BIOMICROSCOPY - COMMON FINDINGS OF THE ANTERIOR SEGMENT

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In biomicroscopy, it is beneficial to adhere to a routine method of examination that will allow for effective recognition of normal and abnormal findings. The following describes a systematic approach to Slit Lamp Examination (SLE) that incorporates the techniques into a routinely performed sequence.

The logical approach in biomicroscopy is to examine the tissues from the most anterior structure to the most posterior structure. The routine proceeds therefore from the lids & lashes to conjunctiva to sclera to cornea and anterior chamber angle assessment, to iris to anterior chamber to lens and finally to anterior vitreous.

With the routine use of the biomicroscope, a “new world” of findings, normal & abnormal, opens to the eye care practitioner. One must naturally establish an understanding of common anterior segment presentation prior to developing the ability to recognize and manage “truly” abnormal presentations.

The SLE routine is therefore presented in combination to the common “normal” and “abnormal” appearances of the anterior segment. This will render the use of the SLE more clinically relevant by directly relating the procedures to their application with regards to clinical findings.

Additionally, the problem oriented SOAP system (SOAP = Subjective, Objective, Assessment and Plan) is used to facilitate the presentation of findings & to familiarize the student with this useful clinical method of documentation.

LIDS & LASHES

METHOD OF OBSERVATION

The evaluation of lids and lashes is performed by using a direct diffuse illumination or a wide parallelepiped with low to moderate magnification. Points to inspect include the tissue of the lids, lashes, caruncle and plica semilunaris, the lid position and apposition to the globe, the lid margin including glands, tear prism and puncta and finally the integrity of the lashes.

NORMAL

The lid tissue should be devoid of lumps, bumps, inflammation and unusual pigmentation or vascularization. The position of the lid is such that it covers 1-3mm of the superior limbus /cornea adhering closely to the globe. The lid margin should appear free of blocked glands, infection, inflammation and the tear prism should be 0.2-0.4mm in height. The lashes should be clear of flaking or debris and each lash should arise separately from its respective follicle as opposed to being matted together. Finally, as part of the lachrymal apparatus, both the superior and inferior puncta should be visible and open upon eversion of the lids.

ABNORMAL

Blepharoptosis (ptosis):

Definition: A drooping or abnormally low position of the upper eyelid.

S: The patient usually has no complaints but they may have cosmetic concerns. The clinician must determine if the ptosis is congenital or acquired. It is possible to confirm congenital diagnosis by history and/or old photos. If the lid crease is absent, it is indicative of a long-standing ptosis. An acquired ptosis requires further evaluation to determine cause. Must note a unilateral versus bilateral nature. Congenital ptosis is usually bilateral and acquired is usually unilateral.

O: The presentation varies from a subtle difference between lid apertures to a total unilateral or bilateral closure of the lid.

A: Both congenital & acquired ptosis have many etiologies or differential diagnosis including neurological, aponeurotic, mechanical, myogenic, trauma, multiple sclerosis, myasthenia gravis, etc.

P: The management depends on the etiology of the ptosis. A referral may be necessary for evaluation of an acquired ptosis.

Dermatochalasis

Definition: Protrusion of superior lid tissue secondary to attenuation or stretching of the orbital septum from aging.

S: The patient usually has no complaints but they may have cosmetic concerns. It presents in middle age to elderly persons. It is usually bilateral and has a familial tendency.

O: The draping of superior lid tissue over septum or lid margin causes a loose or redundant tissue fold. It may have a puffy appearance due to fatty tissue herniation. The lid crease may become indistinct and produce a pseudo-ptosis. It may cause a visual field deficit if it covers the pupil.

A: Primarily due to the aging process.

P: Surgery is indicated if the patient suffers a functional deficit (e.g. visual field defect) or for cosmesis, otherwise no treatment is required.

Hordeolum

Definition: An **acute staphylococcal infection** of the glands of Zeiss, Moll or Meibomian.

S: Hodeoli are usually seen as an acute presentation or within 24-48 hours of onset. The patient suffers either generalized lid tenderness/soreness or distinct tenderness/pain with palpation. They may have a history of chronic blepharitis.

O: 2 types:

External Hordeolum ("stye") or an infection of the glands of Zeiss or Moll. There is a tender lump at lid margin and the exudate "points" outward, either through a gland orifice or skin surface. Appearance is red and swollen.

Internal hordeolum is an infection of a Meibomian gland. Because it is anatomically deeper, It is less common and more painful than an external hordeolum. The "lump" may "point" in or out and diffuse redness and swelling are noted.

A: The staphylococcal infection can be an isolated incident or associated with a chronic condition such as blepharitis. As part of the differential diagnosis, the clinician must rule out the presence of preseptal cellulitis which is an infection of the structures anterior to the septum. It is also recommended to palpate nodes to rule out a viral etiology.

P: Most resolve spontaneously. Resolution may be promoted by hot compresses performed 15-20 minutes QID. Antibiotics are commonly prescribed for hordeolum, but their usefulness is controversial. If it does not resolve excision may be required.

Chalazion

Definition: Granuloma or nodule of granulized tissue occurring as a result of **chronic inflammation** of a Meibomian or Zeiss gland. An internal chalazion is a granuloma of the meibomian gland and an external chalazion is a granuloma of the Zeiss gland.

S: Painless lid bump (painless unless inflamed) that may stay the same size or progress. The patient may report a recent hordeolum at same location.

O: Firm round or elongated mass. The external points outward and the internal points inward toward the palpebral conjunctiva. Eversion of the lids is a must.

A: Lipogranulomatous inflammation secondary to retention of sebum caused by obstruction of the duct of a gland. Differential diagnosis includes preseptal cellulitis, sebaceous cell carcinoma(suspect in recurrent chalazion) and pyogenic granuloma.

P: Chalazions will usually resolve by themselves however they may be treated with warm compresses. Often, they require surgical excision or incision and curettage. If the chalazion is located near the lacrimal apparatus, injection of steroids into the lesion may be considered rather than excision. Antibiotics are commonly prescribed for chalazion but their usefulness is controversial.

Chronic Marginal Blepharitis

Definition: Chronic infection of lids and lashes.

S: Itching, burning, irritation, foreign body sensation, tearing, crusting on awaking, inflammation. Possible history of frequent hordeoli, chalazia of chronic duration.

O: Thickened, rounded, ill-defined hypertrophic lid margins, telangiectatic blood vessels, moderate to abundant flat yellowish crustations around base of lashes. May have madarosis, poliosis, trichiasis, hordeoli, chalazia, SPK, or dry eye association. There are 2 main types: dry-seborrheic type which is associated with skin problems and an infectious bacterial type.

A: The dry-seborrheic type is associated with acne rosacea and eczema and the chronic infectious type is usually caused by staphylococcus.

P: Blepharitis is treated by routine & maintenance use (2 times/day) of warm compresses, lid scrubs and artificial tears. This will remove the source of the inflammation/infection, lubricate the eyes and will provide much relief to the patient.

Moderate to severe presentations with a high degree of pain may require more frequent compresses, lid scrubs and artificial tear use. Antibiotic or antibiotic-steroid combinations are sometimes recommended. However, removing the source of the inflammation with warm compresses and lid scrubs is the first line of defense and usually sufficient. The treatment is always aimed at the underlying cause which may be infectious (staphylococcal origin) or seborrheic (oily skin).

Meibomianitis (Meibomian Gland Dysfunction, Posterior Blepharitis)

Definition: Build up of fatty esters in meibomian glands which are frequently associated with seborrhea (oily skin) and atopic allergic history.

S: Itching, burning, irritation, foreign body sensation, tearing, crusting on awaking, inflammation. Possible history of frequent hordeoli, chalazia of chronic duration.

O: Mild to moderate inflammatory appearance to posterior lid margin congested orifices of multiple meibomian glands in palpebral conjunctiva palpebral conjunctiva red, velvety if chronic: thickened, rounded lid margins associations: almost always see a blepharoconjunctivitis (>inferior) - SPK possible tear film disturbances (rapid tear break-up time, “frothy” tears) - DRY EYE.

A: Many causes of inflammation and congestion of these glands. Remember it is not an infectious organism but rather a congestion and inflammation of the glands.

P: MGD is treated by routine use of ocular massage, warm compresses, lid scrubs and artificial tears. Ocular massage is performed by using rotary action of the fingers at the lid margins. This is a crucial part of the therapy because simple MGD is not caused by an infectious organism. MGD is a congestion and inflammation of the glands by sebum (sterol fatty esters). When the patient is in office it recommended to express the meibomian glands. Depending on severity, home therapy is started on a frequent basis (TID or QID) & decreased gradually to a maintenance therapy (BID, QD).

In more complex cases, MGD can be associated to seborrheic dermatitis, or acne rosacea in which case treatment with topical or oral antibiotics & steroids or combinations of both may be indicated.

Ectropion

Definition: Inferior eyelid turning outward.

S: Eye/eye lid irritation , epiphora or patient may be asymptomatic.

O: Inferior lid margin is not in apposition with the globe; punctal ectropion occurs when the puncta is not in apposition with the globe.

A: Lid atonia due to aging, chemical burn, surgery, lid laceration, 7th nerve palsy(Bell's Palsy), also cicatricial (scarring).

P: None / taping / surgical repair. If the cornea is compromised, lubricating agents, bandage soft CL, mild antibiotic ointment.

Entropion

Definition: Inferior lid & lashes turning inward.

S: Excess tearing, lid spasms, corneal foreign body sensation, irritation, red eye.

O: Lids / lashes turned inward & rub against corneal surface which may result in corneal foreign body tracking, SPK and conjunctival injection.

A: May be congenital (rare). Differential diagnosis includes spastic response on forced closure of lids, aging (involutional), cicatricial, ocular pemphigoid, Stevens-Johnson, chemical burns, trauma, trachoma, surgical , blepharospasm.

P: Definitive treatment is usually surgical. Can also use bandage CL to protect cornea or complete epilation (removal of lashes). Taping offers temporary relief.

Poliosis

Definition: Whitening of eyelashes.

S: Cosmetic complaint.

O: Unilateral or bilateral, partial to complete, whitening of lashes of inferior or superior lashes.

A: Can be congenital in ocular albinism. The differential diagnosis for acquired causes includes staphylococcus or chronic blepharitis, chronic uveitis, chemotherapy, Vogt Koyanagi Harada syndrome.

P: Treat underlying cause (e.g., treat staphyloccoccal infection).

Madarosis

Definition: Loss of eyelashes.

S: None. Usually a cosmetic concern.

O: Partial to complete loss of inferior or superior lashes. Unilateral or bilateral.

A: Congenital vs. acquired. The differential diagnosis includes toxic reaction to staphylococcus, systemic relationships (medications, chemotherapy, other hair loss), or self-inflicted.

P: Aim treatment at the causative agent.

Papilloma

Definition: Benign epithelial tumor

S: None, usually a cosmetic concern. Generally seen in children associated with a virus and in older patients without a viral association.

O: Epithelial overgrowth with a wide variation in size & shape. Presenting as singular or multiple masses, they are amelanotic to black (black when they outgrow underlying blood supply and necrose). Often at mucocutaneous borders of the eyelid, they can be anywhere. They are avascular with roughened (but not eroded!) granulated surfaces due to redundant epithelial cell growth. The surface texture is different than the surrounding skin.

A: Abnormal cell growth (benign tumor). The clinician must rule out neoplasm.

P: Must document size and appearance. Photodocument if lesion is questionable. If surgically removed, it is a complete excision with biopsy.

Sebaceous Cyst

Definition: fatty, fibrous cyst of a sebaceous gland.

S: Cosmetic concern. The patient may report either recent onset or long-standing.

O: 2 types:

Superficial: Superficial cysts range from 2-5 mm in size with a wide variation. There is a caseous ("cheesy") yellowish material in recently developed cysts covered by a thin, flattened epithelial layer. It presents as an individual cyst or multiple cysts and is located commonly around the lids, especially at inner and outer canthus.

Subcutaneous (deep): The deep cyst is an epidermal inclusion cyst. A slightly moveable lump, it is variable in size (1- 20 mm or greater) and can be located anywhere on the body. The overlying skin is normal but may show prominent blood vessels, telangiectasia, or venous congestion.

A: Results from a blockage of the gland and accumulation of material within it. Clinician must rule out malignancy from the differential diagnosis.

P: None. Can be removed if desired.

Verrucae

Definition: Viral wart.

S: Usually a cosmetic concern. The patient may report a slow, insidious development and may report similar lesions elsewhere (auto-innoculation tendency).

O: Single or multiple non-secreting wart(s). The coloration varies from gray-brown to yellowish-brown. They present in various shapes such as planar - flat, or round. Vulgaris - is raised and irregular with a broad base. Digitata - is cauliflower-like on narrow stalk. They have smooth surfaces with redundant tissue waves.

A: Verruca can resemble other lid bumps such as papilloma and neoplasm. Therefore the clinician must rule out malignancies from the differential diagnosis.

P: Educate patient as to its contagious nature. Consider surgical removal for cosmesis concern.

Trichiasis

Definition: In-turning lash(es).

S: Frequent complain of hyper-lacrimation and epiphora or foreign body sensation.

O: Lash or lashes turning inward toward globe and irritating corneal surface. The inferior lid is more commonly affeted than the superior. Foreign body tracking may be seen. Note that the lid position is normal as opposed to entropion where it is turned inward.

A: Congenital or acquired. The differential diagnosis for acquired causes includes chronic staphylococcal reaction/blepharitis, also scarring pemphigoid, chemical burns, trachoma, Stevens-Johnson syndrome.

P: Usual treatment is epilation; electrolysis or laser ablation may be used for multiple lashes.

Nevus

Definition: Well circumscribed pigmented spot devoid of vasculature.

S: None; usually a cosmetic concern.

O: 3 basic types of nevi:

Dermal: Most common; deep form; raised or flat; rarely becomes malignant.

Junctional: Superficial; usually flat; may convert to malignancy.

Transitional: A mixed form that is pigmented (usually brown) to amelanotic. The spots on the skin surface have well-defined borders and are usually < 8-10 mm. They may increase in size with age (can also decrease) but may also increase in size or change pigmentation with hormonal changes.

A: Usually congenital or early onset ; if acquired, need to rule out malignancies from the differential.

P: Photo-documentation for most; referrals for suspicious lesions where there is a change in the presentation of the lesion.

Xanthelasma

Definition: Cutaneous deposition of lipid material.

S: Cosmetic concern. Usually found in older patients, in females more than males. The patient may report a history of atherosclerosis, hyperlipidemia, or a high risk cardiovascular history.

O: Flat, triangular, elevated areas (usually base in!). They are generally found at the inferior or superior inner canthal lid sulcus. Color appears light brown to yellowish. Usually bilateral and symmetrical.

A: Deposition of lipid is chronic and is associated with raised blood cholesterol.

P: Cosmetic surgery is performed if it is desired by the patient. More importantly, the clinician must advise the patient that a medical work-up may be necessary to rule out any serum cholesterol or lipid disorder.

CONJUNCTIVA

METHOD OF OBSERVATION

By using direct diffuse illumination, indirect illumination, or wide parallelepiped with low to moderate magnification, examine the superior and inferior palpebral and bulbar conjunctiva with lid eversion. Also examine the medial and temporal bulbar conjunctiva including the inner canthus. Evert inferior lids routinely and evert superior lids as indicated by factors specific to the individual patient.

NORMAL

The palpebral conjunctiva should appear pink/healthy and devoid of papillae, follicles, discharge, infectious/ inflammatory membranes, filamentary strands, pinguecula and unusual injection of the blood vessels. The bulbar conjunctiva should appear white/healthy and devoid of injection, cystic formation or unusual pigmentation.

ABNORMAL

Calcium Concretions

Definition: Hard spots of calcium on palpebral conjunctiva.

S: Usually asympytomatic. Patients sometimes have complaints of corneal irritation or foreign body sensation. It is commonly seen in the elderly.

O: Small, white to yellowish hard spots on palpebral conjunctiva usually located inferior or superior. They are usually 1-3 mm and rarely > 5 mm, and can present as single or multiple lesions.

A: Simply an accumulation of calcium.

P: Usually no treatment necessary; may be “pried” off if causing irritation.

Inclusion Cyst

Definition: Clear to yellow fluid or caseous-filled cyst on conjunctiva.

S: Usually asymptomatic but their appearance may produce concern in patients.

O: Small to moderate size (2-5 mm) cystic formations, appear clear to yellowish in color. They have a variable location usually at the fornices, palpebral conjunctiva most common. They frequently present in multiples.

A: Simply an accumulation of aqueous fluid.

P: Usually no treatment; may be surgically removed if cosmesis is a concern.

Lymphangiectasia

Definition: Clear fluid-filled cyst on bulbar conjunctiva.

S: None/cosmesis is a possible concern.

O: Clear cyst of variable size and shape that is usually 2-10 mm. They are focal or segmental dilations of thin-walled lymphatic vessels. Present as single or multiple lesions and are always clear and transparent. In comparison with inclusion cysts, the latter have thicker walls and thus yellowish appearance. Inclusions cysts are also more common nasally and on the palpebral conjunctiva while Lymphangiectasia are more common temporally.

A: Lymph filled cyst.

P: None needed; can be drained if necessary.

Telangiectasia

Definition: Isolated, superficial, dilated or convoluted blood vessel (arteriole) on bulbar conjunctiva.

S: None / cosmesis is a possible concern and it occurs in any age group.

O: Vessel as described above and it may be simple convolution or sac-like. It is usually unilateral.

A: Most commonly idiopathic but possible systemic causes include: vascular disease, diabetes, and acne rosacea.

P: None except for routine monitoring; may consider laser if cosmesis is a concern.

Conjunctival Melanosis

Definition: Pigment in the conjunctiva which can be congenital or acquired.

S: Congenital or acquired. Congenital are more common in dark races and they may increase with age. Acquired are most common between 30-40 years of age and present more commonly in females.

O: 2 types:

Congenital: Flat, pigmented patches, usually at limbus which vary in size and shape. Coloration varies from grayish-brown to black.

Acquired: Irregular, diffuse, flat patches of grayish-black conjunctival pigmentation that develop spontaneously and may extend onto the palpebral conjunctiva. The pigmentation and shape may change over time.

A: Accumulation of melanin. Must rule out malignancy from the differential diagnosis.

P: No Tx for congenital but careful monitoring with photo-documentation; possible referral for acquired.

Nevus

Definition: Localized area of pigmentation.

S: None/cosmetic concern. Usually congenital or develops early in life.

O: Smooth, flat surface lesion with well-demarcated pigment edges. They have variable degrees of pigmentation, from almost amelanotic to very dark. They are usually superficial located on the bulbar or palpebral conjunctiva and have a greater frequency of presentation at the inner canthus.

A: Accumulation of melanin.

P: Must provide photo-documentation and rule out neoplasm from the differential diagnosis.

Pinguecula

Definition: Benign degenerative tumor of the bulbar conjunctiva.

S: Usually asymptomatic. Patient may note irritation or redness. Patient reports a frequent history of outdoor or UV exposure.

O: Slightly raised, yellowish-white triangular (base toward limbus) thickening on either side of the cornea. It is found on exposed lateral areas of bulbar conjunctiva (>nasal). They are commonly found bilaterally and may become surrounded by hyperemic blood vessels.

A: Deposition of hyaline substance thought to be associated with wind and UV exposure.

P: Usually none. Recommend UV protection. Lubricants are sometimes used for symptomatic (inflamed) presentations. Vasoconstrictors and cold packs may be used if hyperemic. They may be excised for cosmetic purposes.

SCLERA

METHOD OF OBSERVATION

By using indirect illumination during evaluation of the conjunctiva, view the inferior, superior, medial and lateral scleral tissues.

NORMAL

The sclera should appear white /quiet and devoid of injection, nodules, yellowing and abnormal pigmentation. A very common normal entity is termed an Axenfeld loop. It is blue/black in presentation and is an extension of the ciliary nerve loops on the surface of the sclera. They are usually located within a few millimetres of the limbus and are more commonly located nasally. Sometimes the nerve loop is accompanied by an adjacent vessel loop.

ABNORMAL

Blue Sclera

Definition: Hereditary defect in which the sclera has a bluish appearance. The sclera is thinner than normal and susceptible to rupture.

S: None / cosmesis may be a concern. Obvious presentation is seen in newborns which causes parent concern.

O: Variable density, intensity and distribution of pale to dark blue coloration to white of eyes. It is common and generally normal in infants with large globe size at birth there is a thin scleral tunic transmitting the choroid.

A: In children and elderly, mechanism is as described above. In adults and acquired cases, it can be related to systemic or developmental conditions.

P: Reassure in case of children, elderly. Appropriate referral for acquired.

CORNEA

METHOD OF OBSERVATION

By using direct diffuse, illumination, indirect illumination, parallelepiped, optic section, specular reflection of the endothelium and scleral dispersion with medium to high magnification one can examine the clarity, uniformity and various layers of the cornea.

NORMAL

The layer(s) being examined will vary depending on the method of observation. However, the cornea should appear clear, intact and of uniform thickness. It should be clear of opacities, disruption of tissue components and edema. A very common normal entity is the appearance of corneal nerves. The cornea has a rich supply of sensory nerves. It includes ciliary nerve and the ophthalmic division of the 5th nerve which enters the middle and anterior stromal layers of the cornea in a radial fashion. They are viewed as fine white lines in the corneal stroma and are more evident in the peripheral cornea when using indirect illumination.

ABNORMAL

Arcus Senilis

Definition: Grayish-white ring (or part of ring) opacity occurring in periphery of cornea.

S: Asymptomatic finding found in 50% of persons by age 50 and near 100% of persons by age 80. More common and pronounced on black individuals.

O: Broad (1-2 mm) whitish mid-peripheral ring of lipid substances. It is usually seen bilaterally. It is at the level of Bowman's layer and has a gradual development. The ring is separated from the limbus by zone of clear cornea.

A: Due to lipoid infiltration of the corneal stroma. Aging process in older individuals, but in younger patients it is associated with systemic disease such as hyperlipidemia and cardiovascular disease.

P: None usually. In young individual (< 40 y/o), the clinician must refer for serum cholesterol testing.

White Limbal Girdle of Vogt

Definition: Narrow band of fine crystal-like opacities lined up along nasal or temporal limbal borders.

S: Asymptomatic lesion most common in women over age 50 and presents bilaterally.

O: Semilunar opacity (subepithelial hyaline degeneration) without a clear separation from the limbus at the interpalpebral limbus. Nasal affected twice as temporal.

A: Age-related degeneration.

P: None.

Hudson-Stahli Line

Definition: Line of iron in cornea at level of Bowman's layer.

S: Usually none.

O: Orange-brown line in band region of cornea where margins meet on blink. More common in males, the frequency usually parallels the age (e.g., age 30=30%, age 40 = 40%, ...). There are three typical presentations which are: faint segmented line, continuous distinct line, and line with surrounding opacities. The Hudson-Stahli line is a frequent site of spontaneous or recurrent corneal erosions.

A: May be produced by migration of ions over time from blinking action.

P: None.

ANTERIOR CHAMBER ANGLE ASSESSMENT

METHOD OF OBSERVATION

Using the Van Herrick method which is an optic section at 60° with 16X or greater magnification, the examiner can accurately assess the depth of the anterior chamber nasally, temporally, superiorly and inferiorly. This method denotes the risk of angle closure.

NORMAL

Van Herrick Grade	Dac/Dc	Risk of Angle Closure Upon Dilation
0	~ 0	Extremely narrow / closed
I	< 1/4	Considerable risk
II	= 1/4	Moderate risk
III	1/4 to 1/2	Rare
IV	> 1/2	Rare

Dac = Depth anterior chamber Dc = Depth of the cornea

ABNORMAL

Iris Nevus

Definition: Iris freckle.

S: None / possible concern.

O: Flat or raised hyperpigmented spot on the iris stroma that creates no distortion to the iris, pupil or pupil dilation.

A: Accumulation of melanin. Must rule out melanoma from differential diagnosis.

P: Slight increased risk for melanoma. Clinician must photo-document & monitor for changes.

ANTERIOR CHAMBER CLARITY

METHOD OF OBSERVATION

After turning off the room lights use the conical beam to examine the superior, inferior, nasal and temporal aspects of the anterior chamber with low and high magnifications.

NORMAL

Black and quiet appearance of empty space.

ABNORMAL

Presence of inflammation or uveitis (in the form of cells, flare or hypopion), cysts or hyphema (blood). There exists a grading scale for the presence of inflammation, which will be covered elsewhere (pathology course). There are a number of systemic associations to uveitis that must be considered and these will also be covered within the pathology course.

NORMAL & ABNORMAL FINDINGS OF THE LENS

METHOD OF OBSERVATION

The examination of the lens is performed by using a direct illumination, parallelepiped, optic section, retro-illumination and specular reflection with moderate magnification. When observing with parallelepiped and optic section, one should scan from the anterior lens capsule to the posterior lens capsule both medially and laterally. When observing the tissues with retro-illumination or specular reflection of the anterior lens surface, one must focus at the plane of the iris. To observe specular reflection of the posterior lens surface, one must focus at the plane of the posterior capsule.

NORMAL

The examiner is able to view the various layers of the lens using a parallelepiped and optic section. The layers include the capsule, subcapsular space, cortex and nucleus. Anterior and posterior portions should appear clear and free from opacities. The anterior erect Y suture and the posterior inverted Y suture are visible within the fetal nucleus. By using retro-illumination the examiner will view the red reflex which should be devoid of opacification.

During lens development, new fibers from the epithelial layer are produced continuously and migrate centrally towards the cortex and nucleus. Due to this development, the lens increases in sagital width and the nucleus becomes less flexible with increasing age.

The embryonic blood supply to the lens is the tunica vasculosa lentis and it is replaced during development. Sometimes it does not completely atrophy. In this case there remains an embryological remnant attached to the posterior capsule. It is termed a Mittendorf dot and it can be viewed by using an optic section or retro-illumination. It is most commonly located inferior and nasal to the optic axis.

ABNORMAL

Cataracts

Cataract refers to the opacification of the lens. Cataract development is a major contributor to low vision and blindness around the world. Cataracts are classified either as acquired or congenital and result from a variety of etiologies:

Acquired	Congential
Senile/Age-Related	Maternal Infection
Traumatic	Birth Trauma
Metabolic/Systemic Disease	Metabolic/Systemic Disease
Genetic Disease	Genetic Disease
Toxic	Ocular Maldevelopment Syndromes
Intraocular Disease	

Acquired Cataracts

Senile/Age Related Cataracts

S: Decreasing vision, glare, reduction in contrast sensitivity.

O: Yellowing or darkening of the lens as well as the formation of vacuoles and irregularities within the lens fibers.

To grade age-related changes of the lens in an objective manner, the Lens Opacification Classification System III (LOCS III) is used. By adopting this system of classification, one can develop a standard routine of examining and classifying senile changes within the lens. Utilization of a standard classification system will reduce error introduced by subjective grading of lens opacities. This will also enhance the management of lens opacities.

The most common forms of senile/ age related cataracts are:

- Nuclear (NUC), resulting in an increasing degree of opacification of the nucleus of the crystalline lens.
- Cortical (COR), involving the cortex from the periphery toward the centre with classical wedge-shaped radial spokes.
- Posterior sub-capsular (PSC), developing distinct central or paracentral opacities on the posterior capsule.

In 2002, Thylefors et al. proposed a method for grading the presence and severity of different cataract types.

Known as the World Health Organisation (WHO) simplified cataract grading system, it is designed to enable observers using a slit-lamp to obtain comparable data across countries based on in-the-field assessment of the most common forms of cataract.

The grading system is designed to:

- Facilitate epidemiological studies
- Increase the comparability of studies
- Estimate cases that are likely to be in need of surgery

The classification system employs three levels of progressive severity for grading nuclear, cortical and posterior sub-capsular cataract.

Grading nuclear cataract

The WHO classification system for nuclear cataract is defined in terms of the opacification of the lens nucleus. The examiner assigns a severity grade by comparing the degree of opacification in the slit-lamp appearance with three standard photographs.

When grading the severity of any nuclear cataract, Thylefors proposes that only a specified grading region of the nucleus should be examined with the slit-lamp. The anterior and posterior borders of this region are limited by the anterior and posterior nuclear shells, respectively. The region contains bright features which include the anterior shell, the anterior embryonal nucleus, the posterior embryonal nucleus, and the posterior shell.

Three nuclear cataract standard photographs are included, representing different severities:

- NUC Standard - 1 – The embryonal nuclei are more visible than normal but the central clear zone is still easily distinguishable. Severe enough to be considered a “case” i.e. clinically significant nuclear cataract.
- NUC Standard - 2 – The nuclear zone is more uniformly opaque and the central clear zone is not clearly visible. Moderately advanced progression.
- NUC Standard - 3 – The nuclear zone is densely opaque. Severity sufficient to consider surgery.

The examiner assigns a severity grade by comparing the degree of nuclear opacification observed using the slit-lamp with the standard photographs.

Three nuclear cataract grades are included, representing different severities:

1. Grade NUC - 1 – Cataract equal to or greater than the NUC Standard - 1 but less than NUC Standard - 2.
2. Grade NUC - 2 – Cataract equal to or greater than the NUC Standard - 2 but less than NUC Standard - 3.
3. Grade NUC - 3 – Cataract equal to or greater than the NUC Standard - 3.

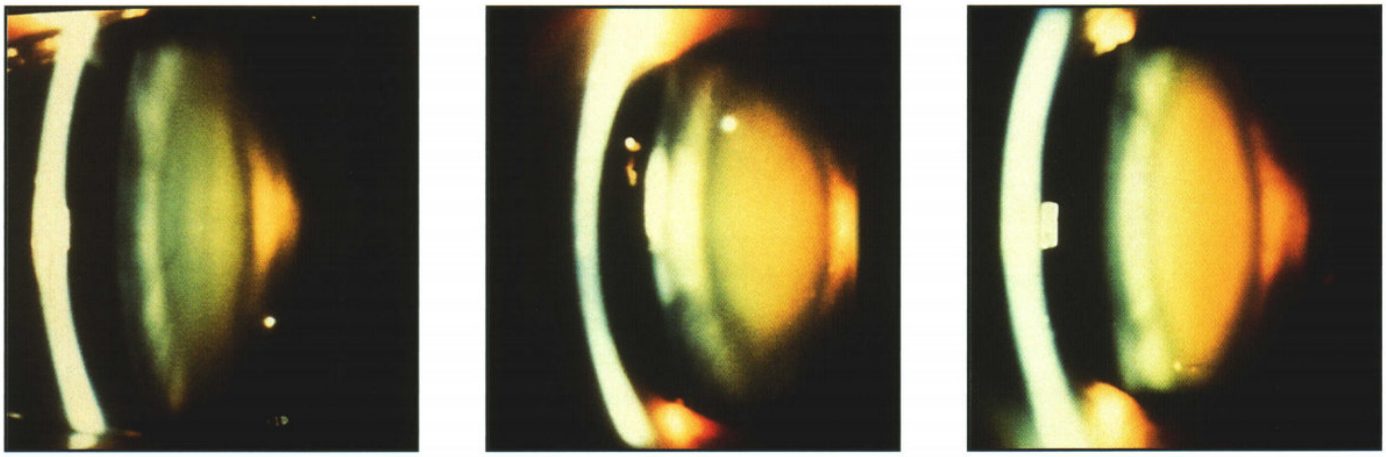

Fig 1: Grading cortical cataract photographs. left: NUC-1, middle: NUC-2, right: NUC-3

The WHO classification system for cortical cataract seen on retro-illumination using the slit-lamp is defined in terms of sharp and well-defined anterior and posterior cortical opacities.

Three cortical cataract grades are included, representing different severities:

1. Grade COR - 1 – Cataract involves one eighth, but less than one quarter, of the circumference.
2. Grade COR - 2 – Cataract involves a quarter, but less than one half, of the circumference.
3. Grade COR - 3 – Cataract involves half or more of the circumference

Thylefors recommends in cases of a dispersed cortical cataract (with several non-contiguous spoke opacities) that all of the opacities should be aggregated for the purpose of grading the circumferential extent.

Progression of the cortical cataract toward the central optical zone is also graded as follows:

Grade CEN – Involvement of the central optical zone of 3 mm diameter (Yes / No)

Grading posterior sub-capsular cataract

The WHO classification system for posterior sub-capsular cataract seen on retro-illumination using the slit-lamp is defined in terms of the vertical diameter (in mm) of the opacity.

Three posterior sub-capsular cataract grades are included, representing different severities:

1. Grade PSC - 1 – Cataract equal to or greater than 1.0 mm, but less than 2.0 mm. Severe enough to be considered a “case”.
2. Grade PSC - 2 – Cataract equal to or greater than 2.0 mm, but less than 3.0 mm. Progression which may require surgery.
3. Grade PSC - 3 – Cataract equal to or greater than 3.0 mm. Progression which usually requires surgery.

A: Lens fiber changes that result from aging processes and the accumulation of lens fibers within the capsular bag as a result of continued cell growth throughout life.

P: Ultimately, surgery is required to remove the cataractous lens and replace it with an artificial lens. The cataract is monitored until the decrease in visual function affects daily activity. Referral for surgery is based on an individual patient basis.

Traumatic Cataract

S: Patients may report a history of penetrating injuries, concussion injuries, receiving radiation, glass blower’s injury or electric shock.

O: Penetrating injuries display opacification in the area penetrated. Concussion may lead to a Vossius ring or what is viewed as an imprinting of the iris pigment onto the anterior capsule.

Radiation & electric shock induced cataract vary in presentation. Glass blower cataract appears as exfoliation.

A: Penetrating, Concussion, Radiation, Glassblower’s, Electric shock.

P: As any type of opacification, the cataract is monitored until the decrease in visual function affects daily activity. Referral for surgery is based on an individual patient basis.

Metabolic/Systemic Disease

S: Patient may report a history of Diabetes, Galactosaemia, Mannosidosis, Wilson's disease, Hypocalcemia or no reported disease.

O: Diabetic cataracts present in 2 forms. The first, termed "true" diabetic, is due to osmotic over-hydration of the lens & appears as bilateral white punctate or "snowflake" or "rosette" opacities that are located either anteriorly or posteriorly. The second, termed "senile" diabetic cataract, is similar to the common senile changes discussed previously but occurs earlier in the diabetic.

Alpha Galactosidase A or Fabry's disease cataract has 2 different presentations. The first, sometimes referred to as an "oil droplet" appears as a fine anterior subcapsular cataract that is cream colored & feathery. The other, located in the posterior lens, is shaped like a star or cross.

Wilson's syndrome cataract, called green "sunflower", consists of central pigmented opacities with tapering extensions. Because copper is deposited anteriorly & posteriorly within the lens, it takes on a yellow-green appearance.

Hypocalcemia cataract consists of multicolored crystals or flecks. They are small white or polychromatic crystals located in the anterior and posterior cortex just beneath the capsule. A clear zone separates this zonular cortical cataract from the nucleus.

Mannosidosis cataract varies in presentation.

A: Diabetes, Alpha Galactosidase A, Wilson's disease, Hypocalcemia, Mannosidosis.

P: As any type of opacification, the cataract is monitored until the decrease in visual acuity affects daily function. Referral is based on an individual patient basis.

Genetic Disease

S: Patients may report a history of Myotonic dystrophy or Down's syndrome.

O: Myotonic dystrophy causes a "Christmas tree" cataract, which is a stellate figure in the posterior subcapsular area with or without multicolored dust-like opacities present in the cortex.

Down's syndrome cataracts vary in appearance but generally have the potential to decrease VA. The more common presentations consist of cortical flake opacities or arcuate opacities.

A: Myotonic dystrophy, Down's syndrome.

P: As any type of opacification, the cataract is monitored until the decrease in visual function affects daily activity. Referral for surgery is based on an individual patient basis.

Toxic

S: Use of steroids, anticholinesterases, arrhythmic agents or antipsychotics may be reported.

O: Steroids have an association with posterior subcapsular cataracts following long term use of either topical or systemic forms.

Phosphospholine iodide, an anticholinesterase, causes cataracts in the form of anterior subcapsular vacuoles.

Amiodarone causes anterior subcapsular lens opacities.

A: Steroids, Anticholinesterases, Arrhythmic agents, Antipsychotics.

P: As any type of opacification, the cataract is monitored until the decrease in visual function affects daily activity. Referral for surgery is based on an individual patient basis.

Intraocular Disease

S: Patient may have a history of chronic intraocular inflammation or infection, retinal disease, or vitreo-retinal disease.

O: Uveitic cataracts appear as a colorful luster at the posterior pole of the lens as well as anterior and posterior subcapsular opacities. If allowed to progress, a fibrovascular membrane may grow over the anterior lens surface.

Retinal disease such as Retinitis Pigmentosa, Leber's Hereditary Optic Neuropathy, Gyrate Atrophy or vitreo-retinal diseases such as Stickler's syndrome or Wagner's syndrome produce posterior subcapsular lens opacities.

"Glaukomflecken" present as fine whitish-gray anterior subcapsular opacities in the area of the pupil and result from an acute angle closure attack.

A: Uveitis, Retinal disease, Vitreo-retinal disease.

P: As any type of opacification, the cataract is monitored until the decrease in visual function affects daily activity. Referral for surgery is based on an individual patient basis.

Congenital Cataracts

Maternal Infection/Drug Ingestion

S: Patient reports that their biological mother had a history of Rubella(viral infection) or ingested medications such as steroids or thalidomide during pregnancy.

O: Rubella infection during pregnancy produces congenital cataracts, which are present unilaterally or bilaterally. They appear as either a diffuse opacity throughout the lens or a dense pearly nuclear cataract that is surrounded by a less dense cortical opacity. Certain cases of rubella may exhibit microspherophakia.

Ingestion of medications during pregnancy produces cataracts, which vary in appearance according to the medication taken. In particular, long-term use of steroids may yield posterior subcapsular cataracts.

A: Rubella, Steroids, Thalidomide.

P: The severity of the opacification is assessed and referral for surgery is based on an individual basis with the risk for amblyopia in mind.

Birth Trauma

S: Patient reports a history of trauma at birth.

O: Cataract appearance secondary to birth trauma depends on the type of trauma.

A: Trauma.

P: The severity of the opacification is assessed and referral for surgery is based on an individual basis with the risk for amblyopia in mind.

Metabolic/Systemic Disease

S: Patient reports a history of Alpha Galactosidase A or no related history of disease.

O: Alpha Galactosidase A cataract (refer to previous section on acquired cataracts related to metabolic/systemic disease).

A: Alpha Galactosidase A.

P: The severity of the opacification is assessed and referral for surgery is based on an individual basis with the risk for amblyopia in mind.

Genetic

S: Patient reports a history of Lowe's oculocerebrorenal syndrome, or Down's syndrome or no systemic disease.

O: 100% of patients with Lowe's present with a congenital cataract. The lens appears thin and small and is referred to as microphakia. Opacities may be present in the capsule, cortex or nucleus.

Down's syndrome is associated with various forms of cataracts. (Refer to previous section on acquired cataracts related to genetic etiologies). The cataracts usually have the potential of causing decreased vision.

Congenital nuclear cataracts without systemic association may present in two forms. The first is termed the Embryonal or nuclear cataract (cataracata centralis pulverulenta) which contains small star-shaped opacities that are located in the embryonal nucleus. The fetal nucleus is not affected. This type of cataract has a dominant inheritance pattern, is usually bilateral and does not affect vision adversely. The second is termed the total nuclear cataract. This type of cataract affects both the embryonal and fetal nucleus and therefore may affect vision adversely.

A: Lowe's syndrome, Down's syndrome.

P: The severity of the opacification is assessed and referral for surgery is based on an individual basis with the risk for amblyopia in mind.

Ocular Maldevelopment

S: Patient reports a history of Peter's Anomaly or no related anomaly.

O: The cataract associated to Peter's Anomaly appears in conjunction with a central corneal defect. which is in apposition with the lens. The anomaly is referred to as keratolenticular strands.

A: Peter's Anomaly.

P: The severity of the opacification is assessed and referral for surgery is based on an individual basis with the risk for amblyopia in mind.

Abnormalities in Lens Shape & Positioning

S: Patient may complain of blurry and/or monocular double vision. They may report a history of Lowe's syndrome, Weill-Marchesani syndrome, Marfan's syndrome, Alport's syndrome, Homocystinuria or Hyperlysinaemia or Ehlers-Danlos.

O: Lowe's - may display posterior lenticonus in which the posterior pole of the lens is conical. Spherophakia may be present which is defined as an abnormally short lens radius of curvature.

Weill-Marchesani - may display spherophakia, subluxation of the lens due to defective lens zonules. After subluxation, the lens may dislocate anteriorly.

Marfan's - may present with microspherophakia. Due to defective lens zonules, 80% of patients present with bilateral lens subluxation. The lens is usually displaced upward and this is referred to as Ectopia Lentis.

Alports - may present with an anterior lenticonus where the anterior pole of the lens is conical. Anterior lenticonus produces irregular astigmatism as well.

Homocystinuria - may present with subluxation of the lens due to defective zonules. Lens is usually displaced downward.

Hyperlysinaemia - may present with microspherophakia.

Ehlers-Danlos - may present with subluxation of the lens.

A: Lowe's, Weill-Marchesani, Marfan's, Alports, Homocystinuria, Hyperlysaemia, Ehlers-Danlos.

P: Treatment is dependent on anomaly and presentation.

ANTERIOR VITREOUS

METHOD OF OBSERVATION

Performed by using a parallelepiped or optic section. Focus past the posterior capsule of the lens to view the anterior vitreous and scan both the right and left portions. By having the patients look up and then straight ahead, one can view the movement of the vitreous. This movement is referred to as the Ascension phenomenon of Vogt.

NORMAL

Anterior vitreous should appear black and free of debris, inflammation, pigment or blood.

ABNORMAL

Any presence of debris, inflammation (cells / flare), pigment or blood.

CHART NOTATIONS FOR SLE OBSERVATIONS

The chart notation for biomicroscopy is quite straightforward. A ***"Cl"*** is used to denote *clear* unremarkable findings except for the A/C clarity where ***(-) C/F*** is used to denote the absence of cells & flare and the VH angle evaluation where a roman numeral ***(0 - 4***) is used to indicate the angle grade. Abnormal findings are either described verbally or preferably drawn while the ***WHO system*** is used to describe cataracts.
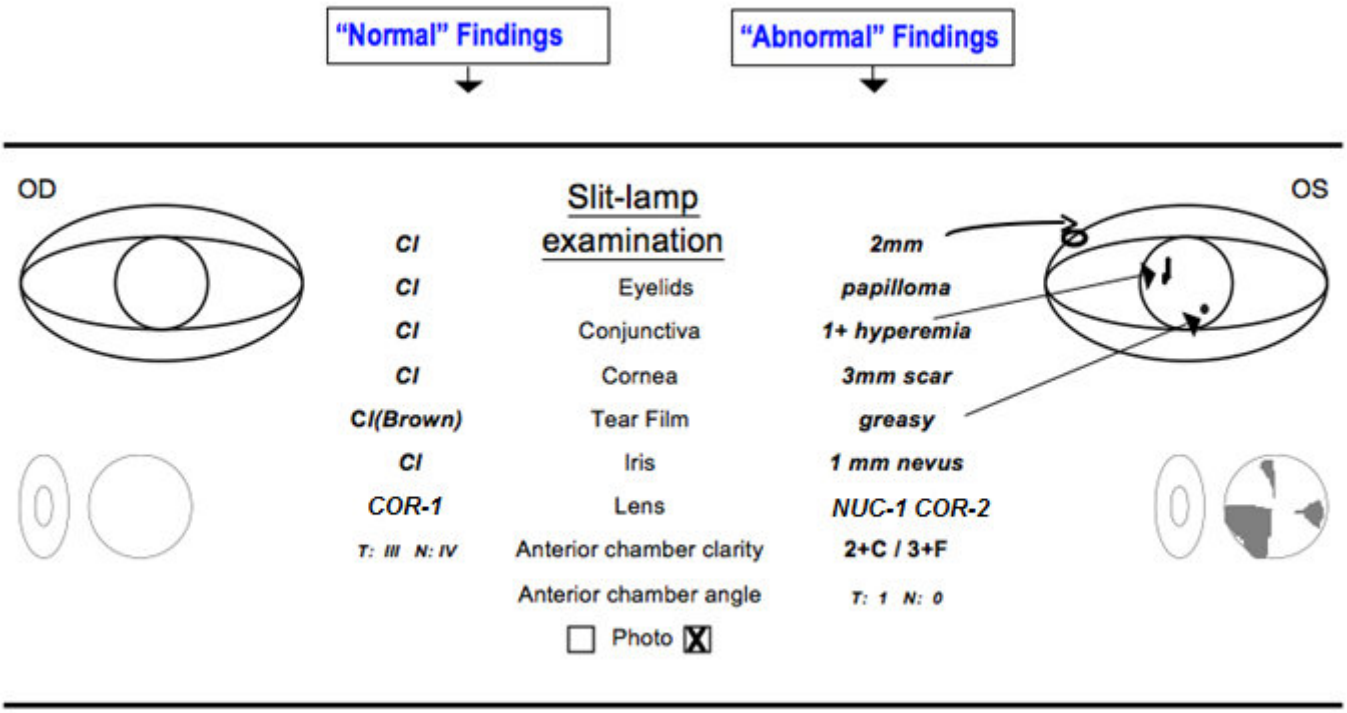
CHART EXAMPLE: SLE SECTION