

Ocular Examination

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Aim and Objectives

Understand the fundamental principles and perform a systematic eye examination.

On completion of this session you will be able to:

- Recognise normal and abnormal anatomy
- Systematically examine an eye

Equipment required to examine an eye

- Fine beamed torch (with optional blue filter for examination using Fluorescein)
- Cotton buds
- Local anaesthetic eye drops, eg Amethocaine 0.5%, Oxybuprocaine 0.4%
- Fluorescein strips
- Magnification – slit lamp, indirect ophthalmoscope, loupes or Woods lamp

Patient Preparation

- Head well supported (eg. chair back against the wall prevents head moving back and away)
- If using a slitlamp make sure patient is correctly positioned.
- Appropriate lighting for patient comfort
 - e.g. dim lights if photophobic

Head posture

- **Abnormal head posture(AHP):**
 - Motor adaptation to strabismus
 - Occurs primarily in children with congenitally abnormal eye movements who use AHP to maintain binocular single vision(BSV) and diplopia
 - Loss of AHP indicates loss of BSV and need surgical intervention
 - Head is turned into the direction of action of weak muscles so that eyes move opposite direction(head will turn where eyes cannot)

Components of AHP

- Face turn:
 - Adopted to control purely horizontal deviation
 - In left lateral rectus palsy, face will be turned to left which deviates the eye to right
 - In Paresis of right superior oblique face is turned to left to avoid side where vertical deviation is greatest

Right lateral rectus palsy(right face turn)



Components of AHP

- Head tilt:
 - Adopted to compensate for torsional and/or vertical diplopia
 - In right superior oblique weakness, right eye is relatively deviated and the head is tilted to left: this reduces vertical separation of diplopic images and permits fusion

Left superior oblique palsy(right head tilt, right face turn, chin depressed)



Components of AHP

- Chin elevation or depression:
 - Adopted to compensate for elevator or depressor weakness or to minimise the horizontal deviation when an A or V pattern is present

Superior rectus palsy(chin lift)



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Ocular margins:

- Involved in fractures and bony tumors
- Look for
 - Tenderness
 - Irregularity
 - Crepitus

Eyebrows

- Level
- Form: synophrys is a condition where eye brows are joined. Associated with hypertrichosis
- Color: canities is physiological greying of hair whereas poliosis is pathological greying
- Loss of lateral 1/3 rd of brow hair is know as madarosis. Seen in leprosy, hypothyroidism, chemotherapy

Eyelids and Eyelashes

- Body of the lid
 - Thickness
 - Uniformity
 - Lesions
 - Location in relation to cornea and pupil: upper lid margin rests 2 mm below the limbus and lower lid rests at the limbus
 - Width of palpebral fissure
 - Margins and eye lashes: Eye lashes are arranged in 2-3 rows; in upper lid they are directed forward, upward and backwards; and in lower lids, forward, downward and backwards
- The edge of the lids are in apposition to eyeballs

Eyelids and Eyelashes

- Edema of lids:
 - Inflammatory: dermatitis, stye, insect bite, inflammations of conjunctiva and lacrimal sac, chronic thickening in erysipelas
 - Passive: renal or cardiac failure, angioneurotic edema
- Inflammations of lids: blepharitis (anterior and posterior), allergic dermatitis

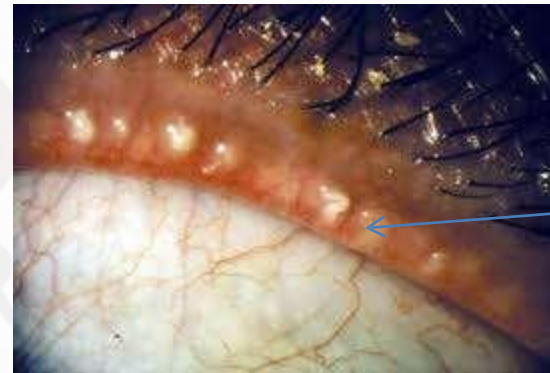
Lid edema



Blepharitis



Scaly flakes over lashes



Meibomian pouting

Eyelids and Eyelashes

- Inflammations of glands of lids: stye/external hordeolum, hordeolum internum, chalazion
- Anomalies of position of lashes and lids:
 - Blepharospasm
 - Trichiasis (misdirection of cilia backwards)
 - Entropion (rolling inwards of lid margins)
 - Ectropion (eversion of lid margins and lashes away from globe),
 - Symblepharon (adhesion of lids with the globe)
 - Ankyloblepharon (adhesion of margins of lids)
 - Blepharophimosis (smaller palpebral fissure)
 - Lagophthalmos (incomplete closure of the palpebral aperture when an attempt is made to shut eyes)
 - Ptosis (drooping of eyelids)

Stye/ ext hordeolum



Chalazion



Internal hordeolum



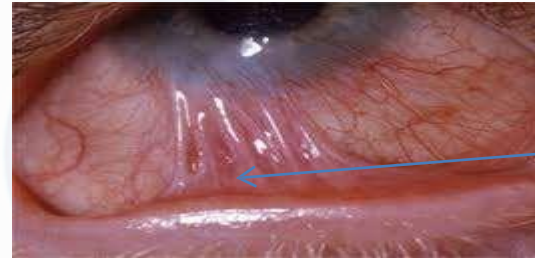
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Trichiasis



Misdirection of lashes

Symblepharon



Fibrosis b/w lid and globe

Ectropion



Eversion of lid and lashes

Ankyloblepharon



Adhesion of margins of lids

Entropion



Inward rolling of lids

Blepharophimosis



Smaller palpebral aperture (normal: vertical 10mm and horizontal 30mm)

Ptosis



Drooping of lid

Lagophthalmos



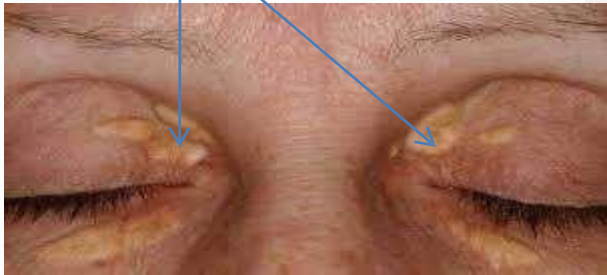
Incomplete lid closure on attempted shutting of eye

Note upward rolling of eyeball suggesting good Bell's Phenomenon

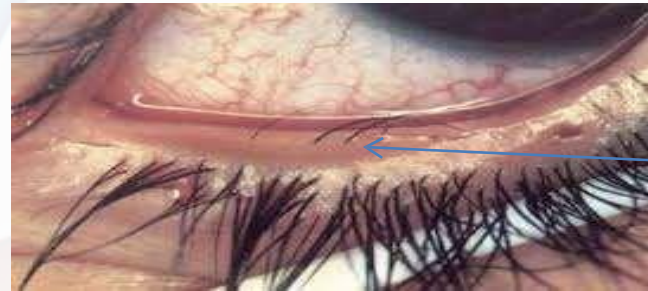
Eyelids and Eyelashes

- Tumors of lids:
 - Benign growths- xanthalesma or xanthoma(raised yellow plaques), nevus/moles, hemangiomas, neurofibromatosis
 - Malignant growths- basal cell carcinoma, squamous cell carcinoma, kaposi sarcoma, malignant melanomata
- Injuries of lids: contusions, wounds, burns
- Congenital anomalies of lids:
 - Distichiasis(extra posterior row of cilia),
 - Coloboma of lids(notch in the edge of lids),
 - Cryophthalmos(skin passing continuous from brow over the eye to cheek),
 - Microblepharon(abnormally small lids),
 - Epicanthus(semilunar fold of skin covering the inner canthus)
- Age related changes: wrinkles, large skin folds, fullness, dermatochalasis (loose folds of skin and muscles due to weak connective and elastic tissue)

Xanthelasma



Distichiasis



Extra
posterior
row of
lashes

Basal cell ca



Coloboma



Defect
in
upper
lid
margin

Microblepharon

Abnormally
small lids



Figure 1A. Patient at 1 year. The lateral upper and lower eyelids are pulled away from the globe.

Dermatochalasis

Age related
loose fold of
upper lid skin



Epicanthus

Semilunar
fold of
skin over
medial
canthus



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Conjunctiva

- To examine conjunctival sac it is necessary to expose palpebral conjunctiva and fornices
- Lower fornix exposed by drawing lower lid down while patient looks up
- Upper palpebral conjunctiva is exposed by everting the upper lid

Conjunctiva

- Eversion of upper lid- A probe or pencil is placed along skin of upper lid at upper border of tarsus while patient is looking at his feet. Eye lashes are grasped b/w index finger and thumb, drawing lid away from the globe. Lid is rotated in vertical direction round the probe, and the probe is withdrawn
- Double eversion- to view upper fornix. Ideally done under LA. Lid retractor is placed anterior to already everted lid, above the superior border of tarsus. Lashes are used to evert lid onto the retractor, which is then gently pulled away from the globe

Eversion of lids



Twist cotton-tipped swab upward



Look downward

ADAM

Double eversion



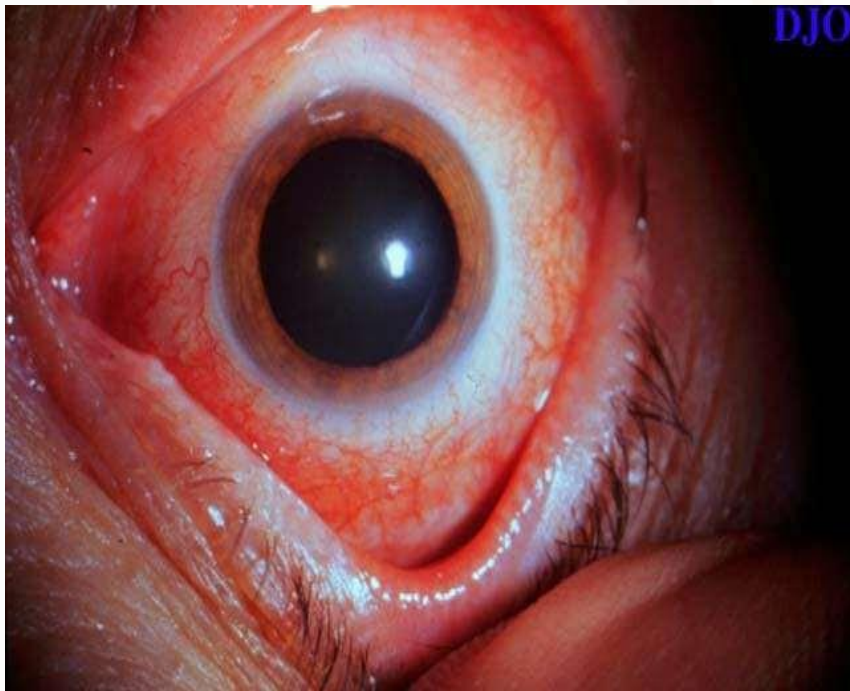
Desmarres retractor over anterior lid surface

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Conjunctiva

- Examine for **Congestion**
- Redness, leaving a relatively white zone around cornea with mucus/ mucopurulent discharge is indicative of conjunctivitis
- If associated with irritation, photophobia, lacrimation and blepharospasm- look for FB, misplaced lashes, corneal abrasion, erosions, ulcers or keratitis. Vessels in circumcorneal zone are bright red with dilated corneal loops of limbal plexus
- Ciliary congestion- In inflammations of iris and sclera, pink perilimbal injection is supplemented by a dusky, lilac tint due to congestion of deeper, anterior ciliary vessels
- Ciliary congestion vs conjunctival congestion- congestion decreases after instillation of 10% phenylephrine; blanches on digital pressure through lids, vessels fill from fornix inwards on releasing pressure in conjunctival congestion

Conjunctival congestion



Ciliary congestion

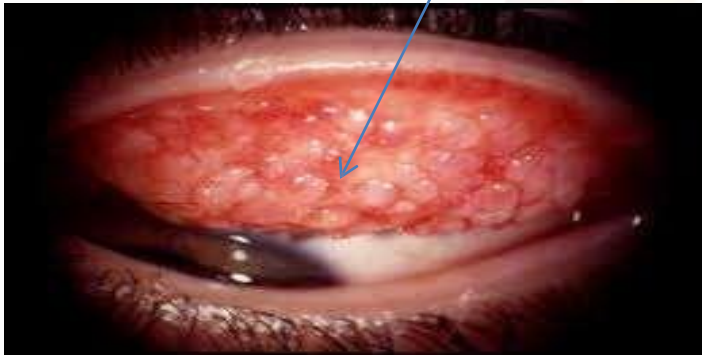


Conjunctiva

- Presence of foreign bodies
- Papillae/follicles-
 - papillae: cobblestone arrangement of flattened nodules with central vascular core. Seen in vernal and atopic keratoconjunctivitis, contact lens or ocular prosthesis
 - Follicles: small dome shaped nodules without a prominent central vessel. Seen in viral and atypical bacterial conjunctivitis, toxin and topical medications like brimonidine
- Cysts
- Concretions- small, hard, yellowish white calcified matter, buried beneath palpebral conjunctiva
- Tumors
- General status of ocular surface and tear film

Papillae

Cobblesone appearance



Concretions



Follicles

cysts

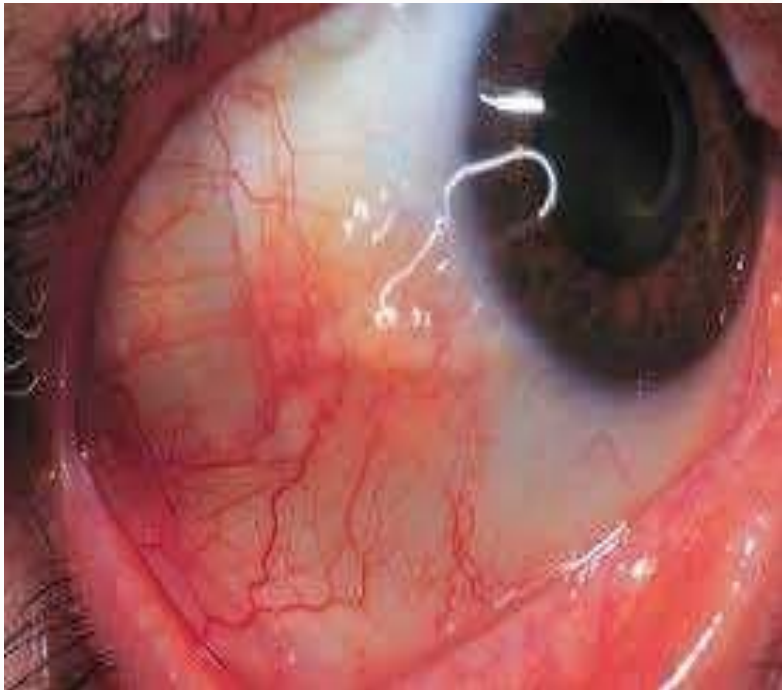
Dome shaped nodules



Sclera

- Episcleritis- raised, congested, painless nodules around cornea
- Deep scleritis- deep red, dusky congestion associated with peripheral keratitis and uveitis
- Definite blue coloration of circumcorneal sclera is pathological except in very young children. Seen in staphylomata, scleral ectasia with herniation of uveal tissue owing to weakness of sclera following injury or scleritis, increased IOP
- Pigmentation around the points where anterior ciliary vessels perforate sclera indicates melanosis. Slight duskiess in people with dark complexion is common

Episcleritis



Scleritis



Cornea

- Corneal surface-
 - Placido keratoscopic disc used to assess corneal surface
 - Has alternating black and white painted circles. Observer looks through a hole in the center at corneal image reflected by a light behind patient
 - Loss in sharpness of the outline of the image denotes a loss of polish of corneal surface
 - Irregularities in rings reflect irregularities of corneal surface
 - Similarly , posterior surface of cornea, the anterior chamber and lens can be imaged using slit scanning technology like Orbscan

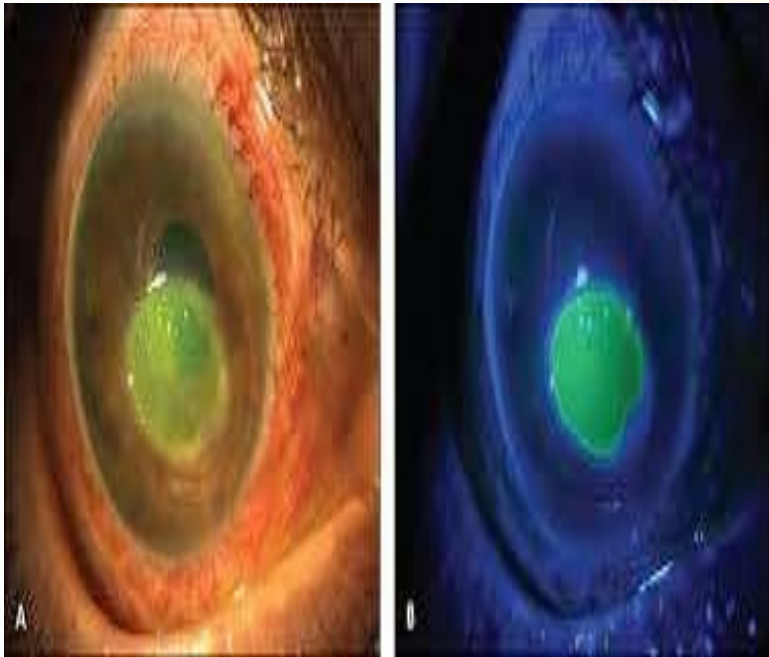
Placido keratoscopic disc



Cornea

- Corneal epithelium-corneal staining with vital dyes. 3 dyes are used
 - Fluorescein is useful in delineating denuded epithelium(abrasions, multiple erosions, ulcers) , stain brilliant yellow green when seen with cobalt blue light
 - Rose bengal stains diseased and devitalised cells red (superficial punctate keratitis)
 - Alcian blue dye stains mucus selectively delineates excess mucus produced when there is deficiency in tear formation

Fluorescein dye



Rose bengal

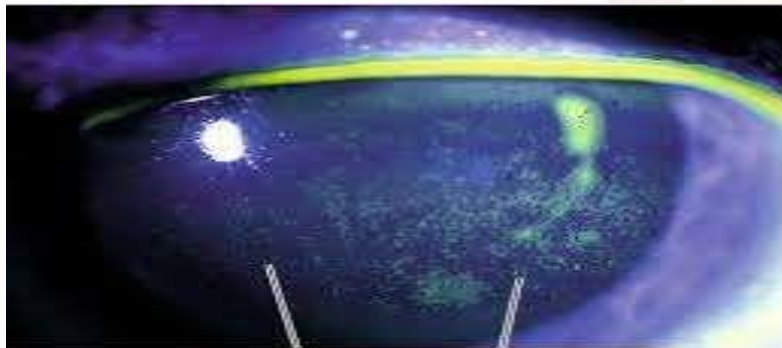


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Cornea

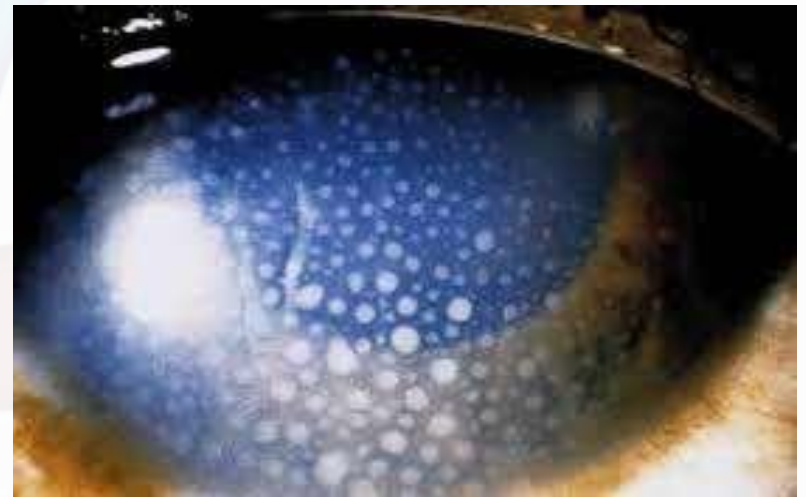
- Corneal opacities- best studied with slit lamp
 - Epithelial or subepithelial Superficial punctate keratitis
 - keratic precipitates: small accumulations of inflammatory cells derived from uvea- appear white, round and dome shaped when fresh
 - Mutton fat keratic precipitates: large, waxy KPs are seen in granulomatous uveitis
 - Fine KPs are present in Fuchs cyclitis and herpes zoster uveitis

Superficial punctate keratitis



Superficial punctate keratitis

Mutton fat keratic precipitates



Keratic precipitates



Cornea

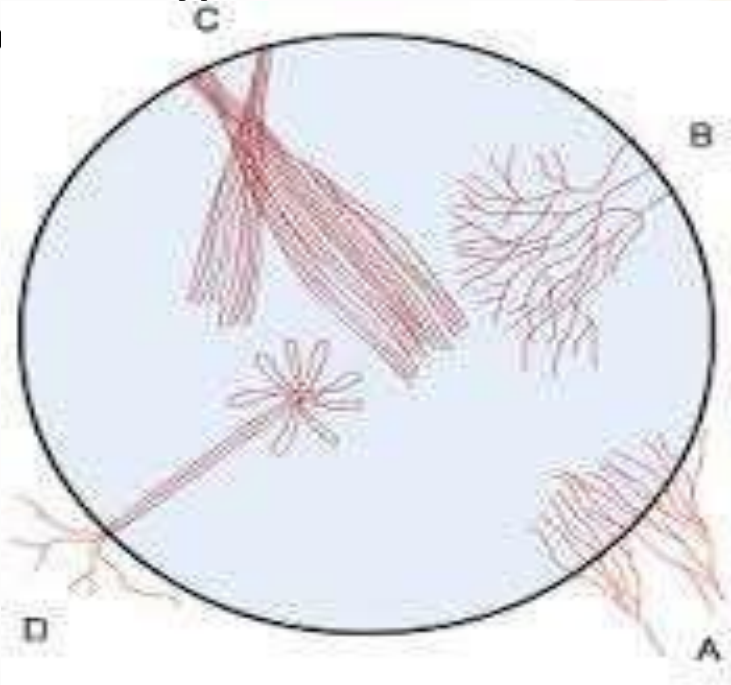
- Corneal endothelium-
 - Specular examination technique on slit lamp
 - Objective examination by specular microscopy: average cell count is 2800/mm². identifies pleomorphism(decrease in cell density) and polymegathism(variation in cell size)
 - Confocal microscope: shows endothelial and epithelial cells, keratocytes
 - Endothelial cell count is done before corneal grafting
 - Abnormal cell count if less than 1500/mm²

Cornea

- Corneal vascularisation
 - Superficial vessels: can be traced over the limbus into conjunctiva. They are bright red and well defined. Branch dichotomously in an arborescent fashion. They may raise epithelium over them and make corneal surface uneven
 - Deep vascularisation: end abruptly at limbus. They are ill defined, greyish red or diffuse red blush. They run more or less parallel in radial direction. Branching is at acute angle and their course is determined by the lamellar structure of substantia propria. Though hazy, surface is smooth

Superficial corneal vascularisation

- A. Superfial
- B. Terminal loop
- C. Brush type
- D



Deep corneal vascularisation



Cornea

- Corneal sensitivity-
 - Wisp of a cotton or aesthesiometer(objective)
 - Brisk reflex closure of lids
 - Diminished after any gross disorder
 - Herpes keratitis: minimal corneal changes are associated with gross diminution of sensations

Corneal sensitivity test with wisp of cotton




Cornea

- Corneal curvature: measured by keratometer
- Corneal thickness: measured by optical pachymetry on slit lamp or ultrasonic pachymetry

Anterior chamber

- Anterior chamber depth:
 - Shallow in very young and in old age
 - Normal depth is about 2.5 mm
 - Measured as distance b/w posterior surface of cornea and anterior surface of lens
 - Clinically evaluated by focussing beam of light on temporal limbus, parallel to iris surface. In normal or deep anterior chamber the beam will pass through directly, illuminating opposite limbus



Anterior chamber depth

Normal – note light
illuminating both sides of iris



Shallow – nasal side of iris is
in darkness



U N I V E R S I T Y

Anterior chamber

- Anterior chamber depth....
 - Van herrick method: an optical section of peripheral cornea and anterior chamber is made on slit lamp with illumination and viewing arms 60 degrees to each other, and viewing arm perpendicular to cornea, with magnification of 15. If anterior chamber depth is equal to or less than $1/4^{\text{th}}$ of thickness of cornea, angle closure is possible. If anterior chamber is more than half the corneal thickness, closure is unlikely
 - Objective measurement is by pachymetry on slit lamp or Orbscan II usg

TABLE 1

Original van Herick grading scale

Van Herick's grading	Ratio of gap to limbal corneal section
Grade 1	<1:4
Grade 2	1:4
Grade 3	1:2
Grade 4	1:1 (or >1:1)

Anterior chamber

- Anterior chamber depth..
 - Shallow in angle closure glaucoma
 - Deeper in periphery than in the center in iridocyclitis
 - Deep in center and shallow in periphery with funnel shaped ,bowed forward iris as in iris bombe
 - Subluxation of lens causes chamber to be deeper on one side
 - Deepening seen adjacent to angle recession following trauma

Anterior chamber

- Aqueous cells- seen in active uveitis
 - Graded by counting number seen in a 2 by 1 mm slit
 - Trace if 1-5 cells present
 - 1+ if 5-10 cells
 - 2+ if 10-20 cells
 - 3+ if 20-50 cells
 - 4+ if >50 cells

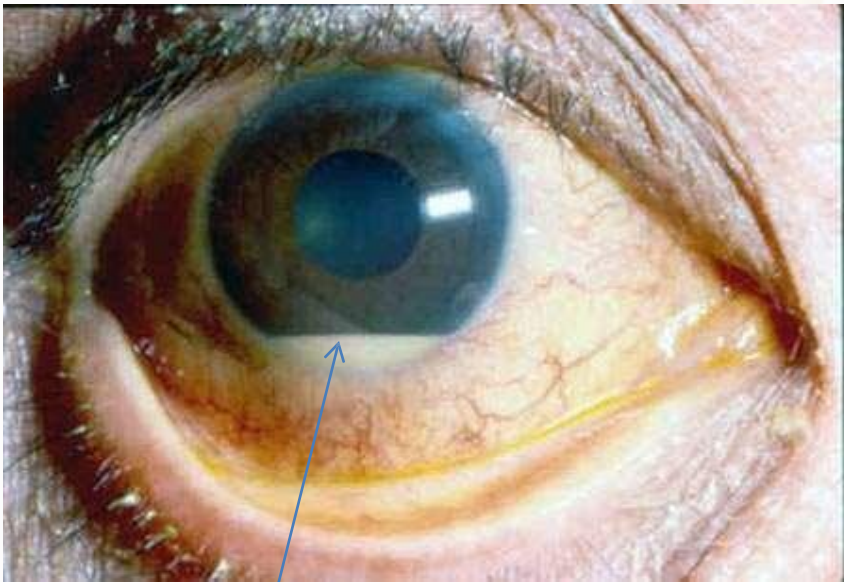
Anterior chamber

- Aqueous flare:
 - Protein exudation from the iris or ciliary vessels produces opalescence of the aqueous
 - Graded as 1+ if barely present
 - 2+ if moderate
 - 3+ if obscures visualisation of the iris pattern
 - 4+ if fibrin is present in anterior chamber

Anterior chamber

- Hypopyon-
 - In infected wounds and ulcers of cornea, iridocyclitis, there is collection of lymphocytes in anterior chamber forming a sediment at the bottom
- Hyphema
 - Collection of blood after contusions or spontaneously
- Microfilariae seen in anterior chamber in onchocercias

Hypopyon



Collection of
lymphocytes in anterior
chamber

Hyphema



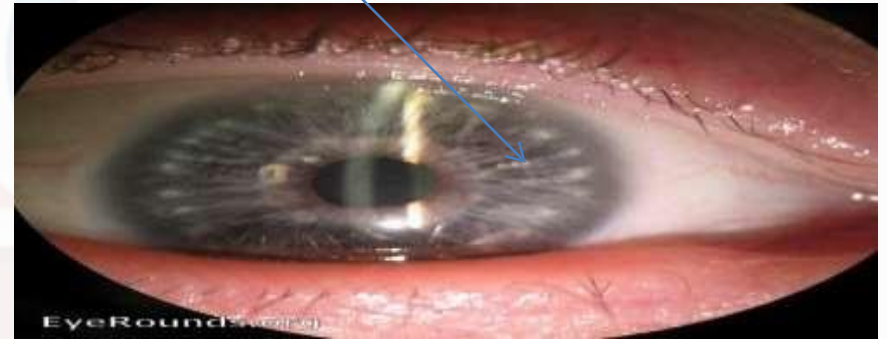
Iris

- Color and clarity of iris pattern:
 - Heterochromia iridium or iridis- two irides or parts of same iris may be different color
 - A dull, ill defined pattern or muddiness of iris suggests atrophy from iridocyclitis
 - Sectoral atrophy suggests an acute angle glaucoma or herpes zoster
 - Freckles: flat darkly pigmented spots
 - Brushfield spots in downs syndrome
 - Pedunculated nodules(Lisch) in neurofibromatosis
 - In acute angle closure glaucoma, pupil is large, immobile, oval with long vertical axis

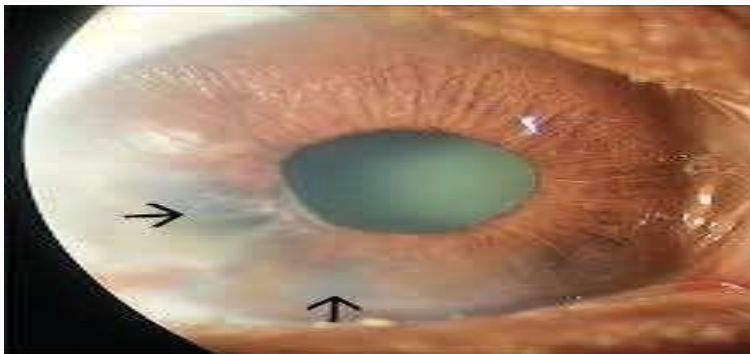
Heterochromia iridis



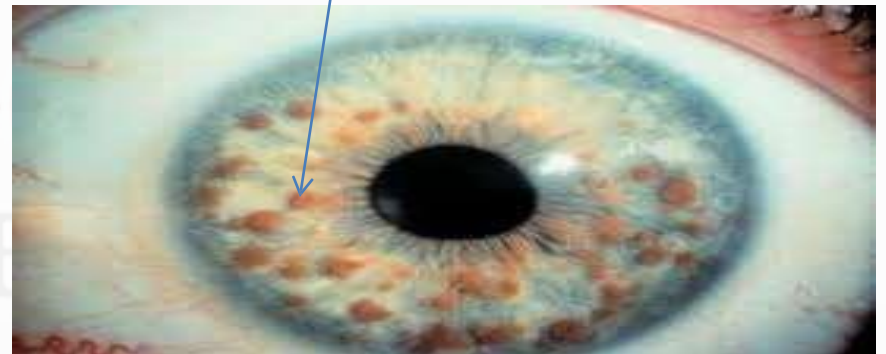
Brushfield spots



Sectoral iris atrophy



Leish nodules



Iris

- Color and clarity of iris pattern:...
 - Flat nodules at pupillary margin(koeppe nodules) or at the peripheral base of iris(busacca nodules)
 - Muddy iris with a small, irregular pupil, sluggishly reacting to light indicates uveitis

Koeppes nodules



Iris in uveitis



Busaca nodules



Iris

- Position of iris:
 - Examine the plane
 - Adhesions or synechiae, anterior to cornea and posterior to lens capsule
 - Tremulousness of iris or iridodonesis is seen when eyes are moved rapidly, seen in absence, shrinkage, or subluxation of the lens. Best appreciated in a dark room with oblique illumination

Pupils

- Examination of pupils should be done before any mydriatic is put
- Illumination in examination room should be low
- Patient should look into the distance- to prevent accommodative constriction of pupil
- Light used should be focussed and bright
- Size, shape, contour of each pupil should be noted
- Pupillary reflexes

Pupils

- Pupillary reflexes:
 - Direct reaction to light: cover both eyes. While patient looks straight ahead remove one hand watch the pupil. Watch if its constriction is well maintained. Replace this hand removing the other and observe other pupil
 - Consensual reaction to light: remove one hand so that pupil is exposed to light and watch the other pupil as the hand is removed from other eye

Pupils

- In absence of natural or diffuse illumination or when reaction is feeble and pupils are small: examination is carried out in a dark room. Light is concentrated upon one pupil by focal illumination so that light shines upon macula to elicit light reflex. Focus of light can be moved on and off the pupil and movements noted constantly.
- Still finer observations can be done by slitlamp by moving beam of light abruptly into pupillary aperture
- This method is utilised in eliciting wernickes hemianopic pupillary reaction where brisk reaction is there when one half of retina is illuminated but sluggish on illuminating other half

Pupils

- Swinging flashlight test
 - Bright light is shone on one pupil and constriction noted. After 2-3 seconds light is rapidly transferred to other pupil. Response is noted with swinging to and fro repeated several times
 - Direct and consensual response are of same magnitude
 - In lesion of optic nerve light transferred to diseased eye leads to dilatation of both eyes and on swinging back to normal side both pupils will constrict: Marcus gunn pupil or relative afferent pupillary defect(RAPD)
 - Convergence and accommodation reflex: patient looks at far end and a target is suddenly held up vertically at 15 cm from patients nose. Movement of pupils studied while he converges

Swinging flashlight test



Pupils

- Abnormal pupil size:
 - Dilatation of pupils with retained reflexes is found in myopes, impaired tone or nervous excitement
 - Small pupils are seen in babies and old people
 - Very large, non reactive pupils suggest that a mydriatic was used: dimness of vision for near work noted by patient
 - Large and immobile pupils noted in bilateral lesions affecting the retina and optic nerve atrophy.
 - Large , immobile pupils also result from third nerve palsy. Accomodation is also affected if third nerve fibres to ciliary muscles is affected(third nerve nucleus lesions, meningitis, encephalitis, cerebral syphilis, diphtheria, lead poisoning, trauma affecting third nerve, ciliary ganglion
 - Bilateral blindness distinguished from bilateral efferent pupillary defect by eliciting near reflex. Patient attempts accomodation by proprioception as thumb is held in front of him

Pupils

- Abnormal pupil size...
 - Blindness with retained direct reflex is seen in lesions above the level of lateral geniculate body(postbasal meningitis, hemorrhage, uremia, bilateral occipital lobe infarction)
 - Opacities in media like cataracts and vitreous hemorrhages never lead to absent pupillary reflex
 - Unilateral dilatation results from irritation of sympathetic nerves. Seen in swollen lymph nodes in neck, apical pneumonia, apical pleurisy, cervical rib and thoracic aneurysms, syringomyelia ,poliomyelitis affecting lower cervical and upper thioracic parts of spinal cord. Conditions causing irritative dilatation leads eventually to constriction from sympathetic paralysis
 - Horner syndrome: sympathetic function on one side is lost leading to miosis, enophthalmos(due to loss of muller muscle tone), unilateral absence of sweating(anhydrosis)

Pupils

- Abnormal pupil size:
 - Small immobile pupils seen in use of drugs like miotics locally and morphine systemically, Old iritis with posterior synechiae
 - Small, sluggish pupil with muddiness of iris suggests active iritis
 - Bilateral small pupil may be due to irritation of third nerves due to CNS disease in vicinity, palsy of sympathetic system as in pontine hemorrhage

Pupils

- **Abnormal pupillary reflexes:**
 - Loss of light reflex from lesions of retina and optic nerve
 - Hemianopic reaction due to lesions in tract
 - Third nerve lesion abolishes both light and convergence reflexes
 - Argyll robertson pupil: damage to relay paths in the tectum mostly syphilitic. Pupil do not react to light but convergence is retained(light near dissociation)

Pupils

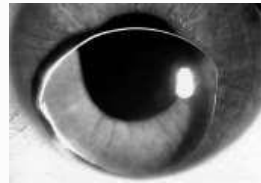
- Abnormal pupillary reflexes:
 - Tonic pupil of adie: seen in young females, often unilateral and associated with absent knee jerk. Pupil is slightly dilated. Light reflex as vermiform, slight constriction. Convergence is sluggish, Latent period is increased. Tonic pupil dilates well with atropine and constricts with 0.1% pilocarpine

Examination of LENS

▶ Can be examined using **oblique illumination, slit lamp biomicroscopy** and **distant direct ophthalmoscopy** with **FULLY DILATED PUPILS**

▶ **POSITION**

- Normal: **patellar fossa** by the zonules
- Dislocation of lens: lens not present in its normal position
 - i. **Anterior** dislocation-present in anterior chamber
 - ii. **Posterior** dislocation-present in vitreous cavity either **floating**(LENSA NUTANS) or **fixed** to the retina(LENSA FIXATE)



- **Subluxation** of lens-lens is **partially displaced** from its position

- Causes-**trauma, marfan's syndrome, homocystinuria**

- **Aphakia**-absence of lens

- It is diagnosed by

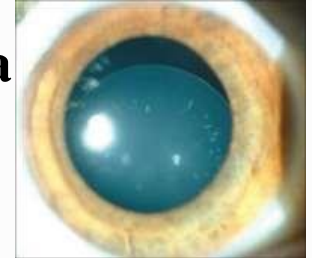
- i. **jet black pupil, deep** anterior chamber, **empty** patellar fossa by slit lamp biomicroscopy

- ii. **hypermetropic eye** on ophthalmoscopy, retinoscopy

- iii. **ABSENCE** of **3rd and 4th** purkinje images

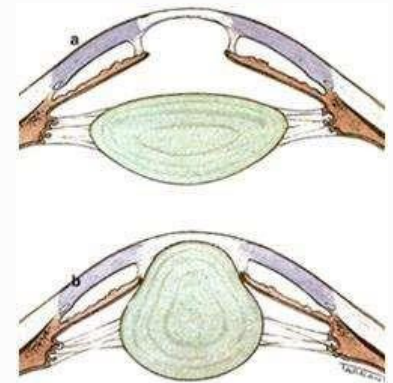
- **Pseudophakia**-

- When **posterior chamber IOL is present**, it is diagnosed by **black** pupil, **deep** anterior chamber, **shining** reflexes (from anterior surface of IOL) and **PRESENCE** of all the **four** Purkinje images



➤ SHAPE

- Normal: **biconvex** structure, on slit lamp-optical section shows embryonic, foetal, infantile and adult nuclei, cortex and capsule
- **Spherophakia**-spherical
- **Lenticonus anterior**-anterior cone shaped bulge (Alport syndrome)
- **Lenticonus posterior**-posterior cone shaped bulge
- **Coloboma** of lens-Notch in the lens



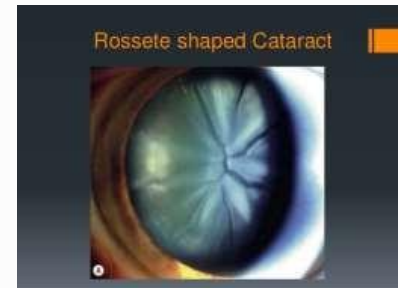
➤ Colour

- Normal: In young age, it is almost **clear** or gives a **faint blue hue**
- Old age-**greyish white** (mistaken to be cataract)
- CORTICAL cataract- **greyish white** (immature), **pearly white** (mature), **milky white** (hypermature)
- NUCLEAR cataract-**amber, brown or black**
- Cataractous lens with siderosis bulbi-**rusty (orange)**



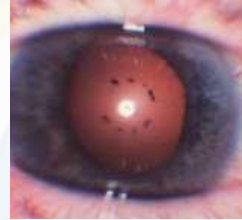
► TRANSPARENCY

- Normal: **transparent**
- Any **opacity** in the lens is called **CATARACT**
- Complicated cataract-breadcrumb appearance (**polychromatic lustre**)
- True diabetic cataract-**snow flake** opacities
- Wilson's disease-**sunflower** cataract
- Concussion injury of lens-**rosette shaped** cataract



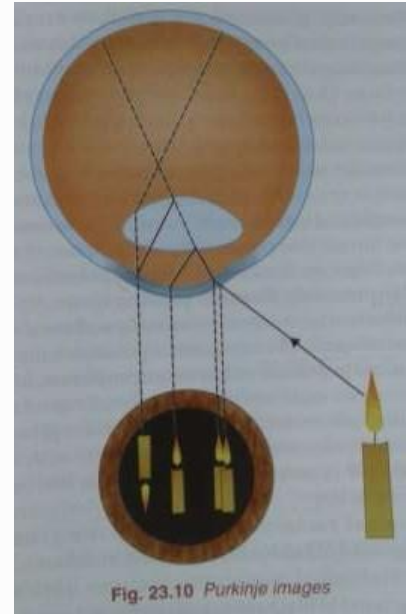
➤ **DEPOSITS ON ANTERIOR SURFACE OF LENS-**

- **Vossius ring**-in blunt trauma
- **Pigmented clumps**-iridocyclitis
- **Dirty white exudates**-uveitis, endophthalmitis
- **Rusty deposits**-siderosis bulbi (deposition of ferrous ions)
- **Greenish deposits**-chalcosis(deposition of copper ions)



► PURKINJE IMAGES TEST

- It WAS used to diagnose mature cataract and aphakia
- Normal-
 - When a strong beam of light is shown to the eye, 4 images (purkinje images) are formed from the four different reflecting surfaces [**ant & post surfaces of cornea and lens**]
- **Mature cataract-4th** image is absent (post surface of lens)
- **Aphakia-3rd** and **4th** are absent (ant & post surface of lens)



References

- *Khurana. (2008). Theory and Practice of Optics and Refraction (2nd ed.)*
- *Clinical Procedures in Optometry*
- *A Hand Book of Basic Optometry & Refraction*
- *<http://medical-dictionary.thefreedictionary.com>*
- *Picture : Me + Internet (Google)*