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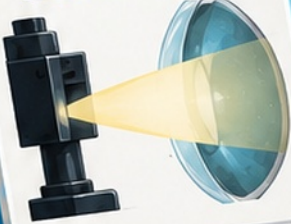
SLIT LAMP EXAMINATION

• GOLDFISH MEMORY SERIES •

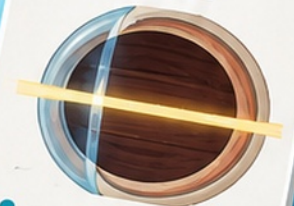
Forgot how to examine the eye systematically?
Let's fix that in **5 minutes**.

What comes
after diffuse
illumination?

**DIFFUSE
ILLUMINATION**



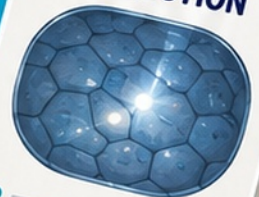
**DIRECT
FOCAL**



**SCLEROTIC
SCATTER**



**SPECULAR
REFLECTION**



D → F → S → R

(Diffuse → Focal → Scatter → Reflection)



**STEPWISE
APPROACH**



**HIGH-YIELD
VIVA POINTS**



**BETTER
RETENTION.**

Because Even Ophthalmologists Forget. ♥



Built for **Ophthalmologists**. Designed for **Recall**.

■ ANATOMY & COMPONENTS OF THE SLIT LAMP

The Slit Lamp — A Microscope Meets a Flashlight

Clinical Analogy: Think of the slit lamp as a **stereo microscope with a variable-angle, variable-width light source**. The 'slit' cuts through ocular structures optically — just as a knife cuts a fruit — revealing cross-sectional detail that flat illumination cannot.

Component	Description / Function
Illumination System	Koehler illumination; variable slit width (0–14mm), height, angle, filter
Observation System	Binocular microscope; magnification 6×–40× (most: 10×, 16×, 25×)
Mechanical Stage	Joystick control; X-Y-Z movement; chinrest & forehead rest
Beam Splitter	Allows photography/video recording attachment
Filters	Cobalt blue (fluorescein), red-free (green), neutral density, diffuser

■ SLIT LAMP ILLUMINATION TECHNIQUES

The 7 Core Illumination Techniques

Technique	Setup	Best For	Key Structures
Diffuse Illumination	Wide beam, low angle, diffuser	Overview, lids, conjunctiva	Surface lesions, gross pathology
Direct Focal (Parallelpiped)	Narrow slit, coaxial or slight angle	Cornea, lens — cross-section	Corneal layers, lens opacities
Optic Section	Narrowest slit, 45° angle	Corneal depth, AC depth	Layer-by-layer corneal analysis
Specular Reflection	Angle of incidence = angle of reflection	Corneal endothelium	Endothelial mosaic, Krukenberg spindle
Sclerotic Scatter	Light at limbus → TIR → lights cornea	Diffuse corneal edema	Faint stromal haze, bedewing
Retroillumination (direct)	Light from iris/fundus behind lesion	Lens vacuoles, KPs	Backlit opacity detail
Retroillumination (indirect)	Adjacent iris illumination	Corneal vessels, ghost vessels	Vascular detail, NVI

■ Viva Pearl — Specular Reflection

- Angle of incidence EQUALS angle of reflection (equal angle technique)
- Illumination and observation arms equidistant from axis
- Patient sees a bright reflex; examiner switches to this reflex
- Used clinically to assess endothelial cell density qualitatively (specular microscopy quantitatively)

■■ SYSTEMATIC SLIT LAMP EXAMINATION

Order of Examination — PEEL-ACLS Mnemonic

P	E	E	L	—	A	C	L	S
Periocular / Lids	Episclera / Sclera	Ext. Eye / Conjunctiva	Limbus		Anterior Chamber	Cornea	Lens / Iris	Stroma / Vitreous

■ CORNEAL EXAMINATION IN DETAIL

Corneal Layers — From Front to Back (Optic Section)

Layer	Thickness	SL Appearance	Key Pathology
Epithelium	50–52 µm (5–6 cell layers)	Bright anterior band, stains with FI	PEE, dendrites, filaments, erosions
Bowman's Layer	8–14 µm (acellular)	Anterior margin of stroma	Cannot regenerate; scars permanently
Stroma	450–500 µm (90% corneal thickness)	Optically clear lamellar zone	Infiltrates, scars, thinning, ectasia
Descemet's Membrane	10–15 µm (thickens with age)	Posterior bright line, elastic	Haab striae, Descemetocoele, folds
Endothelium	Single cell layer, 5 µm	Specular: mosaic pattern	Guttata (Fuchs), bullous keratopathy

■ Exam Pearl — Corneal Thickness by SL

- Optic section: compare thickness to standard slit width (usually 0.2mm set)
- Corneal thinning: suspect keratoconus (inferior), MFD, PUK, Terrien's
- Central corneal thickness (CCT) affects IOP measurement — 520µm is population mean
- Every 10µm deviation from 520µm → Goldmann IOP off by ~0.5 mmHg (approx)

■■ ANTERIOR CHAMBER ASSESSMENT

AC Depth — Van Herick Grading (Peripheral AC Depth Estimation)

Technique: Illuminate limbal cornea at 60° with narrow slit. Compare the dark gap (AC depth) to the adjacent corneal thickness (CT). The ratio gives grade. Used to screen for occludable angles before dilation.

Grade	AC/CT Ratio	Angle Estimate	Clinical Action
Grade 4	> 1 : 1 (AC > CT)	Wide open (35–45°)	Safe to dilate
Grade 3	1 : 4 to 1 : 1	Open (25–35°)	Generally safe
Grade 2	1 : 4 (AC = ¼ CT)	Moderately narrow (20°)	Caution; gonioscopy
Grade 1	< 1 : 4	Very narrow (< 10°)	Do NOT dilate; risk closure
Grade 0 / Slit	No visible space / closed	Closed / iridocorneal touch	Angle closure suspect

■ CELLS & FLARE IN ANTERIOR CHAMBER

Tyndall Effect — The Hallmark of Uveitis

Technique: Use 1mm × 1mm parallelepiped beam at 45°. Darken the room. Look for: **Flare** = protein in aqueous (Tyndall effect — like light beam in dusty room) and **Cells** = WBCs or RBCs floating in beam.

SUN (Standardization of Uveitis Nomenclature) Grading

Grade	Cells/Field (1×1mm beam)	Flare Grade	Flare Description
0	< 1	0	No flare
0.5+	1–5	1+	Faint (barely detectable)
1+	6–15	2+	Moderate (iris/lens details clear)
2+	16–25	3+	Marked (iris/lens hazy)
3+	26–50	4+	Intense (fibrinous / plastic)
4+	> 50	—	Hypopyon if gravity-settled

■ Critical Distinction — Cells vs Flare

- Cells = ACTIVE inflammation (count them, treat actively)
- Flare = blood-aqueous BARRIER damage (may persist despite quiescence)
- Flare ALONE without cells does not mean active uveitis — it can persist chronically
- Pigment cells in AC after YAG/trauma ≠ uveitis cells — look for flare to differentiate

■■ MCQ TRAP: A patient post-YAG iridotomy has 3+ cells and 0 flare. Is this active uveitis?

NO. Pigment dispersion after YAG laser releases melanin granules which mimic cells. Absence of flare suggests no protein leak → no BAB breakdown → not uveitis. Always correlate clinically.

■ CORNEAL STAINING PATTERNS

Vital Dyes — Fluorescein, Rose Bengal, Lissamine Green

Dye	Stains	Illumination	Key Patterns & Diagnoses
Fluorescein sodium	Devitalized/absent epithelium (intercellular gaps)	Cobalt blue filter	PEE (dry eye), dendrite (HSV), corneal ulcer, RCE, abrasion
Rose Bengal 1%	Devitalized/dead cells (filaments, mucus)	White light	Dry eye (interpallpebral), Sjögren's, filamentary keratitis — TOXIC, stings
Lissamine Green	Dead/devitalized cells (like Rose Bengal)	White or red-free	Better tolerated than RB; similar staining pattern; preferred now

Fluorescein Staining Patterns — Pattern Recognition

Pattern	Appearance	Diagnosis
Punctate epithelial erosions (PEE)	Fine dots, diffuse or localised	Dry eye, toxic keratopathy, UV keratitis
Linear / branching dendrite	Branching with terminal bulbs	HSV keratitis (active)
Geographical / amoeboid	Large irregular ulcer	HSV — post-dendritic (healed) or Acanthamoeba
Inferior 1/3 staining	Band or punctate inferiorly	Exposure keratopathy, lagophthalmos
Superior 1/3 staining (SPK)	Superior punctate / filaments	VKC, SLK (limbal staining too), Trachoma
Central oval staining	Central +/- infiltrate	Bacterial/Acanthamoeba keratitis
Starburst / whorl	Central + spoke-like lines	Vortex keratopathy (amiodarone/chloroquine)

■ LENS EXAMINATION

Slit Lamp Assessment of the Lens

Zone	SL Finding	Significance
Anterior capsule	Fibrosis, calcification, plaque	Post-uveitic, mature cataract
Anterior subcapsular	Shield cataract (plaque)	VKC, atopic, steroid use (PSC)
Nuclear	Yellow/brown sclerosis	Age-related NS cataract
Posterior subcapsular (PSC)	Dense opacity, central, glare	Steroids, DM, radiation, Myotonic dystrophy
Posterior capsule	Elschnig pearls (post-op)	Posterior capsule opacification
Anterior vitreous	Cells, pigment (Shaffer sign)	PVD, retinal tear, uveitis, old hemorrhage

■ PSC Cataract — High-Yield Exam Points

- PSC causes MORE visual complaints than nuclear cataract at same Snellen acuity
- Worse in bright light (pupil constricts → more light through PSC zone)
- Worse for near vision (miosis for accommodation → through PSC zone)
- Causes: CSSS — Corticosteroids, Systemic disease (DM), Syndermatotic (atopy), Secondary (radiation/uveitis)
- Myotonic dystrophy: 'Christmas tree' cataract (multicoloured lenticular opacities) — PATHOGNOMONIC

AUXILIARY LENSES FOR SLIT LAMP

Gonioscopy Lenses, Fundus Lenses & Contact Lenses

Lens	Type	Magnification	Mirrors/Prisms	Use
Goldmann 1-mirror	Contact	1×	1 mirror (62°)	Static gonioscopy; AC angle
Goldmann 3-mirror	Contact	1×	3 mirrors (59°/67°/73°)	Gonioscopy + midperipheral + peripheral retina + central fundus
Zeiss 4-mirror	Contact	1×	4 mirrors	Dynamic (indentation) gonioscopy; small — easy to use
Volk 78D	Non-contact	~0.93×	—	Fundus: posterior pole, optic disc, macula
Volk 90D	Non-contact	~0.75×	—	Wider field; vitreous, periphery; less mag than 78D
Volk SuperField	Non-contact	~0.68×	—	Widest field of non-contact lenses
Mainster / Quadraspheric	Contact	Variable	—	Laser treatment; wide-field retinal viewing

78D vs 90D — Exam Trap

- 78D gives HIGHER magnification, SMALLER field than 90D
- 90D gives WIDER field, LOWER magnification — better for screening periphery
- INVERTED and LATERALLY REVERSED image with both (real, inverted image in space)
- Magnification formula: Lens power / Patient's emmetropic power → roughly proportional

GONIOSCOPY — ANGLE ANATOMY

Angle Structures — Anterior to Posterior (SAS-ITM)

Mnemonic: SAS-ITM (from cornea → iris root) → Schwalbe's Line · Anterior TM · Scleral Spur · Iris Root (Ciliary Body Band) · Trabecular Meshwork (posterior)

Structure	Appearance on Gonio	Clinical Significance
Schwalbe's Line (SL)	Anterior white/grey line = end of Descemet's	PAS above SL → Axenfeld anomaly; prominent SL = Posterior embryotoxon
Trabecular Meshwork — ant.	Non-pigmented, anterior band	May be hard to see; coagulated in SLT
Trabecular Meshwork — post.	Pigmented (brown band); most functional	SLT target; pigment graded 0–4+; dense in PXF, pigment dispersion
Scleral Spur (SS)	White/grey ridge; landmark for ciliary body	Identifies anterior and posterior boundary of TM
Ciliary Body Band (CBB)	Dusky grey/brown band	Visible in open angles; absent if angle closed anteriorly
Iris Root	Variable insertion	High = plateau iris; low = angle recession risk

VIVA: What is Sampaolesi's line and when is it seen?

A wavy pigmented line ANTERIOR to Schwalbe's line. Seen in Pseudoexfoliation glaucoma and Pigment Dispersion Syndrome. It represents pigment deposition on the irregular surface of Schwalbe's line — key gonioscopic finding for PXF/PDS.

❄ ■ KERATIC PRECIPITATES (KPs)

KPs — Classification, Distribution, Morphology

Feature	Mutton-Fat KPs	Fine/Stellate KPs	Pigmented KPs
Size	Large, greasy	Small, fine, stellate/powdery	Variable, pigmented
Composition	Macrophages + epithelioid cells	Lymphocytes	Old/resolving KPs
Location	Inferior cornea (Arlt's triangle)	Diffuse or central	Any location
Associated uveitis	Granulomatous (sarcoid, TB, VKH, Lepra)	Non-granulomatous (HLA-B27, Fuchs, HSV)	Chronic/resolved uveitis, Fuchs
Key diagnosis	Sarcoidosis, TB, VKH, sympathetic ophthalmia	Fuchs HCU, HLA-B27, viral	Fuchs (stellate+pigmented = classic)

■ IMPORTANT SLIT LAMP SIGNS — RAPID RECOGNITION

Sign	Description	Disease
Kayser-Fleischer ring	Golden-brown deposits in Descemet's (periphery first)	Wilson's disease (hepatolenticular degeneration)
Hudson-Stähli line	Horizontal iron line at junction of lower 1/3–2/3 cornea	Normal aging / chronic exposure
Fleischer ring	Iron ring at base of keratoconus cone (360° partial)	Keratoconus
Stocker's line	Iron line at advancing edge of pterygium	Pterygium
Ferry's line	Iron line at edge of filtering bleb	Post-trabeculectomy
Haab's striae	Horizontal breaks in Descemet's membrane	Infantile glaucoma (corneal enlargement)
Shaffer sign	Pigment granules (tobacco dust) in anterior vitreous	Retinal tear / PVD
Krukenberg spindle	Vertical pigment spindle on endothelium	Pigment dispersion syndrome
Arlt's triangle	KPs in inferior triangular distribution	Uveitis (any form)
Vossius ring	Pigment ring on anterior lens surface	Blunt trauma (iris pigment imprinted)
Epicapsular stars	Grey star-shaped pigment on lens	Old uveitis / trauma
Zentmayer ring (Scheie stripe)	Pigment on posterior lens capsule (spoke-like)	Pigment dispersion syndrome

■ MCQ TRAPS & CONSULTANT VIVA QUESTIONS

■ MCQ TRAP: Sclerotic scatter requires the beam to be aimed at the CENTRE of the cornea. True or False?

FALSE. In sclerotic scatter, the beam is directed at the LIMBUS (not centre). Light enters the cornea at the limbus and undergoes Total Internal Reflection, illuminating the whole cornea from within. Pathology appears as a bright glow against the dark background.

■ MCQ TRAP: Van Herick Grade 2 means it is safe to dilate the pupil. True or False?

FALSE. Grade 2 means AC depth is $\leq \frac{1}{4}$ corneal thickness — this represents a NARROW angle with high risk of acute angle closure on dilation. Gonioscopy must be performed first. Safe dilation generally requires Grade 3 or 4.

■ MCQ TRAP: The 90D lens gives higher magnification than the 78D. True or False?

FALSE. 78D gives higher magnification ($\sim 0.93\times$) with a smaller field. 90D gives a wider field with lower magnification ($\sim 0.75\times$). Higher diopter = wider field but lower mag. Classic exam reversal trap.

■ MCQ TRAP: Mutton-fat KPs are ALWAYS granulomatous in origin. True or False?

FALSE. While mutton-fat KPs strongly suggest granulomatous uveitis, they can also appear in some non-granulomatous conditions. More importantly, Fuchs Heterochromic Cyclitis has classic small stellate KPs scattered diffusely (not just inferior) — not mutton-fat, yet is non-granulomatous. Know the exceptions.

■ MCQ TRAP: Flare in the anterior chamber represents ACTIVE inflammation and must be treated aggressively.

FALSE. Flare = protein (breakdown of blood-aqueous barrier). It can PERSIST for months to years even after inflammation is controlled. Treating flare aggressively (escalating steroids) when cells are absent is WRONG. The SUN criteria emphasize grading cells (not flare) for treatment decisions.

■ VIVA FOLLOW-UP QUESTIONS

■ VIVA: What is the difference between direct and indirect retroillumination?

Direct retroillumination: The lesion is lit from behind by the reflex from the iris or retina directly behind it — the lesion appears dark against a bright background. Indirect retroillumination: The light source illuminates adjacent iris, and the lesion is seen against the dark pupil background — lesion appears bright against dark. Use direct for opaque lesions (lens opacities, KPs); indirect for vascular lesions (ghost vessels, NVI).

■ VIVA: How does the Goldmann 3-mirror lens allow examination of the peripheral retina?

The Goldmann 3-mirror lens uses 3 mirrors at angles 59°, 67°, and 73° from the optical axis. The 59° mirror (dome-shaped) views the far periphery and ora serrata. The 67° (rectangular) views the equatorial zone. The 73° (quadrangular) views the midperiphery. The central button gives posterior pole/optic disc view. By rotating the lens 360°, the entire fundus can be systematically examined.

■ VIVA: A patient has 3+ cells and 4+ flare with fibrinous exudate in AC. What is the term and mechanism?

This is PLASTIC IRITIS (or fibrinous anterior uveitis). Severe BAB breakdown allows fibrinogen to enter the AC and polymerize into fibrin, forming visible white exudate. Seen in HLA-B27 associated uveitis (especially AS, reactive arthritis), severe trauma, post-surgical inflammation, and Behçet's. Treat with aggressive topical steroids + cycloplegia; systemic steroids may be needed. Risk of posterior synechiae and pupil block.

■ QUICK REFERENCE SUMMARY TABLE

At-a-Glance: Slit Lamp Findings & Diagnoses

Finding on SL	Key Diagnosis	Don't Miss
Dendrite with terminal bulbs	HSV keratitis	Pseudodendrite of Acanthamoeba/HZO lacks terminal bulbs
Radial keratoneuritis	Acanthamoeba keratitis	Pathognomonic; contact lens wearer
Stellate diffuse KPs + no synechiae + iris heterochromia	Fuchs HCU	Cataract surgery → good visual outcomes
Inferior thinning + Fleischer ring + Munson's sign	Keratoconus	Rizzuti sign on penlight from temporal
Pseudoexfoliation material on lens capsule	PXF syndrome	Sampaolesi line on gonio; IOP high
Krukenberg spindle + Zentmayer ring + deep AC	Pigment dispersion syndrome	Young myopic males; exercise-induced IOP spikes
KF ring + Kayser-Fleischer appearance	Wilson's disease	Check liver function; start with superior arc
Haab's striae (horizontal) in infant	Buphthalmos/Infantile glaucoma	Corneal diameter >12mm + photophobia
Snowball / string of pearls in vitreous	Intermediate uveitis (pars planitis)	Young; CME is main visual threat
AC flare + cells + synechiae + rubeosis iridis	Neovascular glaucoma	Check for DM, CRVO, OIS

■ ADVANCED CONSULTANT QUESTION

■ **ADVANCED FOLLOW-UP QUESTION FOR INTELLECTUAL EXTENSION** A 35-year-old male contact lens wearer presents with severe pain, photophobia, and reduced vision. Slit lamp shows a ring-shaped stromal infiltrate, radial perineuritis (keratoneuritis), and overlying epithelial irregularity. Fluorescein shows pseudodendrites. He was treated for 5 days with topical acyclovir with no improvement. Q: (a) What is the diagnosis and what is the single most important confirmatory investigation? (b) Why does this condition mimic HSV and how do you distinguish them on slit lamp alone? (c) What is the mechanism of the ring infiltrate and why is steroid use in this condition controversial?

Hints: Think Acanthamoeba. Ring = immune ring (Wessely ring = antigen-antibody complex in stroma). Radial keratoneuritis is PATHOGNOMONIC. Distinguish from HSV: HSV dendrite has TRUE terminal bulbs + stains with Rose Bengal; Acanthamoeba pseudodendrite is raised epithelial ridge without bulbs. Steroids controversial: suppress immune ring pain but risk accelerating trophozoite-to-cyst conversion making treatment harder.

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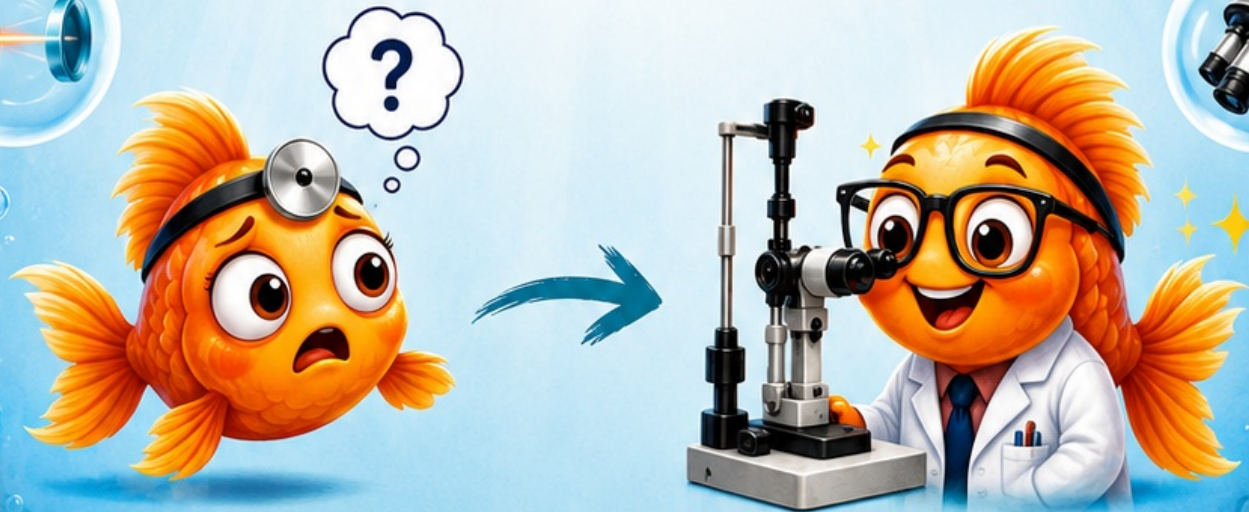
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HIGH-YIELD
NOTES



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