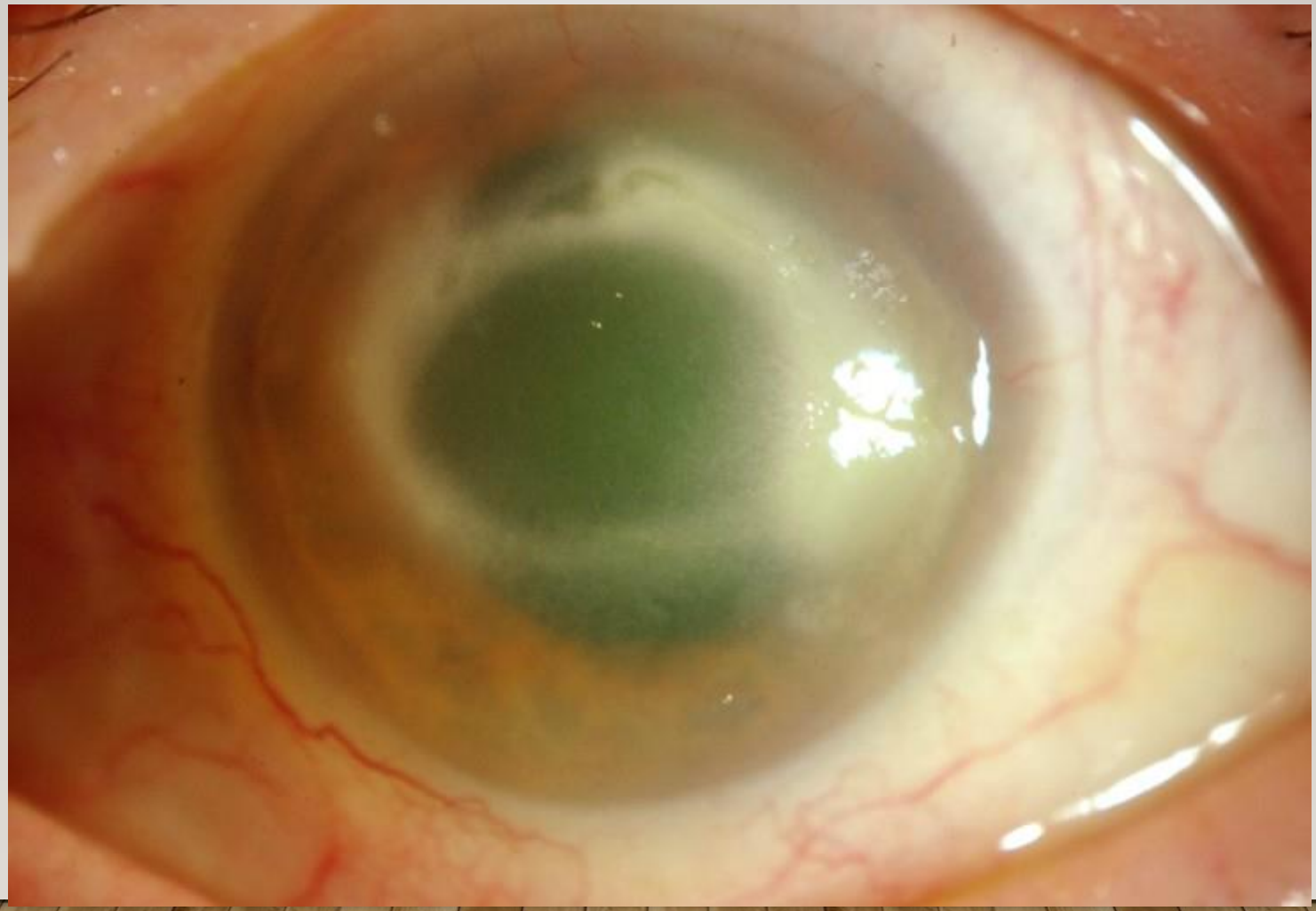


TREATMENT:

- Gram staining and culture + topical antibiotics
- Dual therapy to cover most bacteria (cefuroxime + gentamicin)
- Monotherapy (ciproflpxacin)
- Tissue adhesives and corneal graft for perforated cornea

ACANTHAMOEBA KERATITIS

- Freshwater amoeba >> painful infective keratitis , often with contact lenses .
- Infiltrated corneal nerves , may spread to sclera , can cause blindness.
- DX :in vivo confocal microscopy or corneal scrapes.
- Culture (E.coli lawn) to identify strains or faster with PCR .
- TX :topical chlorohexidine ,polyhexamethylene



FUNGAL KERATITIS

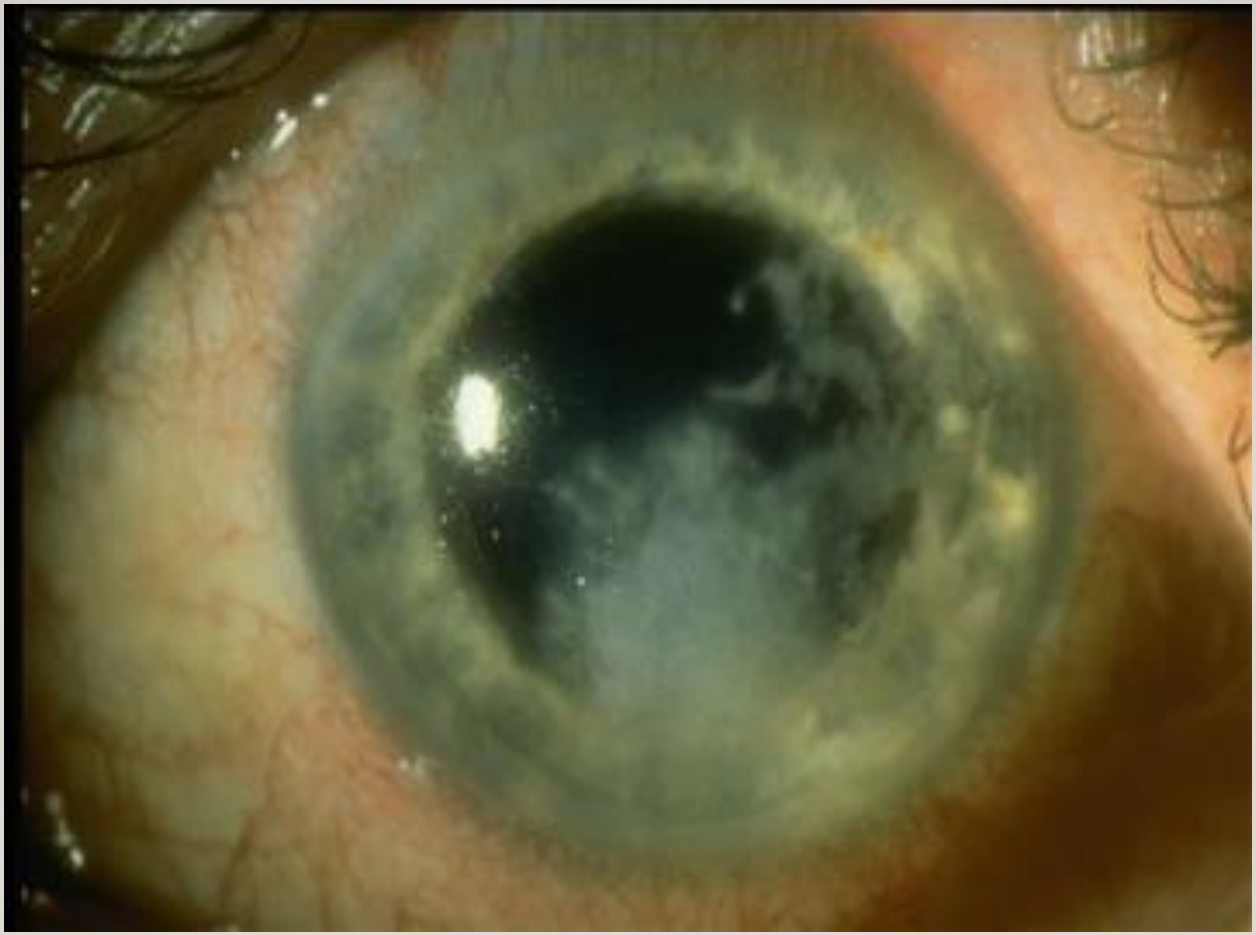
- India , 30-50% of infective keratitis
- **Considered in** :

➢ Not responding to antibacterial therapy in corneal ulceration

➢ Trauma

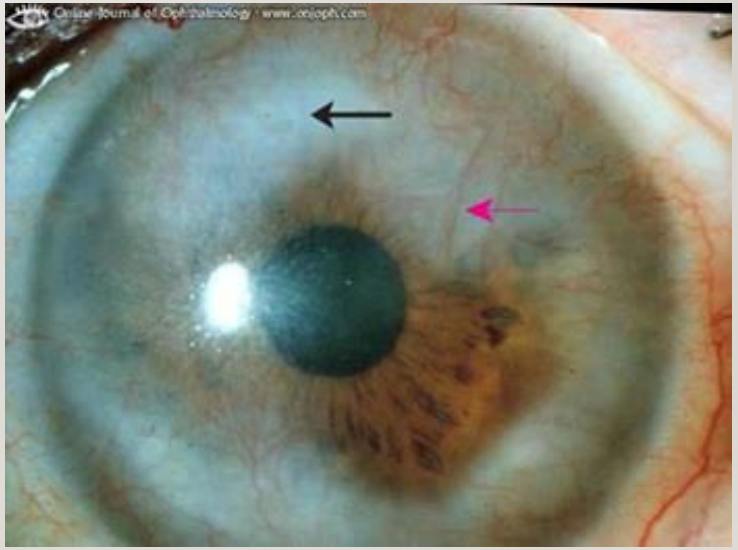
➢ Prolonged use of steroids

- Whitish inflammatory infiltrate with satellite lesions is distinguishing feature
- TX: topical antifungal drop pimaricin (natamycin)

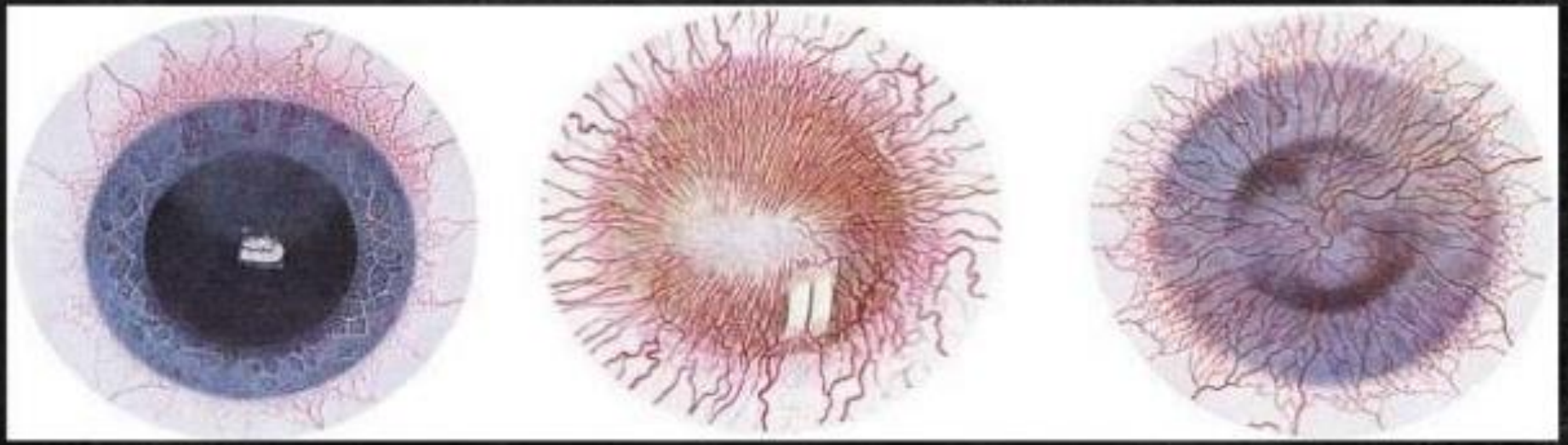


INTERSTITIAL KERATITIS

- Any vascular keratitis that effects the corneal stroma without the epithelium
- Caused by congenital syphilis
- A scar is formed with empty "ghost " blood vessel(late) (neovascularization) .



Progression of syphilitic stromal keratitis

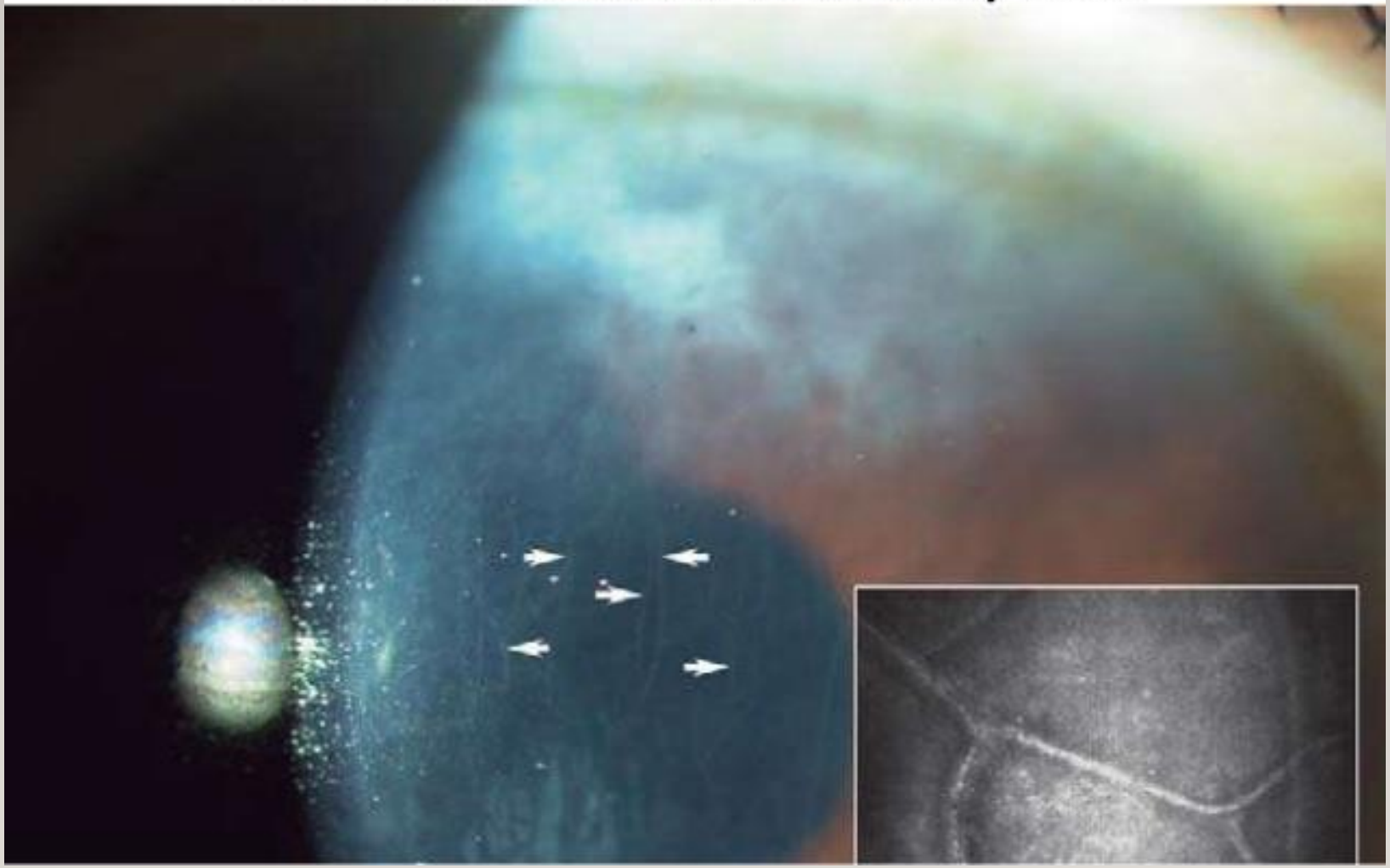


Left Acute stromal inflammatory edema with neovascularization.

Middle Corneal inflammation with dense superficial and deep neovascularization.

Right Partial clearing with regression of vascularization.

Hallmark of Interstitial Keratitis
Stromal Ghost vessels/neo

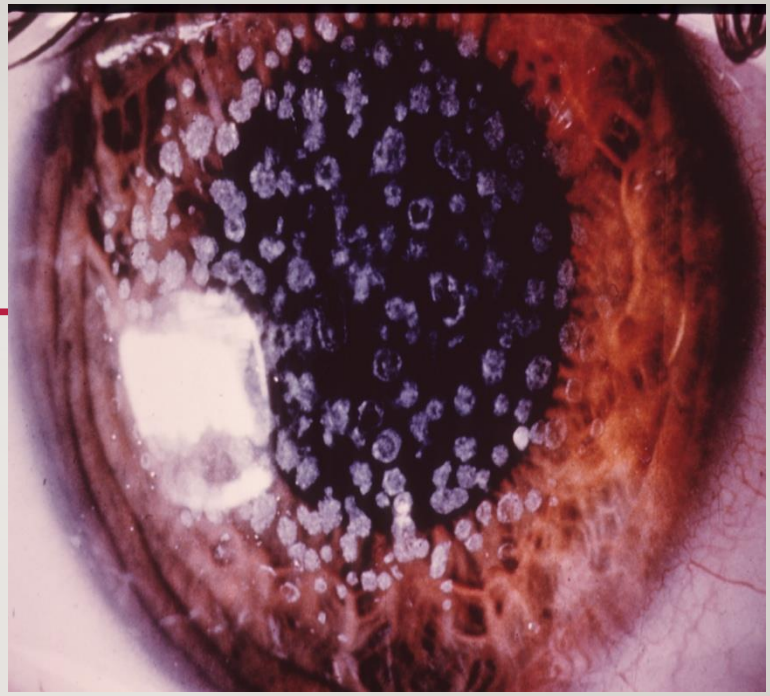


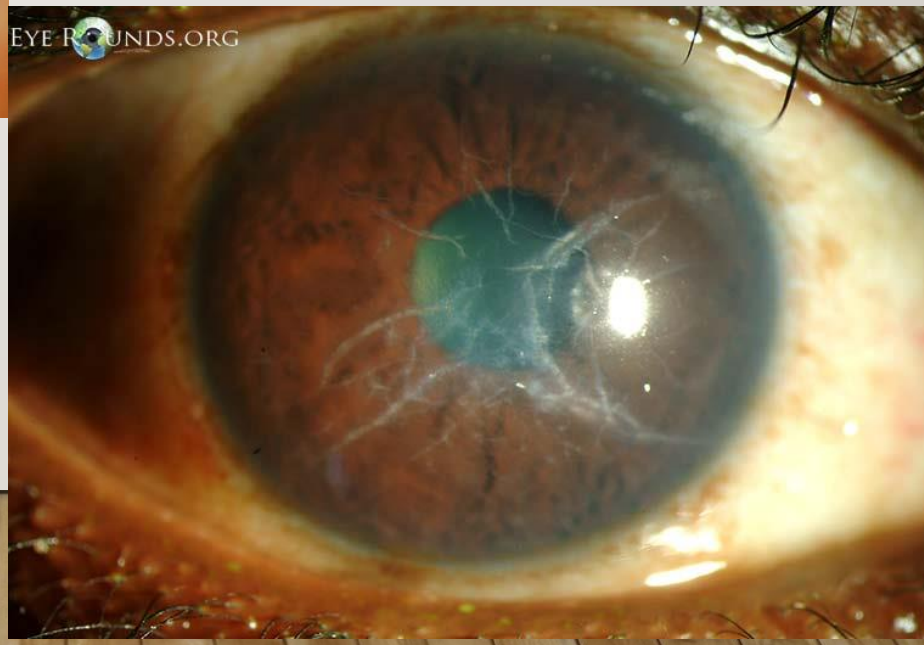
CORNEAL DYSTROPHIES

- *Anterior* dystrophies involving the epithelium and bowman's membrane, such as :meesmann ,AD.Asx

- *Stromal* dystrophies with visual loss causing corneal erosion and pain, like: granular corneal dystrophy (dominant) ,macular dystrophy (recessive) .

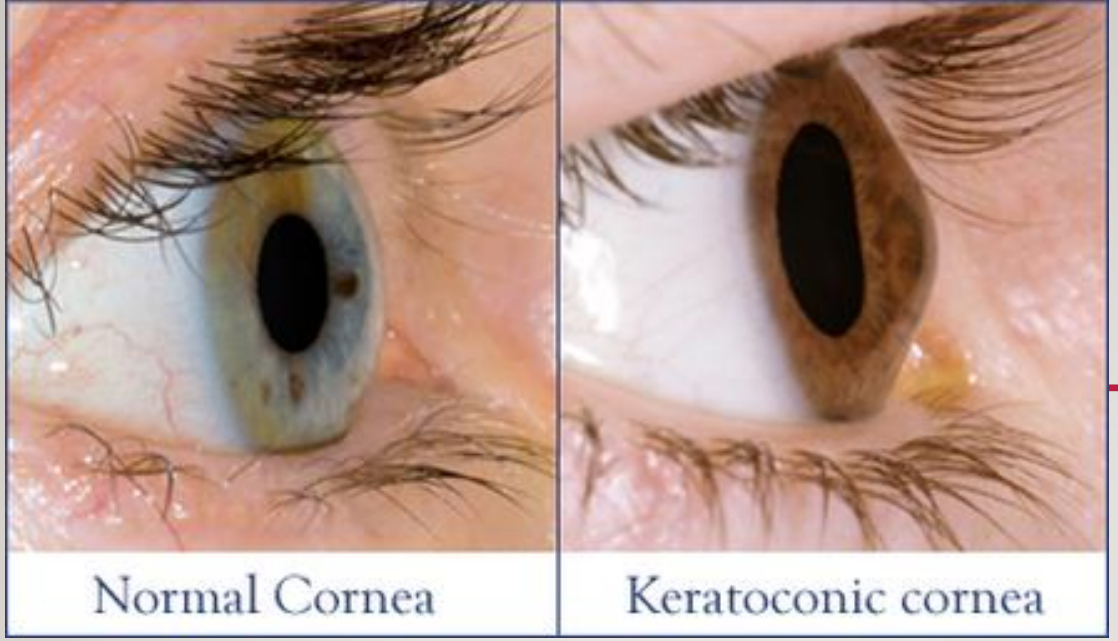
- *Posterior* dystrophies effecting endothelium , lost endothelial pumping , oedema : fuch's dystrophy , can be sporadic ,dominant ,x-linked.




EYE ROUNDS.ORG

KERATOCONUS

- Painless disorder which is resulted from failure of cohesion between stromal collagen fibrils and lamellae of unknown cause, causing them to slip over one another and unravel.
- —> resulting in progressive central corneal thinning –> leads to an ectatic conical cornea and myopia.
- Mostly sporadic / inherited.


Normal Cornea
Keratoconic cornea

- **Presentation:** young patient with myopia, irregular astigmatism , and in severe cases vision loss.
- **Diagnosis:**

1- distorted red reflex during ophthalmoscopy .

2-record surface corneal topography.

- **Treatment:**

1-rigid contact lenses→ arch over the irregularity of the cornea and restores the optics of the eye

2-replacement of the corneal stroma.

3-cross-linking of the anterior stromal collagen—> UVA radiation.

4-corneal graft.

CORNEAL DEGENERATION

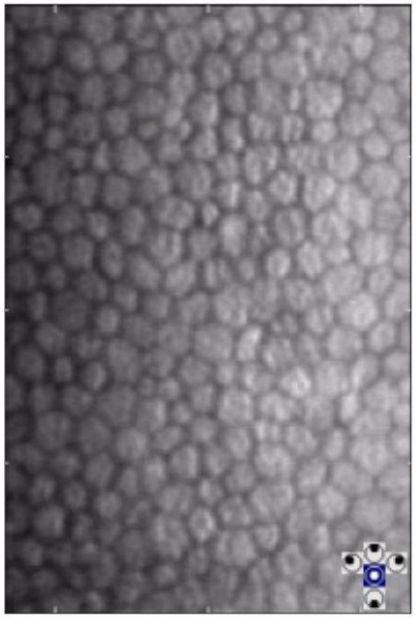
- **Endothelial failure –bullous keratopathy**
- Loss of endothelial cells >>enlargement in cells>> fall in cells density >> loss of barrier and pumping>> stromal oedema .
- **Causes of endothelial cell damage:**

1-uveitis.

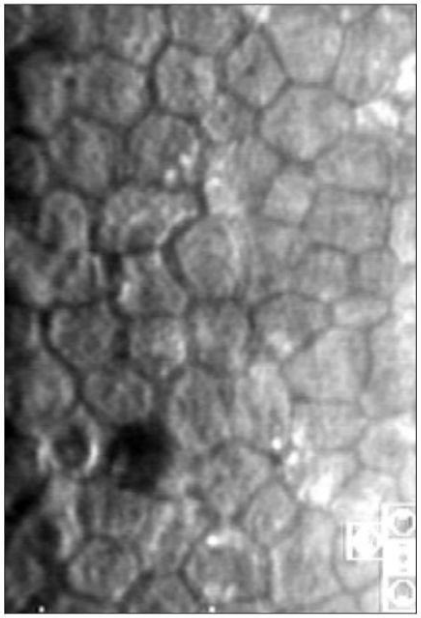
2-cataract surgery.

3-corneal graft failure.

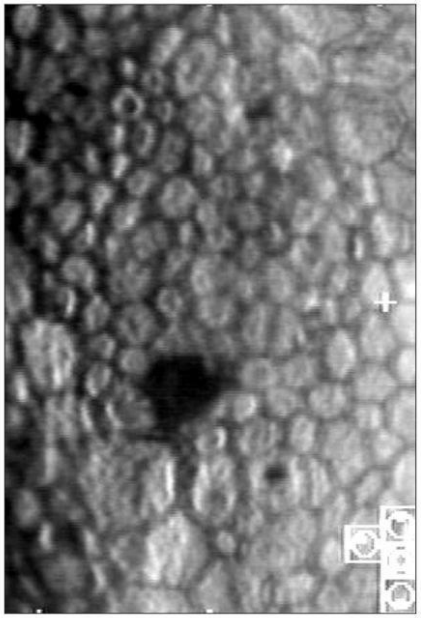
Cornea Endothelium



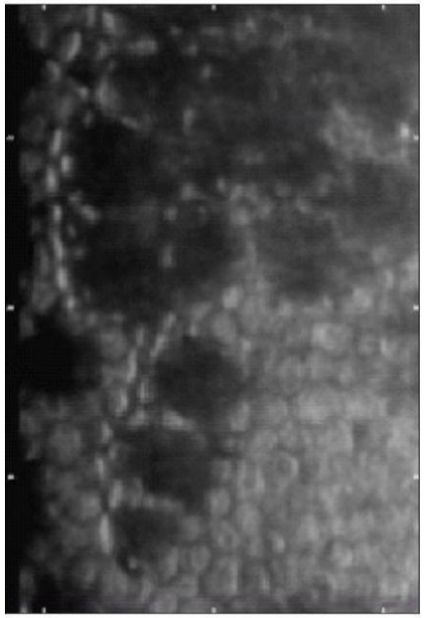
Normal Endothelium
High Cell Density



Very Low Density
High Surgical Risk

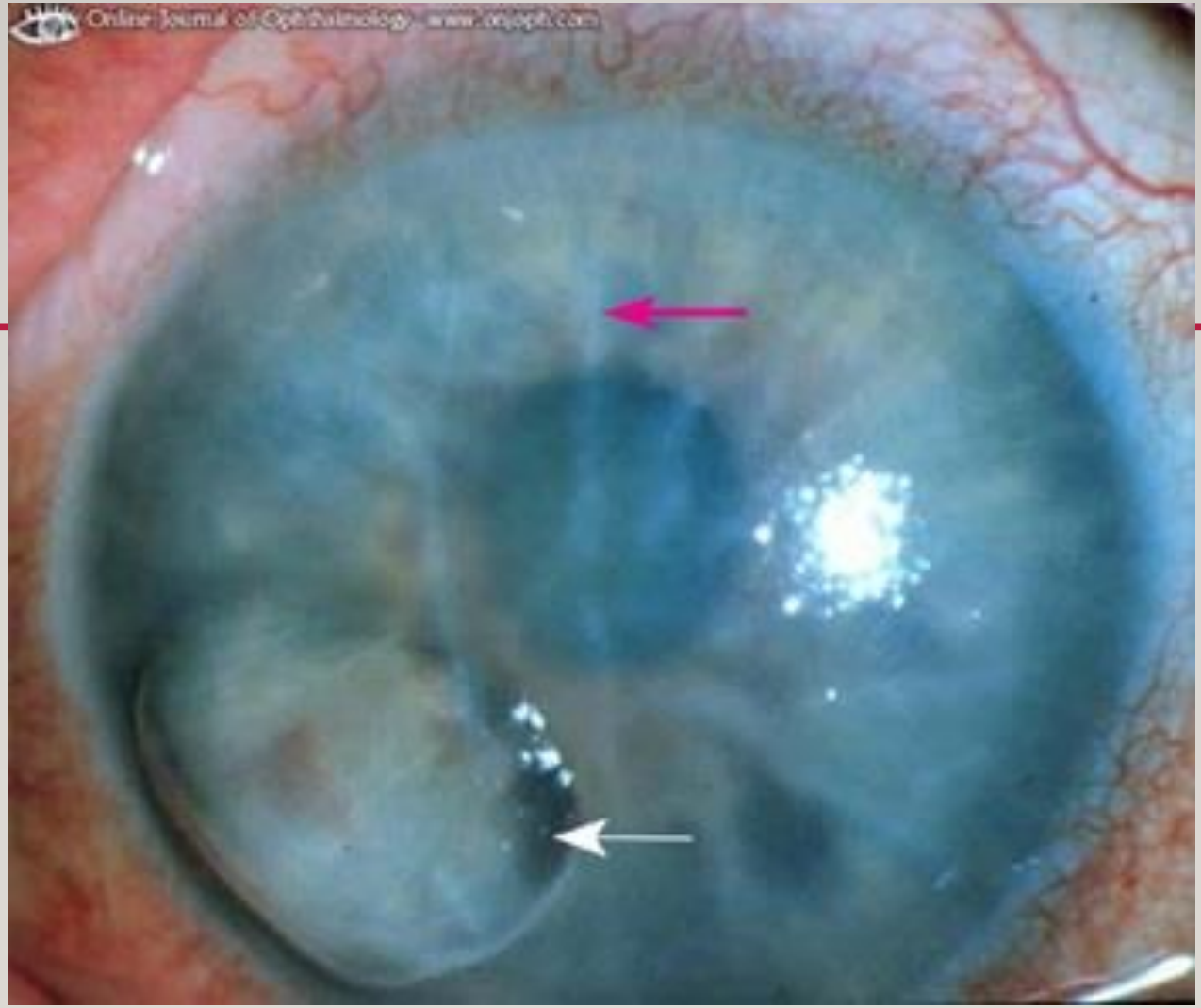


Polymegethism
EW Contact Lenses



Stage 3 Guttata
Normal Cell Count

Konan CellChek™ Specular Microscope Imaging



- Corneal bullae

- Corneal thickening and corneal guttae which is collections of abnormal basal laminar material synthesized by sick endothelial cell.

- Advance stages—> oedema spreads to the corneal epithelium and may result in epithelial bullae —> these bullae may rupture and result in painful erosions.

- **Treatment:**

1-corneal graft.

BAND SHAPED KERATOPATHY

- Subepithelial deposition of calcium phosphate in exposed part of the cornea —> co2 loss and consequent raised ph which favour its deposition.

- **Associated with:** chronic uveitis, glaucoma, and systemic hypercalcaemia (hyperparathyrodism or renal failure).

- **Symptoms:**

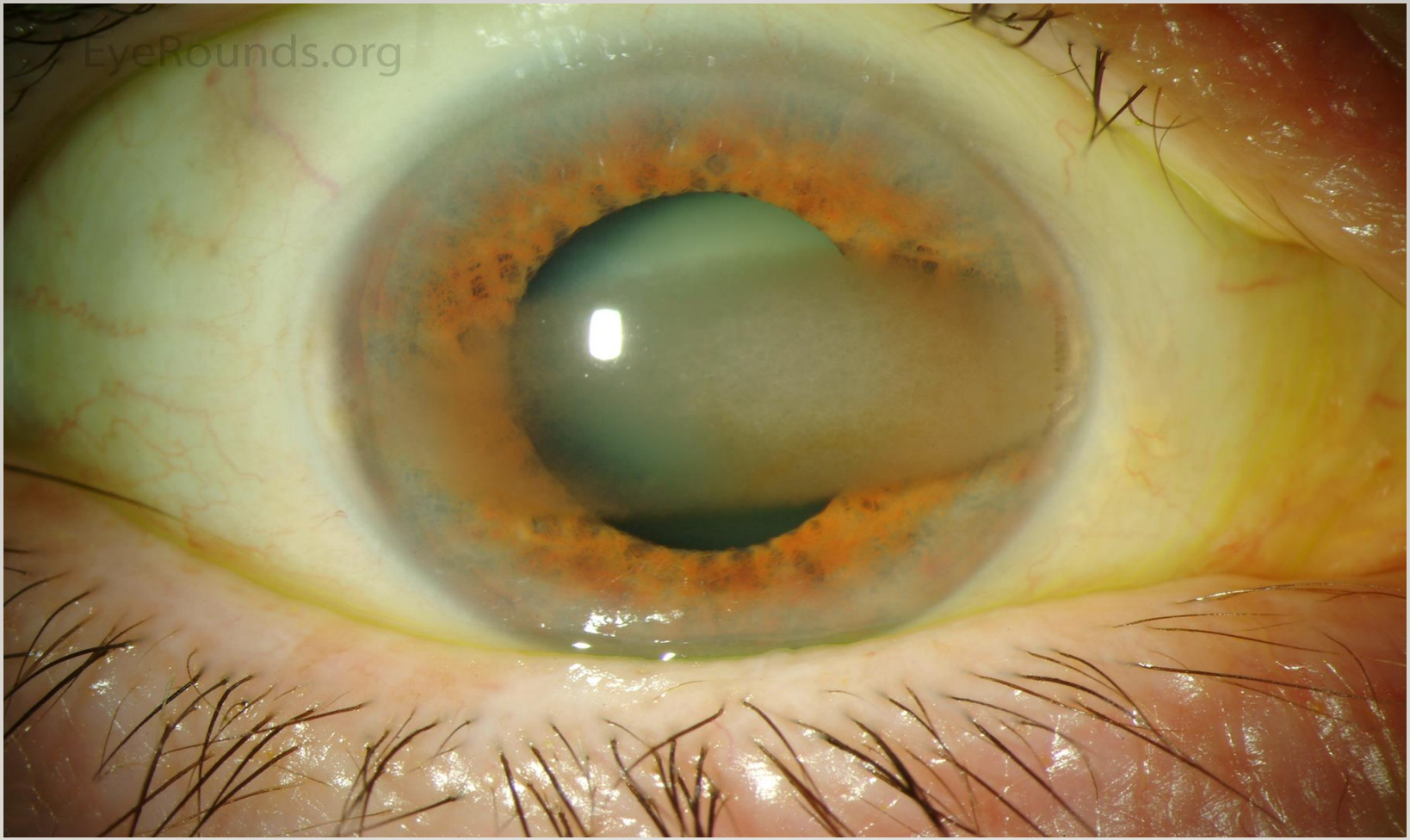
1-visual loss.

2-discomfort—>epithelial erosions.

- **Treatment:**

1-symptomatic—> scraping off surgery with using off chelating agent such as sodium edetate(EDTA-Na).

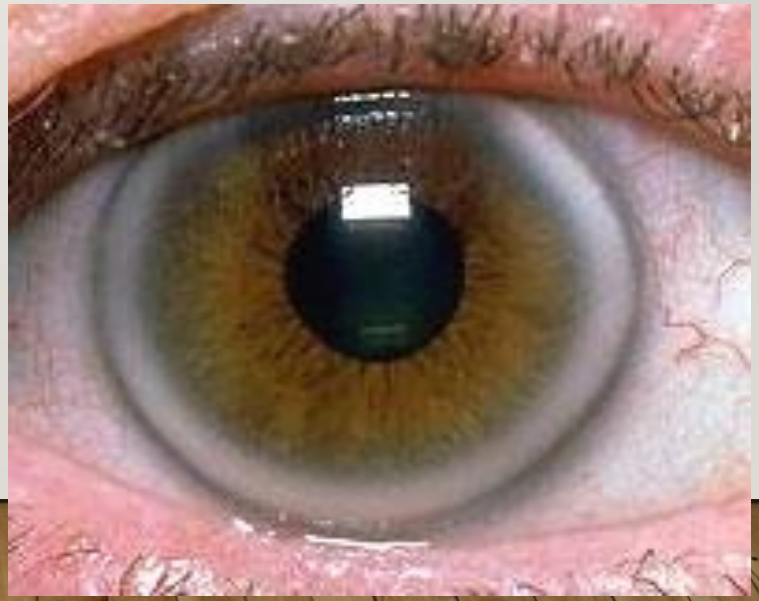
2-excimer laser.

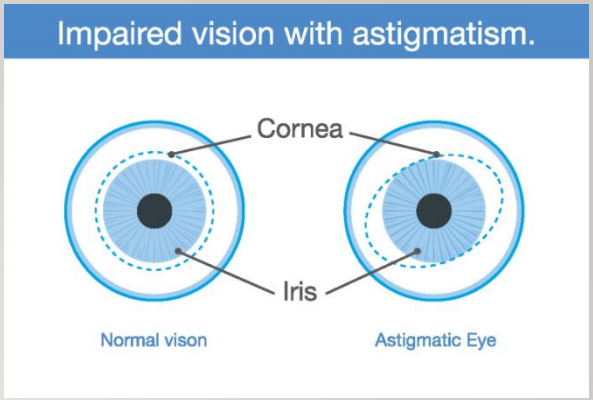


- Band-shaped keratopathy

LIPID ARCUS

- Asymptomatic.
- Peripheral white ring lipid deposit.
- Often Elderly people (arcus senilis) , if young >>hyperlipoproteinaemia.
- No treatment required.





Corneal grafting

*Full thickness keratoplasty.

(for corneal clarity or repair a perforation)

90% success without HLA cross matching with topical corticosteroids (unlike solid organs transplant)

Complications: astigmatism(when cornea is irregularly shaped)

*Descement's stripping endothelial keratoplasty.

No sutures required. Visual recovery faster

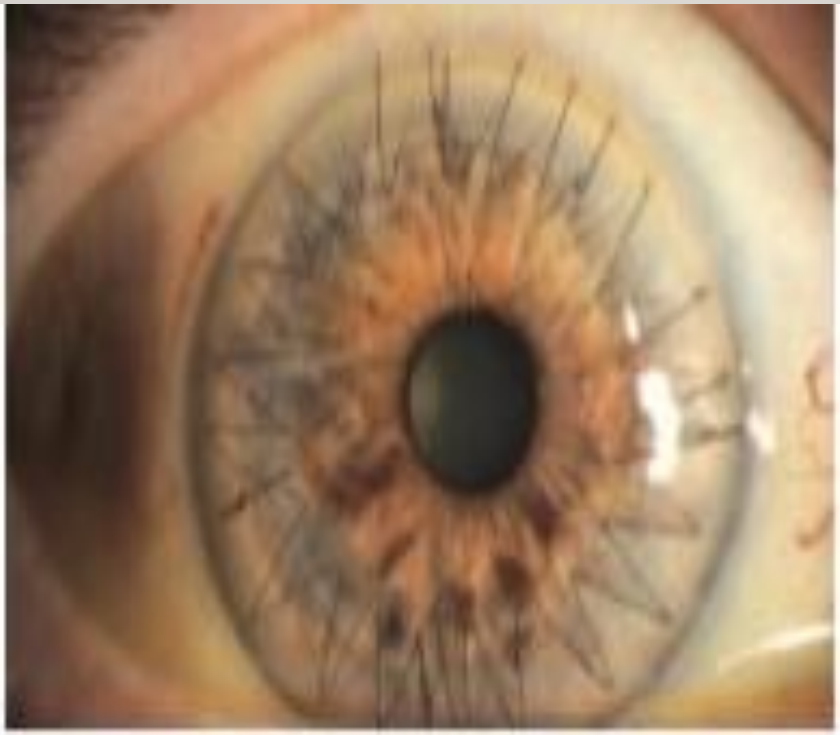


Figure 7.12 A corneal graft. Note the interrupted and the continuous sutures at the interface between graft and host.

Full thickness corneal graft.

Graft rejection

Symptoms:

Had a corneal graft and complains of redness, pain or visual loss .

Signs:

Graft oedema, iritis and a line of activated T- c ells attacking the graft endothelium.

Treatment:

Intensive topical steroid application in the early stages can restore graft clarity.

sclera

Anatomy

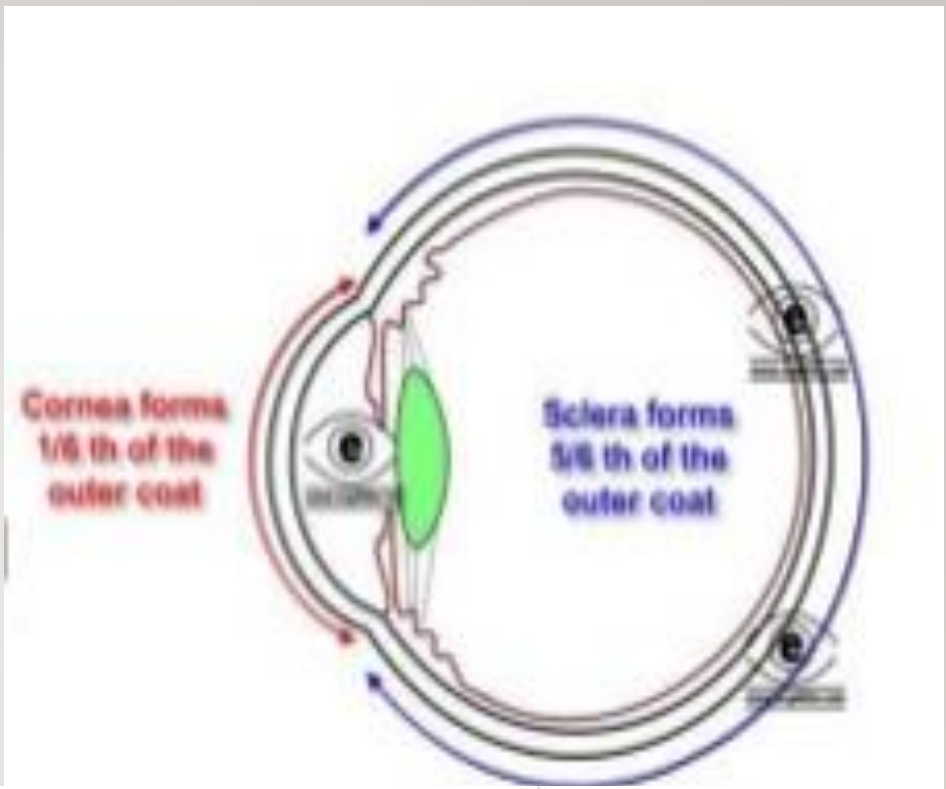
Sclera: is the posterior 5/6th opaque part of the external fibrous covering of the eyeball

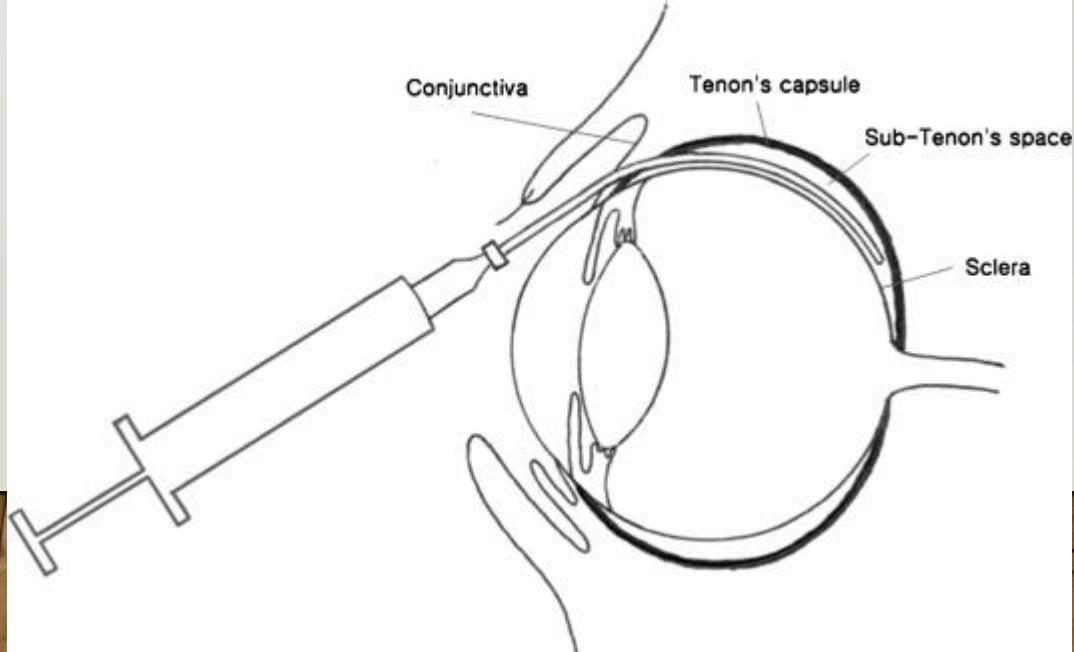
Outer surface > covered by Tenon's capsule.

Anterior part > covered by bulbar conjunctiva.

Its inner surface lies in contact with choroid with a potential suprachoroidal space in between.

In its anterior most part near the limbus there is a furrow which encloses the canal of Schlemm.





Layers of sclera

thin, dense vascularised
layer of connective tissue→ fibroblasts, macrophages and lymphocytes

avascular structure→ dense bundles of collagen fibres.

innermost blends with suprachoroidal and supraciliary
laminae of the uveal tract.
brownish in colour
→presence of pigmented cells.

Inflammations of sclera

- Episcleritis (superficial)
- Scleritis(deep)

EPISCLERITIS

- Inflammation at the surface of the sclera.
- Not associated with systemic diseases.
- **Symptoms:** patches of redness and mild or no discomfort.

- **Treatment:**

1-self limiting.

2-symptom are tiresome—> topical anti inflammatory treatment.

3-sever —> NSAIDs

- Episcleritis

Scleritis

¶ **More severe** condition than episcleritis.

¶Female more, elderly

¶Collagen vascular diseases 50% , most commonly rheumatoid arthritis.

It is a cause of deep ocular pain.

Both inflammatory areas and ischaemic areas of the sclera may occur. Usually anteriorly.

Characteristically the affected sclera is swollen.

The following may complicate the condition:

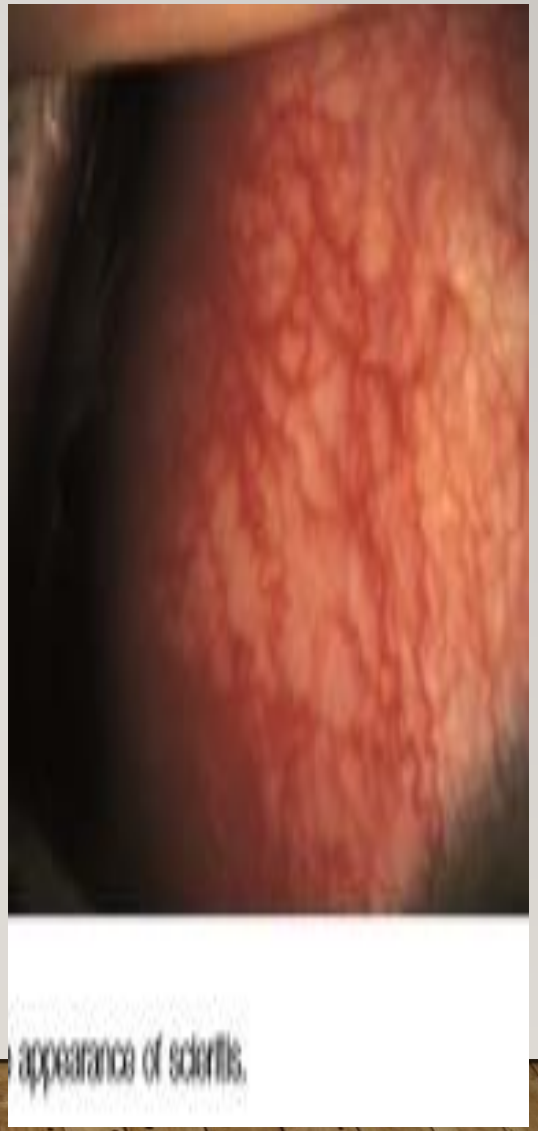
•Scleral thinning (scleromalacia), sometimes with perforation.

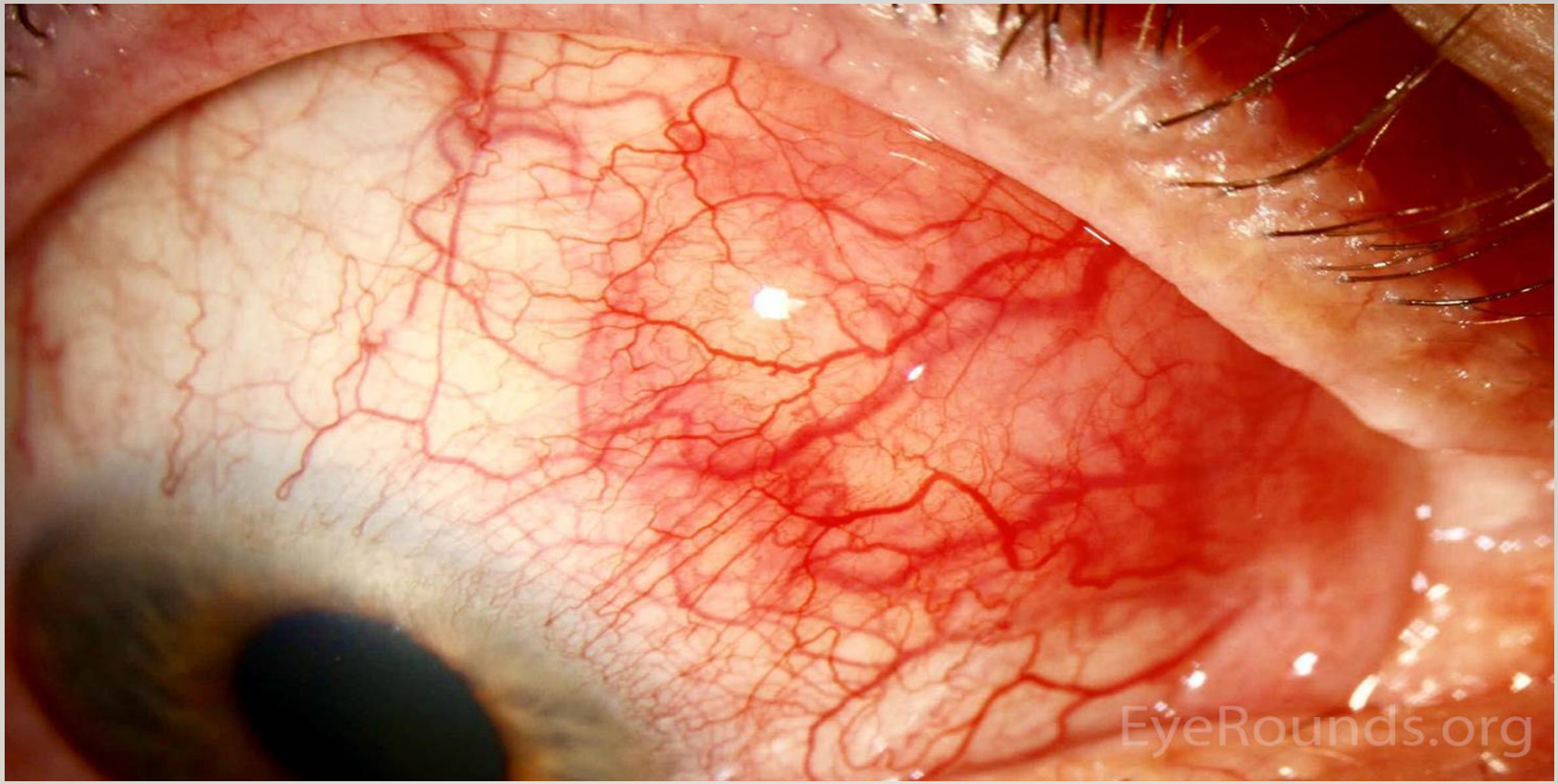
• keratitis.

•Uveitis.

•cataract formation.

•Glaucoma.





NODULAR ANTERIOR SCLERITITS

- **Treatment:**

1- anti-inflammation treatment.

2-immunosuppressants.

3-steroids .

4-cytotoxic therapy.

5-sclera grafting—> prevention of perforation of globe.

Episcleritis	Scleritis
• Discomfort sensation • Usually in young • Self limiting • Not associated with systemic diseases	• Painful • Usually in elderly • Serious case • Associated with systemic diseases mostly RA.