Ministry of High Education and Scientific Research
Al-Furat Al-Awsat Technical University
Al-Najaf Technical Institute

EYE ANATOMY

Optometry Department
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2025 / 2026
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week	Topics Covered
1	General information about the eye and its function. Global Anatomy & Ocular Geometry. Aspherical Nature of the Globe. Segmental Dimensions. The Anterior Segment (Cornea). The Posterior Segment (Sclera).
2	Anatomy of the eye ball and eye layers. External Protection: The Palpebral System. Eyelid Anatomy & Function. Muscular Control. Levator palpebrae superioris. Orbicularis oculi. The Palpebral Fissure. Canthal Anatomy
3	The Lacrimal Apparatus & Tear Dynamics. Tear Production. Secretory Glands:Meibomian Glands. Sweat and Oil Glands. The Drainage Pathway. The Pumping Mechanism
4	Surface Membranes & Surgical Landmarks. The Conjunctiva:Bulbar vs. Palpebral. The Fornix:Defense Mechanisms:. The Lid Margin:The Gray Line: Ciliary Anatomy: Tenon's Capsule:
5	The Tear Film Structure. **The Precorneal Tear Film.** Lipid (Fatty) Layer: Aqueous Layer: Mucous Layer:Primary . Physiological Functions of the Tear film .Clinical Relevance.
6	The Cornea: Refractive Power: Developmental Timeline:Physical Dimensions: Anatomy and Dimensions: The Five (or Six) Layers of the Cornea.Epithelium. Bowman's Membrane. Stroma. Descemet's Membrane. Endothelium. Clinical Considerations & Nutrition. Deturgescence:The Limbus: Corneal Nutrition: Clinical Landmarks & Healing. Scarring Potential:Lid-Cornea Interaction:

week	Topics Covered
7	The Sclera: Structural Integrity. Anatomical Composition: Age-Related Variations.Pediatric: Geriatric:The Lamina Cribrosa: Episcleral Tissue: Functional Role:
8	The Uveal Tract: The Middle Layer. The Iris (The Light Regulator). Pupillary. Mechanics: Sphincter Pupillae :Dilator Muscle: Surface Topography. Chamber Anatomy:The Ciliary Body (The Engine of the Eye).Double Functionality: Accommodation: Presbyopia: . The Choroid (The Nutrient Source). Vascular Nature:Retinal Support:Anatomical Position. Clinical & Physiological Concepts. The Anterior Chamber Angle: Lens Suspension: Visual Transitions:
9	Angle Structures & Aqueous Outflow. The Anatomy of the Angle: The Outflow Pathway: Clinical Correlation (Glaucoma): The Crystalline Lens.Physical Properties: Positioning:Anatomical Components: The Lens Capsule: The Nucleus vs. Cortex: Suspensory Mechanism:
10	The Vitreous Humor.Physical Volume: Biochemical Composition:Attachments & Anchors: Age-Related Degeneration: Vitreous Shrinkage. Floaters:

week	Topics Covered
11	Retina .Photoreceptors: Rods vs. Cones The Sensory Foundation:Comparative Anatomy:The Cones (Photopic Vision): The Rods (Scotopic Vision): Central Vision Anatomy .The Macula Lutea: The Fovea:.Clinical Impact: Peripheral Anatomy & Boundaries .The Ora Serrata: Physiological Boundaries: Retinal Attachment & Pathology Firm Attachment Sites: The Retinal Layers: Pigment Epithelium: Sensory Layers: Mechanics of Retinal Detachment:
12	The Optic Nerve Head (Optic Disc).Ophthalmoscopic Visibility: The Physiological Blind Spot: The Physiologic Cup: Vascular Entry/Exit: Microscopic and Macro Anatomy. Cellular Origin: Structural Exit: The Visual Pathway (The Journey to the Brain). Segmental Lengths: Bony Landmarks: the Optic Chiasm: Clinical Significance The Muscle Cone:Intracranial Transition:
13	Visual pathway .The Optic Chiasm: The Great Crossing. The Optic Tract and Relay Station. Visual Radiations and the Occipital Lobe.The Primary Visual Cortex . The Occipital Lobe: The Visual Striate Area:Conscious Perception:
14	Ocular muscles .The Extraocular Muscles. The Rectus Muscles The Oblique Muscles. Eyelid Muscles. Levator Palpebrae Superioris: Orbicularis Oculi: Clinical & Surgical Concepts. Surgical Accessibility: Ptosis:Terminology of Movement:

References

- Stein, H.A., Stein, R.M. and Freeman, M.I., 2017. The ophthalmic assistant: A text for allied and associated ophthalmic personnel. Edinburgh: Elsevier Saunders . TENTH EDITION

- Stein, H.A., Stein, R.M. and Freeman, M.I., 2022. The ophthalmic assistant: A text for allied and associated ophthalmic personnel. Edinburgh: Elsevier Saunders . ELEVENTH EDITION

Unit 1

- This lecture provides a comprehensive overview of the external anatomy and structural dimensions of the human eye.
- It details how the eye functions not just as an optical organ, but as a protected biological system supported by the eyelids and tear film.

Pre test : Select the correct answer :-

- **The human eye is often called a 'globe,' but geometrically it is actually composed of how many spheres?**

.One true sphere

.Two spheres with different radii

-Three overlapping segments

.An irregular ellipsoid

- **Where are the lacrimal glands, which produce tears, located?**

-Directly behind the pupil

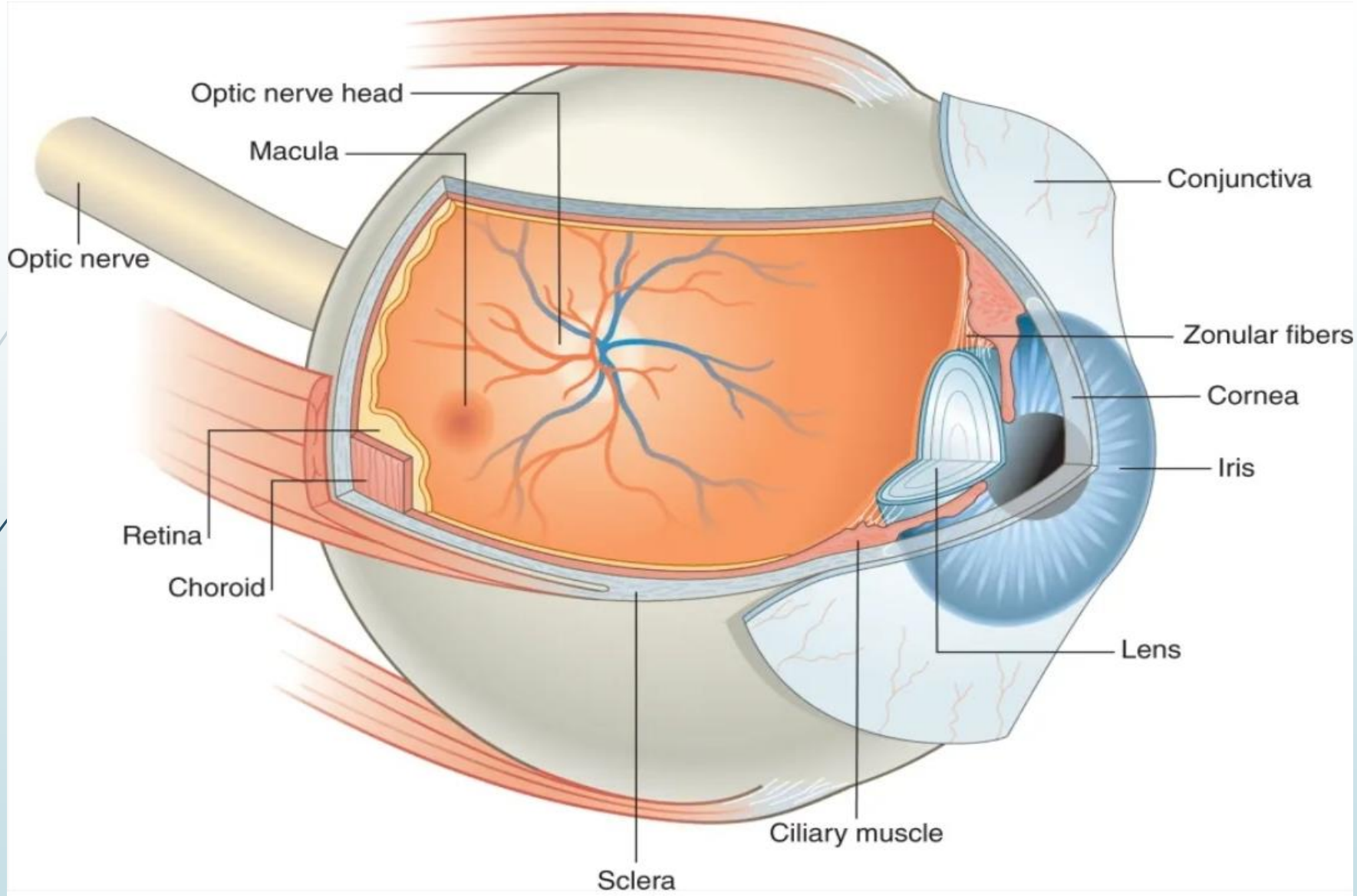
.Below the lower eyelid

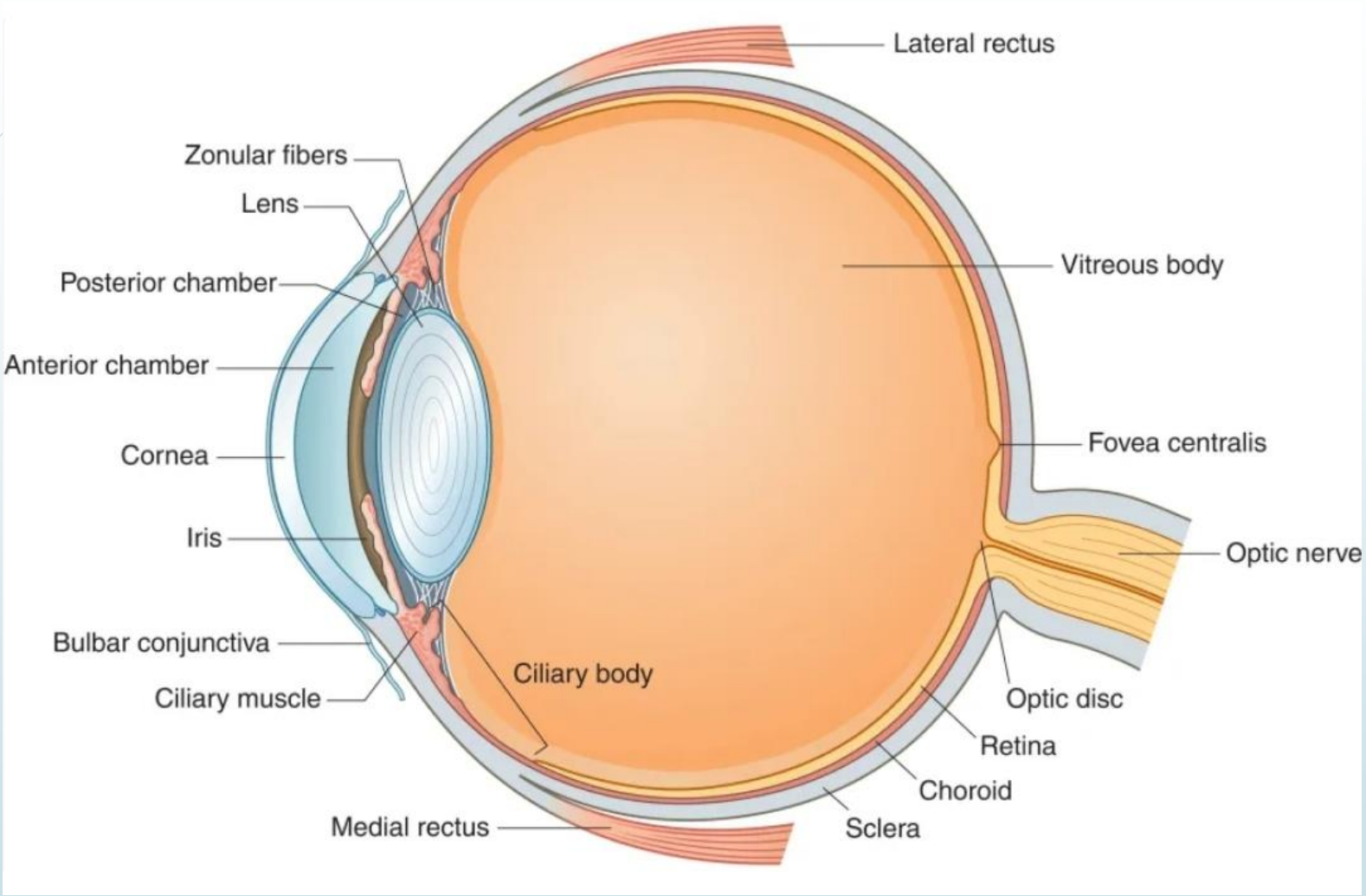
.On the bridge of the nose

.Above and lateral to the globe

Anatomy of the eye

- Although the eye is commonly referred to as the **globe**, it is not really a true sphere.
- It is composed of two spheres with different radii, one set into the other **(Figures 1.1 and 1.2).** The front, or anterior, sphere, which is the smaller and more curved of the two, is called the *cornea*.
- The cornea is the window of the eye because it is a completely trans- parent structure. It is the more curved of the two spheres and sets into the other as a watch glass sets into the frame of a watch.
- The posterior sphere is a white opaque fibrous shell called the *sclera.* The cornea and the sclera are relatively nondistensible structures that encase the eye and form a protective covering for all the delicate structures within.
- In terms of size, the eye measures approximately 24 mm in all its main diameters in the normal adult.


Optic nerve head
Macula
Optic nerve
Conjunctiva
Zonular fibers
Cornea
Iris
Retina
Choroid
Lens
Ciliary muscle
Sclera

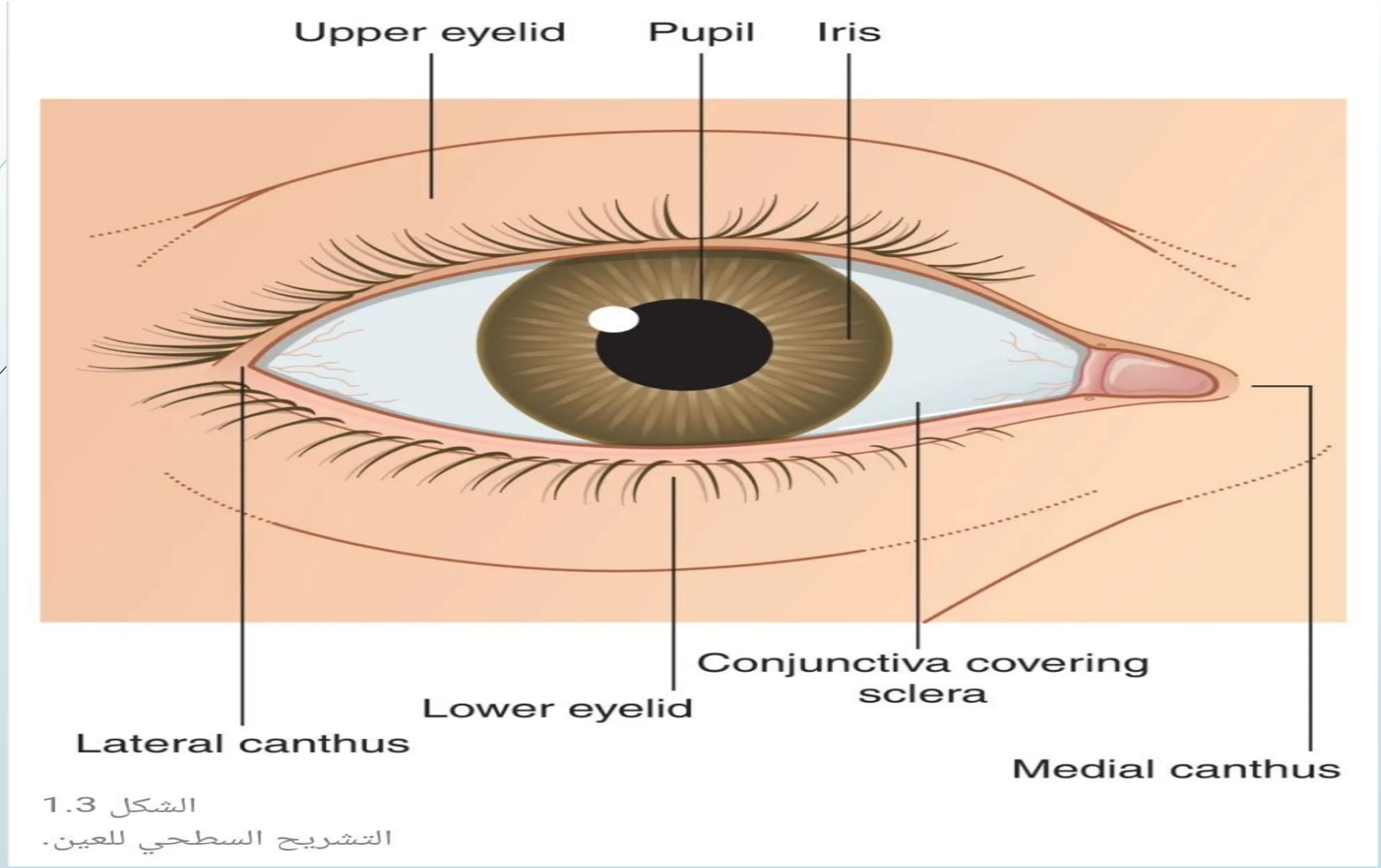

Lateral rectus
Zonular fibers
Lens
Posterior chamber
Vitreous body
Anterior chamber
Fovea centralis
Cornea
Iris
Optic nerve
Bulbar conjunctiva
Ciliary body
Ciliary muscle
Optic disc
Retina
Choroid
Medial rectus
Sclera

SURFACE ANATOMY

- The eye itself is covered externally by the *eyelids*, which are movable folds protecting the eye from injury and excessive light.
- The lids serve to swab the eye and spread a film of tears over the cornea, thereby preventing evaporation from the surface of the eye.
- The upper eyelid extends to the *eye- brow*, which separates it from the forehead, whereas the lower eyelid usually passes without any line of demarcation into the skin of the cheek.
- The upper eyelid is the more mobile of the two and when it is open it covers about 1 mm of the cornea. A muscle that elevates the lid, the *levator palpebrae superioris* , is always active, contracting to keep the eyelid open.
- During sleep the eyelid closes by relaxation of this muscle. The lower lid lies at the lower border of the cornea when the eye is open and rises slightly when it shuts.

SURFACE ANATOMY

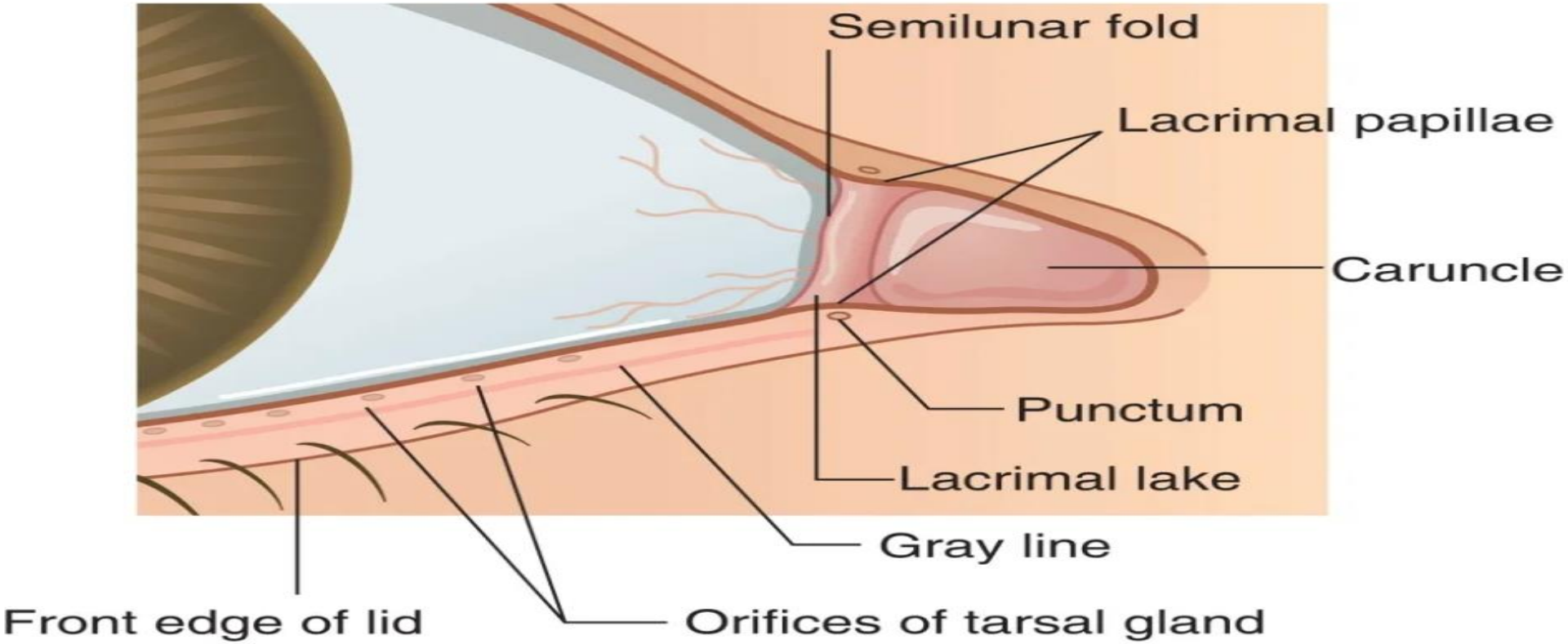
- Normally, when the eyes are open, a triangular space is visible on either side of the cornea.
- These triangular spaces, formed by the junction of the upper and lower lids, are called the *canthi* **(Figure 1.3).**
- These canthi are denoted by the terms *medial* and *lateral,* the former being closer to the nasal bridge.
- Most eyes are practically the same size; therefore, when we speak of the eyes appearing large or small, we usually refer not to the actual size but to the portion of the eyeball visible on external examination, which in turn depends on the size of the *palpebral fissure*.
- The shape of the fissure also determines its appearance.



الشكل 1.3
التشريح السطحي للعين.

SURFACE ANATOMY

- In Asians, a fold of skin extends from the upper lid to the lower lid and covers the medial fissure, giving the eye its characteristic obliquity.
- In the medial fissure there are two fleshy mounds: the deeper one, called the *plica semilunaris* , and the superficial one, called the *caruncle* **(Figure 1.4).**
- The caruncle is modified skin that contains sweat and oil glands. Occasionally it also contains fine cilia or hairs. When the eyes are open, the palpebral fissures measure about 30 mm in width and 15 mm in height.



الشكل 1.4

الزاوية الداخلية للعين، تُظهر الطية الهلالية واللحيمة. عادةً، لا تكون النقطة الدمعية مرئية إلا عند الضغط على الجفن السفلي.

SURFACE ANATOMY

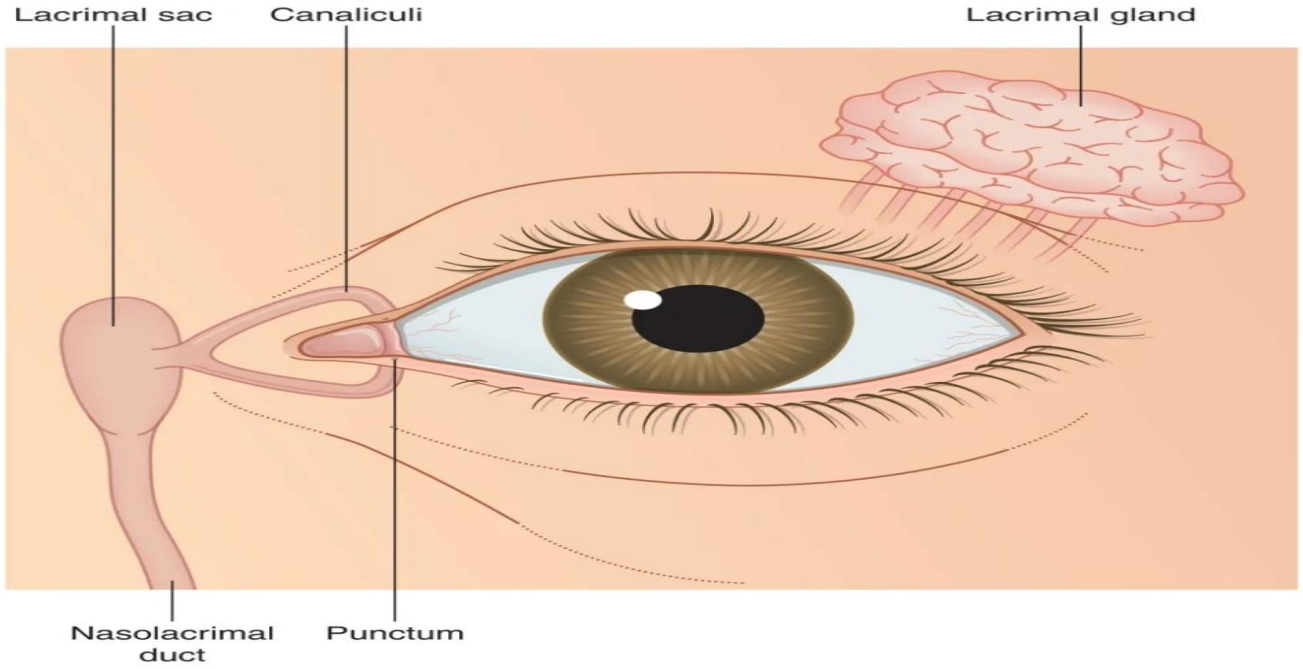
- The free margin of each lid is about 2 mm thick and has an anterior and a posterior border. From the anterior, or front, border rise the *eyelashes,* which are hairs arranged in two or three rows.
- The upper eyelid lashes are longer and more numerous than the lower ones and they tend to curl upward .
- The lashes are longest and most curled in childhood. The posterior border of the lid margin is sharp and tightly abuts against the front surface of the globe.
- By depressing the lower lid, one can see the thin *gray line* that separates the two borders of the lid.
- This gray line is used in many surgical procedures to split the upper and lower lids into two portions. Also visible on both lids are the tiny openings that are the orifices of the sweat- and oil-secreting glands.

SURFACE ANATOMY

- The largest oil-secreting glands, which are embedded in the posterior connective tissue substance of the lids (called the *tarsus*), are called *the meibomian glands*.
- The *lacrimal gland* is located above and lateral to the globe. Tears are produced by the lacrimal gland and travel through fine channels, referred to as *ducts,* to empty onto the conjunctival surface.
- On the medial aspect of the lower lid where the lashes cease is a small *papilla*. At the apex of this papilla is a tiny opening called the *punctum* (**see Figure 1.4).** The punctum leads, by means of a small canal, through the lower lid to *the lacrimal sac* (**Figure 1.5),** which eventually drains into the nose.
- Tears are carried to the punctum by the pumping action of the lids and there they are drained effectively from the eye by means of tiny channels.

SURFACE ANATOMY

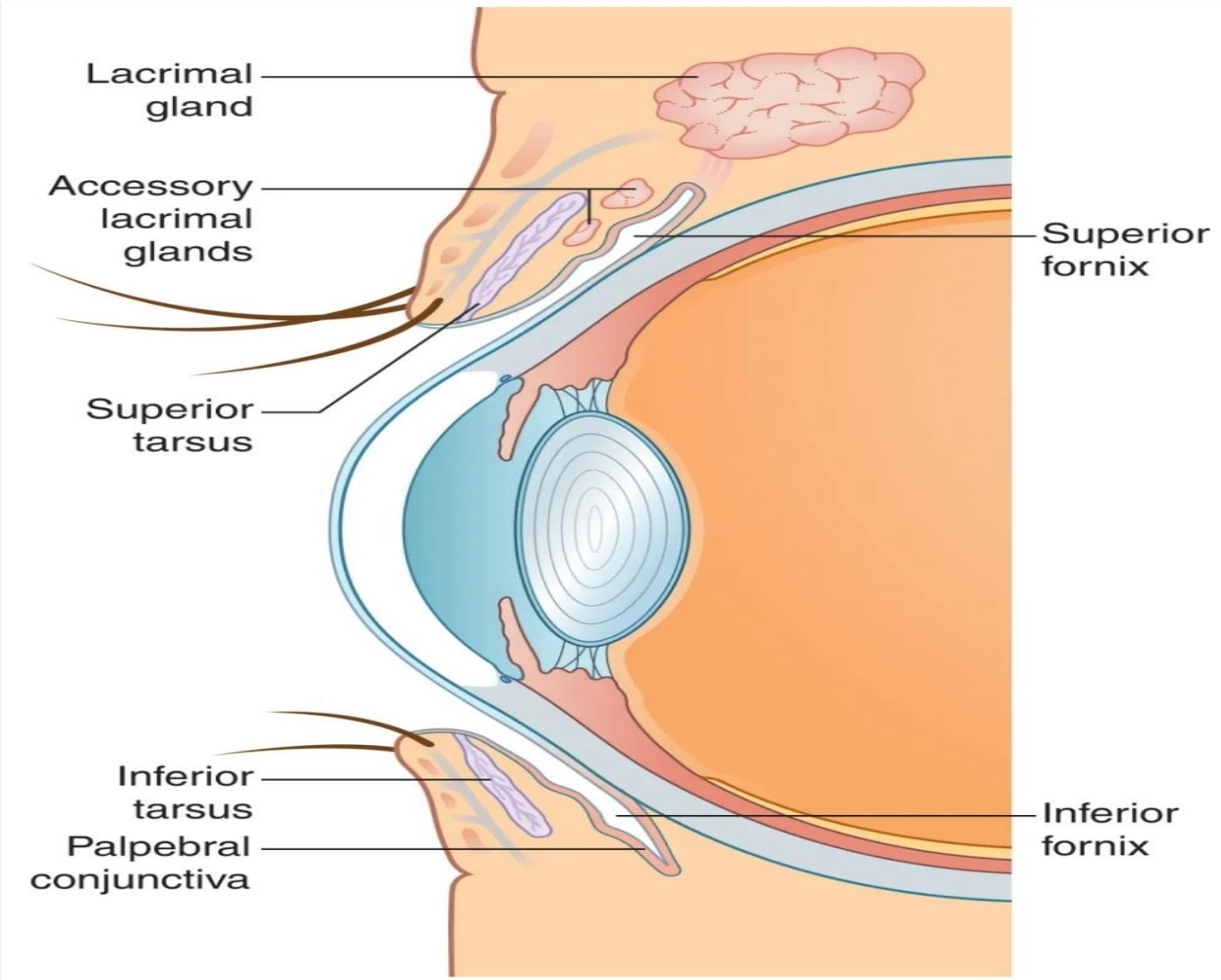
- A similar but smaller opening is found in the upper lid almost directly above it. The punctum normally cannot be seen by looking directly at the eye. It can be seen only by depressing the lower lid or everting the upper lid. The muscle underlying the eyelid skin is the *orbicularis oculi,* which is roughly circular. When it contracts, it closes the eye.



الشكل 1.5
الجهاز الدمعي. يتم تصريف الدموع التي تنتجها الغدة الدمعية من خلال النقطة الدمعية، والكيس الدمعي، والقناة الأنفية الدمعية إلى الأنف.

SURFACE ANATOMY

- The portions of the eye that are normally visible in the palpebral fissures are *the cornea* and *sclera*. Because the cornea is transparent, what is seen on looking at the cornea is the underlying *iris* and the black opening in the center of the iris, called the *pupil*.
- The sclera forms the white of the eye and is covered by a mucous membrane called the *conjunctiva*. The conjunctiva extends from the junction of the cornea and sclera and terminates at the inner portion of the lid margin **(Figure 1.6)**.
- The conjunctiva that covers the eye itself is referred to as the *bulbar conjunctiva*, whereas the portion that lines the inner surface of the upper and lower lids is called the *palpebral conjunctiv*a.
- The junctional bay created when the two portions of the conjunctiva meet is referred to as the *fornix*. The lower fornix easily can be viewed by depressing the lower lid.



الشكل 1.6

مقطع عمودي للجفون والملتحمة. تعمل الجفون كحاجز واقٍ للعين، ولا يظهر منها سوى جزء صغير.

SURFACE ANATOMY

- The role of the conjunctiva is to defend and repair the cornea in the event of scratches, wounds, or infections.
- The almost invisible blood vessels that are present dilate and leak nutrients, antibodies, and leukocytes into the tears that then wash over the avascular corneal surface.
- The conjunctiva also secretes mucus and oil, both of which help to keep the cornea moist and clean and to reduce friction when the lids blink over the cornea. The conjunctival mucous film over the ocular surface catches microorganisms. This mucous net then condenses into a ball and is carried to the nasal canthus where it dries and rolls onto the skin.
- The conjunctiva also helps to resurface the cornea with epithelial cells if the entire corneal surface is scraped or burned.
- Under the conjunctiva is a fibrous layer that overlies the sclera and rectus muscles. This is *Tenon's capsule*, a common surgical landmark.

SUMMARY

- **I.Global Anatomy & Ocular Geometry**
- **Aspherical Nature of the Globe:** Understanding the eye as two overlapping spheres with different radii rather than a true sphere.
- **Segmental Dimensions:** The 24 mm average diameter of the adult eye.
- **The Anterior Segment (Cornea):** Transparency, curvature, and its role as the ocular "window."
- **The Posterior Segment (Sclera):** The fibrous protective shell and its nondistensible properties.
- **II. External Protection: The Palpebral System**
- **Eyelid Anatomy & Function:** Mechanism of protection, light regulation, and the "swabbing" action for tear distribution.
- **Muscular Control:**
  - **Levator palpebrae superioris:** The active muscle for eyelid elevation.
  - **Orbicularis oculi:** The circular muscle responsible for eyelid closure.
- **The Palpebral Fissure:** Dimensions (30 mm x 15 mm) and how fissure size affects the perceived size of the eye.
- **Canthal Anatomy:** Medial and lateral canthi, including the **Plica semilunaris** and the **Caruncle** (glandular tissue).

SUMMARY

- **III. The Lacrimal Apparatus & Tear Dynamics**
- **Tear Production:** The role and location of the **lacrimal gland**.
- **Secretory Glands:**
  - **Meibomian Glands:** Oil secretion within the tarsus to prevent evaporation.
  - **Sweat and Oil Glands:** Orifices located on the lid margins.
- **The Drainage Pathway:** The route from the **puncta** through the canaliculi to the **lacrimal sac** and nasal cavity.
- **The Pumping Mechanism:** How blinking facilitates tear drainage.

SUMMARY

- **IV. Surface Membranes & Surgical Landmarks**
- **The Conjunctiva:**
  - **Bulbar vs. Palpebral:** Differentiation between the membrane covering the globe and the inner lids.
  - **The Fornix:** The junctional bay between the two conjunctival portions.
  - **Defense Mechanisms:** The role of the conjunctiva in corneal repair, vascular response (leukocytes/antibodies), and microbial trapping through mucus production.
- **The Lid Margin:**
  - **The Gray Line:** Its significance as a surgical landmark for splitting lid layers.
  - **Ciliary Anatomy:** Arrangement and characteristics of eyelashes in the upper vs. lower lids.
- **Tenon's Capsule:** The fibrous layer overlying the sclera and extraocular muscles.

Post test :-

- Q1\What is the approximate diameter of a normal adult eye in its main diameters?
- 30 mm
- 40 mm
- 15 mm
- 24 mm

Q2\Draw a horizontal section of the eye with attached muscles and label as many parts as you can without referring to the text.

Unit

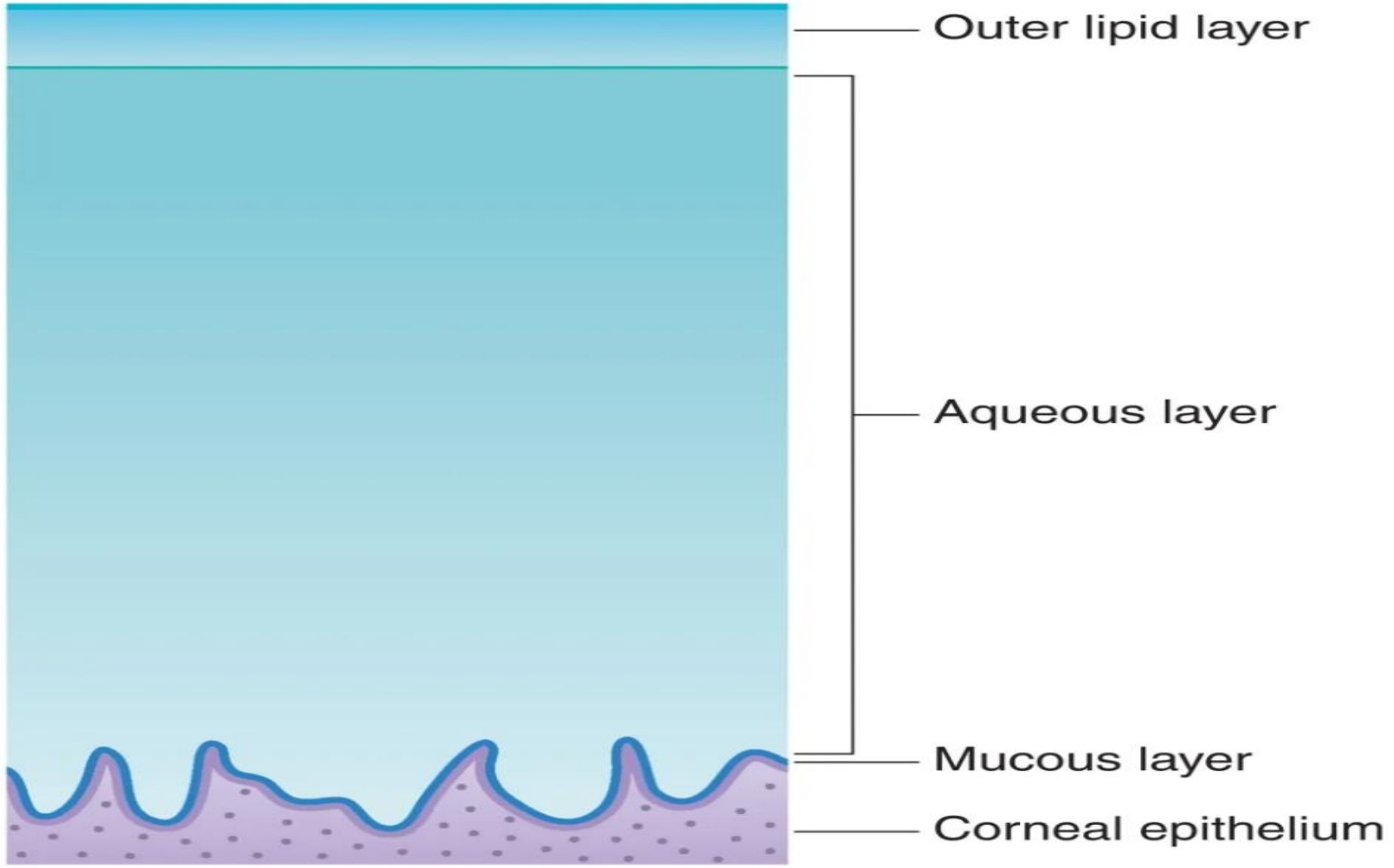
- This lecture focuses on the micro-anatomy of the eye, specifically the composition of the tear film and the layered structure of the cornea. Understanding these layers is critical for clinical practice, particularly regarding contact lens wear and corneal healing.

TEAR FILM

- The tear film is composed of three layers **(Figure 1.7).**
- The outermost layer consists of a lipid or fatty layer, mostly cholesterol esters, and is extremely thin.
- This layer is secreted by the meibomian glands and acts to prevent evaporation of the underlying aqueous layer.
- The central layer is chiefly aqueous, with some dissolved salts as well as glucose, urea, proteins, and lysozyme.
- This layer is secreted by the lacrimal glands.
- The third layer is a very thin mucous layer lying over the surface of the conjunctiva and cornea.
- This layer is secreted by specific cells of the conjunctiva referred to as *goblet cells* and is important in the stability of the tear film.

TEAR FILM

- Tear film abnormalities may arise in association with a number of clinical problems in older adults and in particular problems related to contact lenses.
- **The precorneal tear film layer serves several functions.**
- 1. It forms a smooth refractive surface on the epithelium.
- 2. It maintains a moist environment for the epithelium.
- 3. It carries oxygen to the eye.



الشكل 1.7
بنية الغشاء الدمعي ثلاثية الطبقات.

TEAR FILM

- **The Tear Film Structure**
- The precorneal tear film is a trilaminar (three-layered) structure essential for ocular health and optical clarity.
- **Lipid (Fatty) Layer:** The outermost layer, secreted by the **Meibomian glands**. It consists mainly of cholesterol esters and prevents the evaporation of the watery layer beneath it.
- **Aqueous Layer:** The thick central layer, secreted by the **lacrimal glands**. It contains salts, glucose, proteins, and **lysozyme** (an antibacterial enzyme).
- **Mucous Layer:** The innermost layer, secreted by **goblet cells** in the conjunctiva. It ensures the tear film spreads evenly and remains stable over the corneal surface.
- **Primary Functions of the Tear Film:**
- Provides a smooth refractive surface for clear vision.
- Maintains a moist environment for epithelial cells.
- Supplies vital oxygen to the avascular cornea.

Post test :-

- **Q\ OUTLINE THE PRODUCTION AND FLOW OF TEARS .**

- **Q\WHAT ARE THE FUNCTIONS OF precorneal tear film layer**

UNIT

- This lecture focuses on the micro-anatomy of the eye, specifically the composition of the tear film and the layered structure of the cornea. Understanding these layers is critical for clinical practice, particularly regarding contact lens wear and corneal healing.

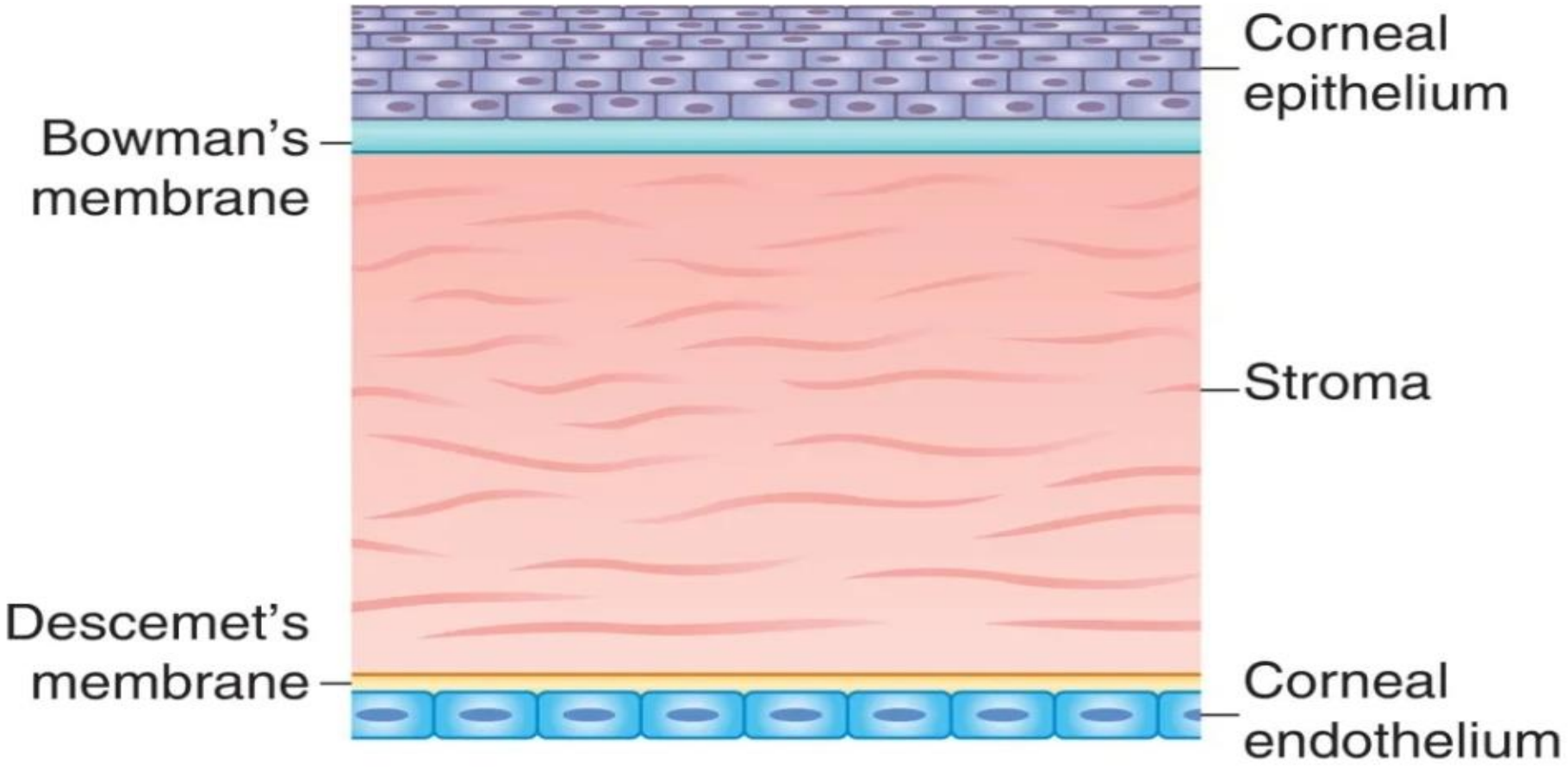
CORNEA

- The cornea is a clear, transparent structure with a brilliant, shiny surface. It has a convex surface that acts as a powerful lens.
- Most of the refraction of the eye takes place not through the crystalline lens of the eye but through the cornea.

- The cornea is relatively large at birth and almost attains its adult size during the first and second years.
- Although the eyeball as a whole increases a little less than three times in volume from birth to maturity, the corneal segment plays a small role in this part, being fully developed by 2 years of age

CORNEA

- The cornea is thicker at its periphery (1 mm) than at the center (0.5 mm). It can be divided into five distinct portions **(Figure 1.8):** the epithelium, Bowman's membrane, the stroma, Descemet's membrane, and the endothelium.
- The ***epithelium*** is the part of the cornea usually injured by superficial abrasions or small foreign bodies. It is 5 to 7 cells thick (50 µm) and is composed of nonkeratinized stratified squamous cells. The epithelium functions as a barrier and as an important refractive optical surface. It regenerates rapidly and heals without leaving a scar. Injury to the deeper structures usually results in formation of an opacity in the cornea.
- ***Bowman's membrane*** consists of randomly oriented collagen fibrils of greater periodicity than the underlying stroma. This acellular layer, which is 10 µm thick, has no regenerative capabilities. Its function is unclear.



الشكل 1.8

القرنية في مقطع عرضي يوضح موضع وتسلسل الطبقات (الرسم ليس على المقياس).

CORNEA

- The layer just under Bowman's membrane is the ***stroma***. This structure is 950 µm at the periphery and about 450 µm centrally; it accounts for 90% of the corneal thickness. The stroma consists of 200 to 250 evenly spaced type I collagen lamellae, which are oriented at right angles to their adjacent lamellae. It is composed of 78% water.

- ***Descemet's membrane*** is 3 µm thick at birth, and 10 to 12 µm thick in older adults. It is composed of type III collagen. This very elastic layer retracts if cut. It forms the basement membrane of the epithelial cells.

CORNEA

- The ***endothelium*** is a 4 to 6 μm monolayer of 500,000 cells.
- There is no known mechanism of attachment between the endothelium and Descemet's membrane.
- The endothelium is responsible for maintaining deturgescence of the cornea.
- No regeneration of this layer has been shown in humans.
- Corneal edema (swelling) can occur when contact lens materials, overwear, improper cleaning, or improper fit. does not allow sufficient oxygen to reach the cornea.

CORNEA

- The junction of the cornea and sclera is demarcated by a demarcated by a gray, semitransparent area referred to as the *limbus*.
- This transitional zone is only 1 mm wide and marks the point of insertion of the conjunctiva. The cornea, which contains no blood vessels, is completely nourished by three sources: **a plexus of fine capillaries at the limbus, the tear film, and the aqueous humor.**
- In a paper published in *Ophthalmology* in 2013, by Dua et al., the existence of a newly described pre-Descemet's layer, hypothetically 15 µm thick, was suggested. Time will be needed to see if others can confirm the existence of this new layer and its potential significance.

- **II. Anatomy of the Cornea**
- **Refractive Power:** The cornea's role as the eye's primary lens (responsible for more refraction than the crystalline lens).
- **Developmental Timeline:** Growth patterns from birth to age two.
- **Physical Dimensions:** Central vs. peripheral thickness (0.5 mm vs. 1.0 mm).
- **The Five Classic Layers:**
  - **Epithelium:** Rapid regeneration and barrier function.
  - **Bowman's Membrane:** Acellularity and the risk of permanent opacities/scarring.
  - **Stroma:** Collagen lamellae arrangement and water content (78%).
  - **Descemet's Membrane:** Elasticity and basement membrane role.
  - **Endothelium:** The monolayer responsible for **deturgescence** (fluid balance).
- **Dua's Layer:** The 2013 discovery of the pre-Descemet's layer.

- **III. Ocular Physiology & Nutrition**
- **Corneal Nutrition:** How an avascular structure survives via the **limbal capillaries**, **tear film**, and **aqueous humor**.
- **Deturgescence and Edema:** The mechanism of the endothelial pump and the consequences of hypoxia (oxygen deprivation) often caused by improper contact lens use.
- **The Limbus:** The anatomical significance of the 1 mm transitional zone between the cornea and sclera.
- **IV. Clinical Landmarks & Healing**
- **Scarring Potential:** Differentiating between epithelial injuries (which heal clear) and deep stromal injuries (which leave scars).
- **Lid-Cornea Interaction:** The role of the blink in maintaining the ocular surface.

Post test :-

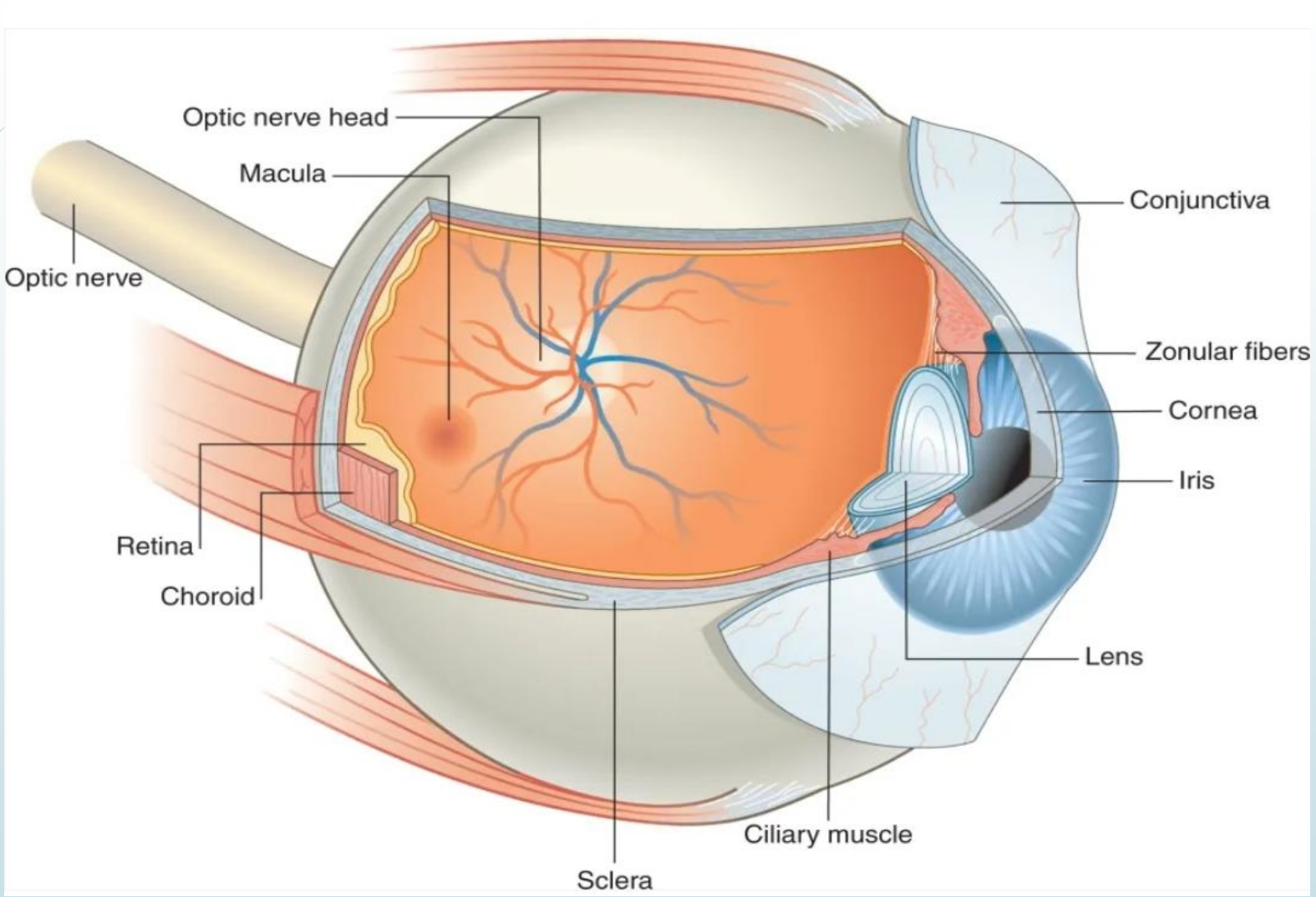
- Q\NAME THE FIVE LAYERS OF THE CORNEA .
- Q\At what age is the cornea fully formed? At what age is the rest of the eyeball fully formed?
- If the epithelium of the cornea is damaged, a fine scar will appear. **T** or **F.**

UNIT

- This lecture covers the structural integrity of the globe provided by the sclera and the vital functions of the uveal tract, which is the vascular and muscular middle layer of the eye.

SCLERA

- The opaque sclera forms the posterior five-sixths of the eye's protective coat.
- Its anterior portion is visible and constitutes the white of the eye. In children the sclera is thin, and therefore it appears bluish because the underlying pigmented structures are visible through it.
- In old age it may become yellowish because of the deposition of fat. Attached to the sclera are all the extraocular muscles


Optic nerve head
Macula
Optic nerve
Conjunctiva
Zonular fibers
Cornea
Iris
Retina
Choroid
Lens
Ciliary muscle
Sclera

SCLERA

- Through the sclera pass the nerves and the blood vessels that penetrate the interior of the eye.
- At its most posterior portion, the site of attachment of the *optic nerve,* the sclera becomes a thin, sieve-like structure called the *lamina cribrosa*, through which the retinal fibers leave the eye to form the optic nerve.
- The episcleral tissue is a loose connective and elastic tissue that covers the sclera and unites it with the conjunctiva above. Unlike the sclera, the episcleral tissue is highly vascular.

SCLERA

- **The Sclera: The Protective Shell**
- The sclera is the tough, white outer layer forming the posterior **five-sixths** of the eye.
- **Appearance:**
  - **Children:** Appears **bluish** because the thin sclera allows underlying pigment to show through.
  - **Elderly:** Can appear **yellowish** due to fat deposition.
- **Key Landmarks:**
  - **Lamina Cribrosa:** A sieve-like area at the back of the eye where retinal fibers exit to form the optic nerve.
  - **Episcleral Tissue:** A highly vascular, loose connective tissue layer that sits between the sclera and the conjunctiva.
- **Function:** It serves as the attachment point for all extraocular muscles and acts as a conduit for nerves and blood vessels entering the eye.

Post test :-

- 1. The main function of the sclera is to keep out light. **T** or **F** .

- 2.It serves as the attachment point for all extraocular muscles and acts as a conduit for nerves and blood vessels entering the eye. **T** or **F**

UNIT

- This lecture covers the structural integrity of the globe provided by the sclera and the vital functions of the uveal tract, which is the vascular and muscular middle layer of the eye.

UVEA

- The uveal tract consists of three structures: the *iris*, *ciliary body,* and *choroid*.
- **Iris**
- The iris is the most anterior structure of the uveal tract. It is perforated at its center by a circular aperture called the *pupil*. The iris has many ridges and furrows on its anterior surface. Contraction of the iris, which occurs in response to bright light, is accomplished by the activity of a flat, washer-like muscle called the *sphincter pupillae* , buried in its substance just surrounding the pupillary opening.

UVEA

- . Expansion or dilation of the pupil is facilitated by relaxation of the sphincter muscle and by activation of the radially oriented dilator muscle of the iris found at its peripheral circumference.
- Expansion and contraction of the iris, like an accordion, form circular pleat lines or furrows visible on its surface.
- In addition to these ridges and furrows, numerous white zigzag lines are formed by the blood vessels of the iris.
- Between the iris and the cornea is a clear fluid called the *aqueous humor*. This fluid occupies the space called the *anterior chamber* of the eye.

UVEA

- **Ciliary body** The *ciliary body* (**Figure 1.9)** is in direct continuity with the iris and is adherent to the underlying sclera.
- Directly posterior to the iris, the ciliary body is plump and thrown into numerous folds referred to as the ciliary processes. This portion of the ciliary body is only about 2.5 mm in length and is responsible for the major production of aqueous fluid.
- The equator of the lens is only 0.5 mm from the ciliary processes and is suspended by fine, ligamentous fibers known as the *zonular fibers* of the lens.
- The posterior portion of the ciliary body is flat. Most of the zonular fibers of the lens originate from the ciliary body.
- The ciliary body in general is triangular, with its shortest side anterior. The anterior side of the triangle in its inner part enters the formation. of the angle of the anterior chamber. The iris takes root from its middle portion.

UVEA

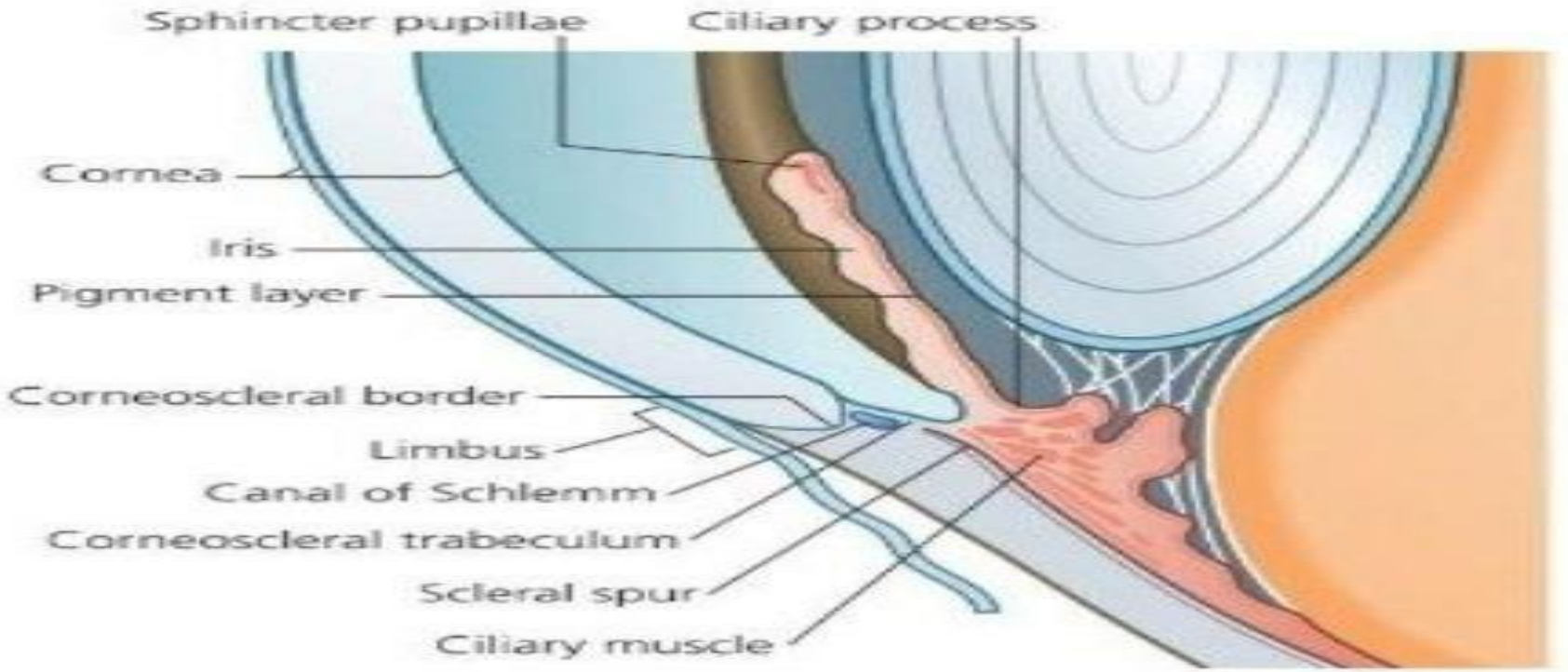


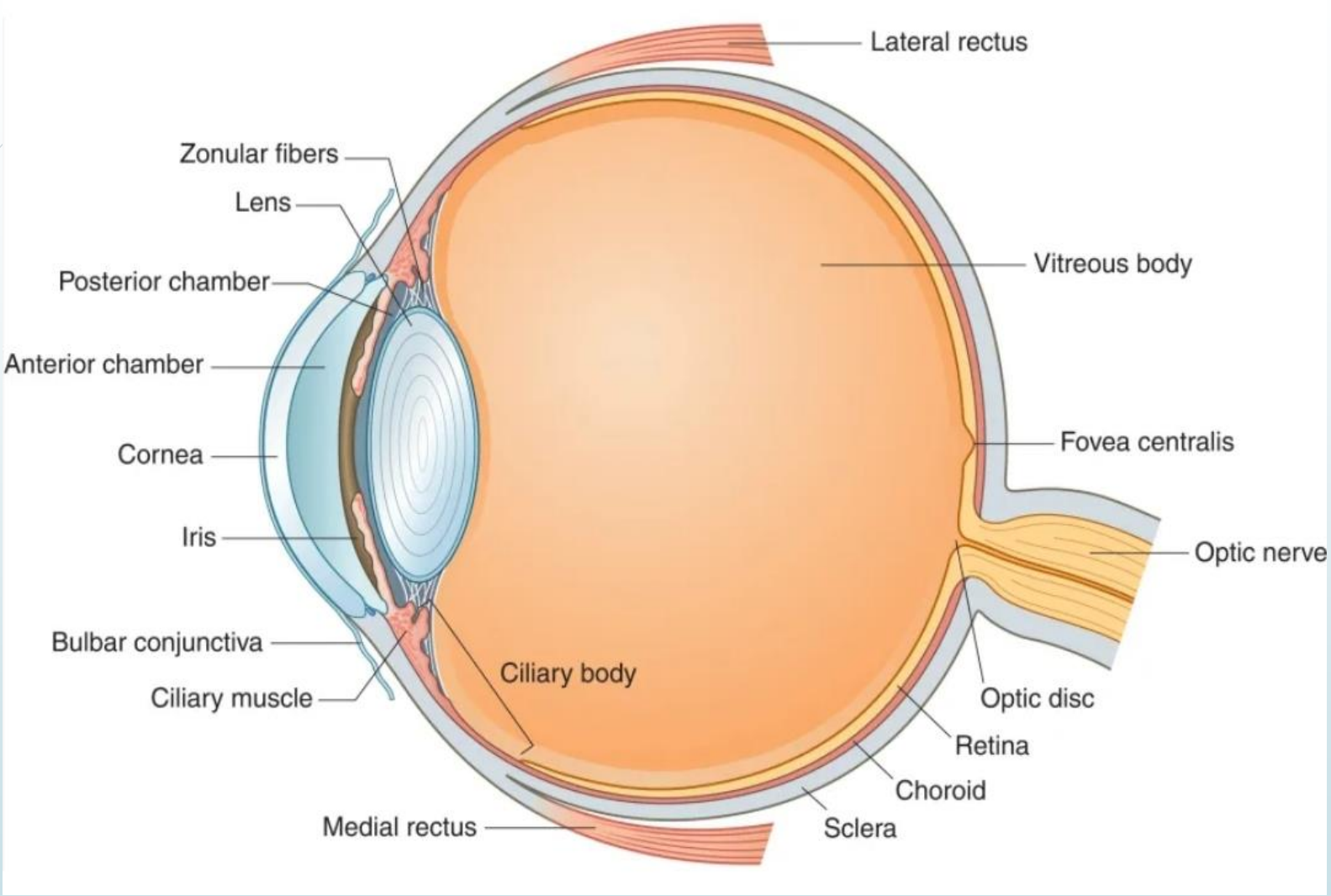
Figure 1.9 Ciliary body and angle structures of the eye. The angle is formed between the iris and the back surface of the cornea, with the aqueous humor of the anterior chamber interposed. The angle structures include the corneoscleral trabeculum, Schlemm's canal, scleral spur, a small extension of the ciliary muscle, and the root of the iris.

UVEA

- On the outer side of the triangle is the ciliary muscle, which lies against the sclera.
- Contraction of the ciliary muscle releases the tension of the zonular fibers, controlling the size and shape of the lens.
- This in turn allows the anterior surface of the lens to bulge forward and increase its power. Therefore, the ciliary muscle directly controls the focusing ability of the eye.
- In children this muscle is extremely active and the lens is easily deformed, which accounts for its powerful range of accommodation, or focusing abilities.
- The ciliary muscle declines with age; after the age of 40 its power becomes weaker and the lens is less able to change shape, so that focusing at near point, or accommodating, becomes difficult. This condition is commonly referred to as *presbyopia*.

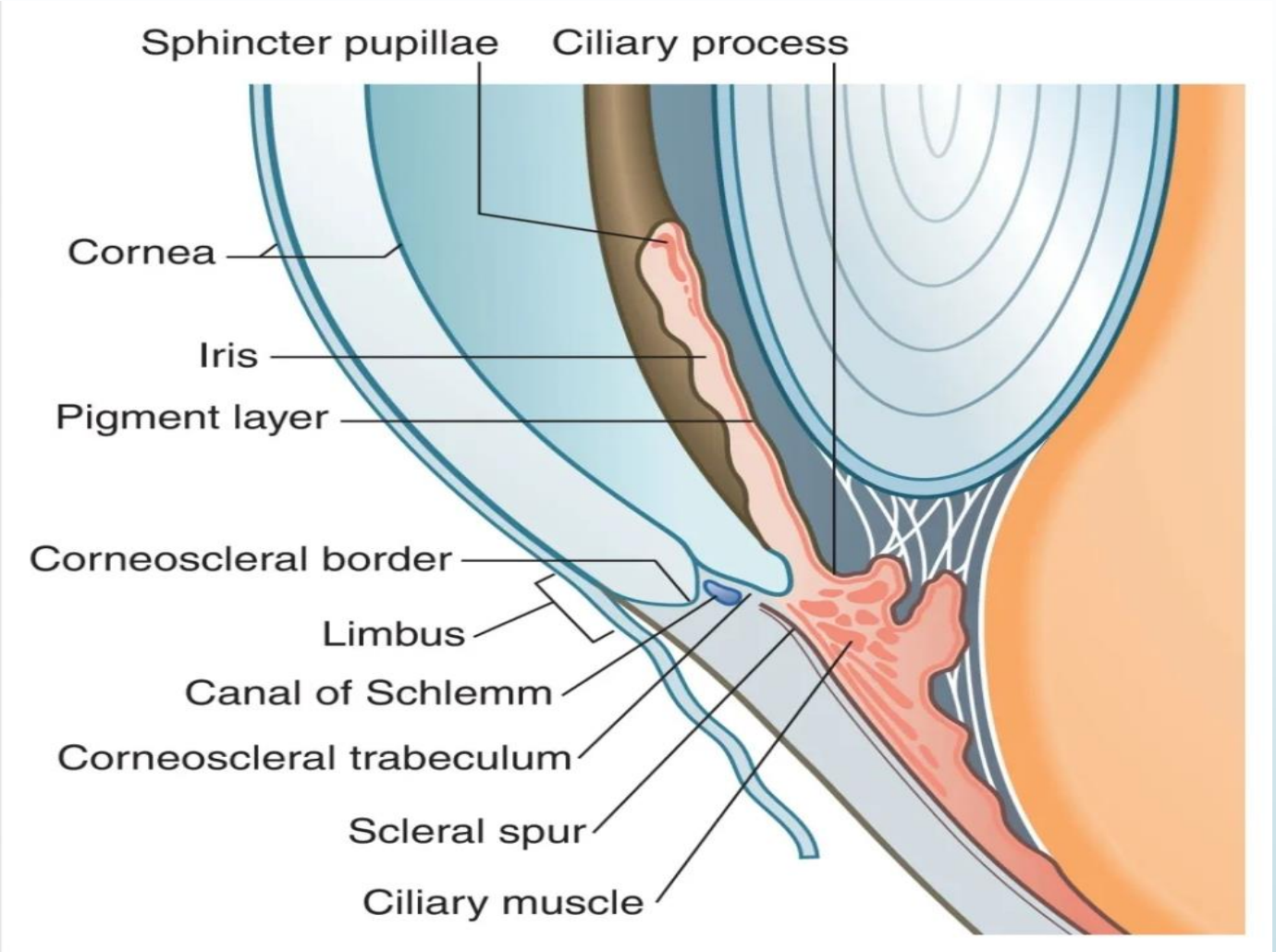
UVEA

- **Choroid**
- The choroid is in direct continuity with the iris and ciliary body and lies between the retina and sclera (**see Figure 1.2).** The choroid is primarily a vascular structure. Its primary function is to provide nourishment for the outer layers of the retina.


Lateral rectus
Zonular fibers
Lens
Posterior chamber
Vitreous body
Anterior chamber
Fovea centralis
Cornea
Iris
Optic nerve
Bulbar conjunctiva
Ciliary body
Ciliary muscle
Optic disc
Retina
Choroid
Medial rectus
Sclera

- **The Uveal Tract (Uvea)**
- The uvea is composed of three continuous structures: the iris, ciliary body, and choroid.
- **A. The Iris**
- The most anterior part of the uvea, acting as the eye's diaphragm.
- **Pupillary Control:**
  - **Sphincter Pupillae:** A circular muscle that constricts the pupil in bright light.
  - **Dilator Muscle:** Radially oriented fibers that expand the pupil.
- **Anatomy:** Contains ridges, furrows, and zigzag blood vessels. It separates the cornea from the **anterior chamber**, which is filled with aqueous humor.

- **B. The Ciliary Body**
- A triangular structure responsible for two critical functions:
- **Aqueous Production:** The anterior portion (ciliary processes) produces the majority of the eye's aqueous fluid.
- **Accommodation (Focusing):**
  - The **ciliary muscle** controls the tension of the **zonular fibers** (ligaments holding the lens).
  - **Presbyopia:** As we age (usually after 40), the ciliary muscle weakens and the lens becomes less flexible, making near-focusing difficult.


Sphincter pupillae
Ciliary process
Cornea
Iris
Pigment layer
Corneoscleral border
Limbus
Canal of Schlemm
Corneoscleral trabeculum
Scleral spur
Ciliary muscle

- **C. The Choroid**
- The posterior portion of the uveal tract, situated between the retina and the sclera.
- **Primary Function:** It is a highly vascularized layer that provides essential **nourishment** to the outer layers of the retina.

Post test :-

- Q\HOW DOES THE IRIS CONTRACT AND EXPAND ?

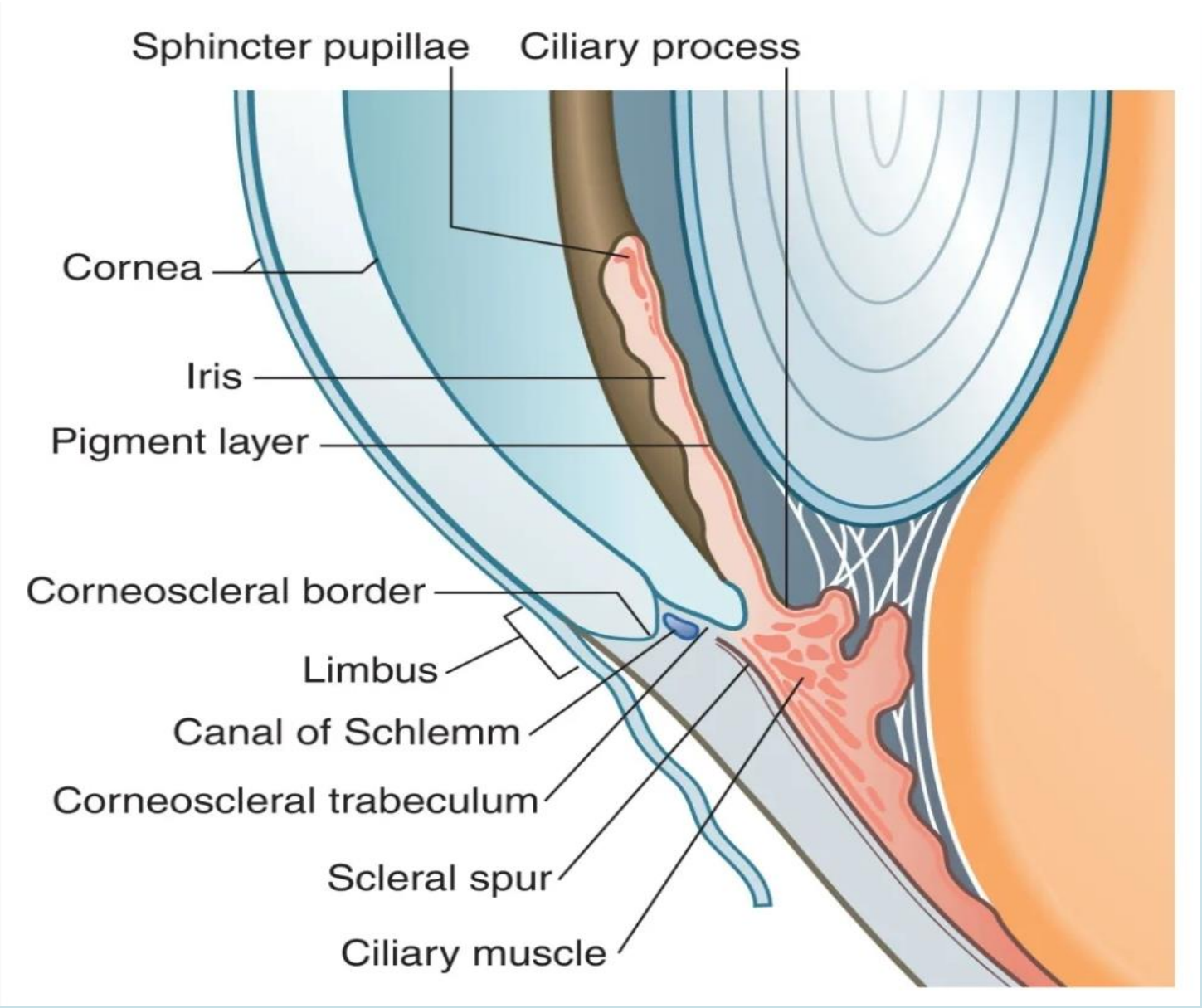
- Contraction of the iris, which occurs in response to bright light .T OR F

UNIT

- This lecture explores the internal drainage systems and the major structural components of the posterior segment: the angle structures, the crystalline lens, and the vitreous humor.

ANGLE STRUCTURES

- The angle structures are formed by the tissues posterior to the cornea and anterior to the iris, with the aqueous humor intervening **(see Figure 1.9).**
- Included in the angle strucures are
- (1) the root of the iris,
- (2) a portion of the anterior surface of the ciliary body,
- (3) a *spur* from the sclera,
- (4) the *canal of Schlemm,* and
- (5) the *corneoscleral trabeculum*.


Sphincter pupillae
Ciliary process
Cornea
Iris
Pigment layer
Corneoscleral border
Limbus
Canal of Schlemm
Corneoscleral trabeculum
Scleral spur
Ciliary muscle

ANGLE STRUCTURES

- Aqueous humor leaves the eye by filtering through the crevices of the *trabecular meshwork*.
- The trabecular meshwork consists of tiny pores through which aqueous humor travels until it reaches *Schlemm's canal*.
- From *Schlemm's canal* the aqueous humor leaves the eye through the aqueous veins that penetrate the sclera.
- Obstruction within the trabecular meshwork or the angle structures, by iris or scar tissue, results in raised intraocular pressure and glaucoma.

LENS

- The lens of the eye is a transparent biconvex structure situ- ated between the iris and the vitreous **(Figure 1.10).**
- Only that portion of the lens not covered by iris tissue (that is, only that portion directly behind the pupillary space) is visible. The center of the anterior surface of the lens, known as its anterior pole, is only about 3 mm from the back surface of the cornea.
- The diameter of the lens is about 9 to 10 mm. Its peripheral margin, called the *equator,* lies about 0.5 mm from the ciliary processes.
- It is attached to the ciliary processes and to the posterior portion of the ciliary body by means of fine suspensory ligaments referred to as the *zonular fibers* (**Figure 1.11).**

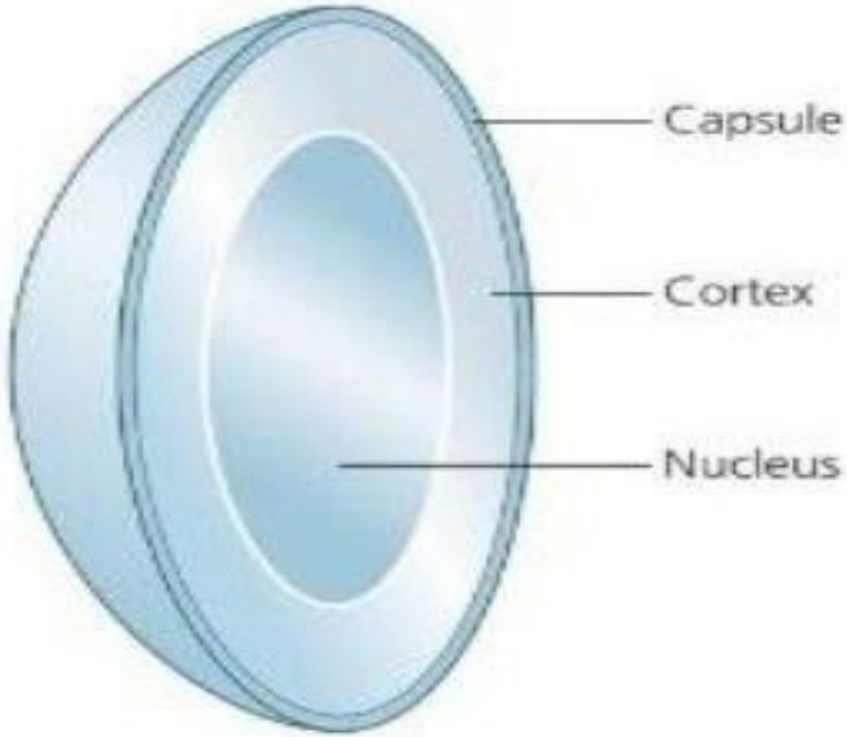


Figure 1.10 Crystalline lens.

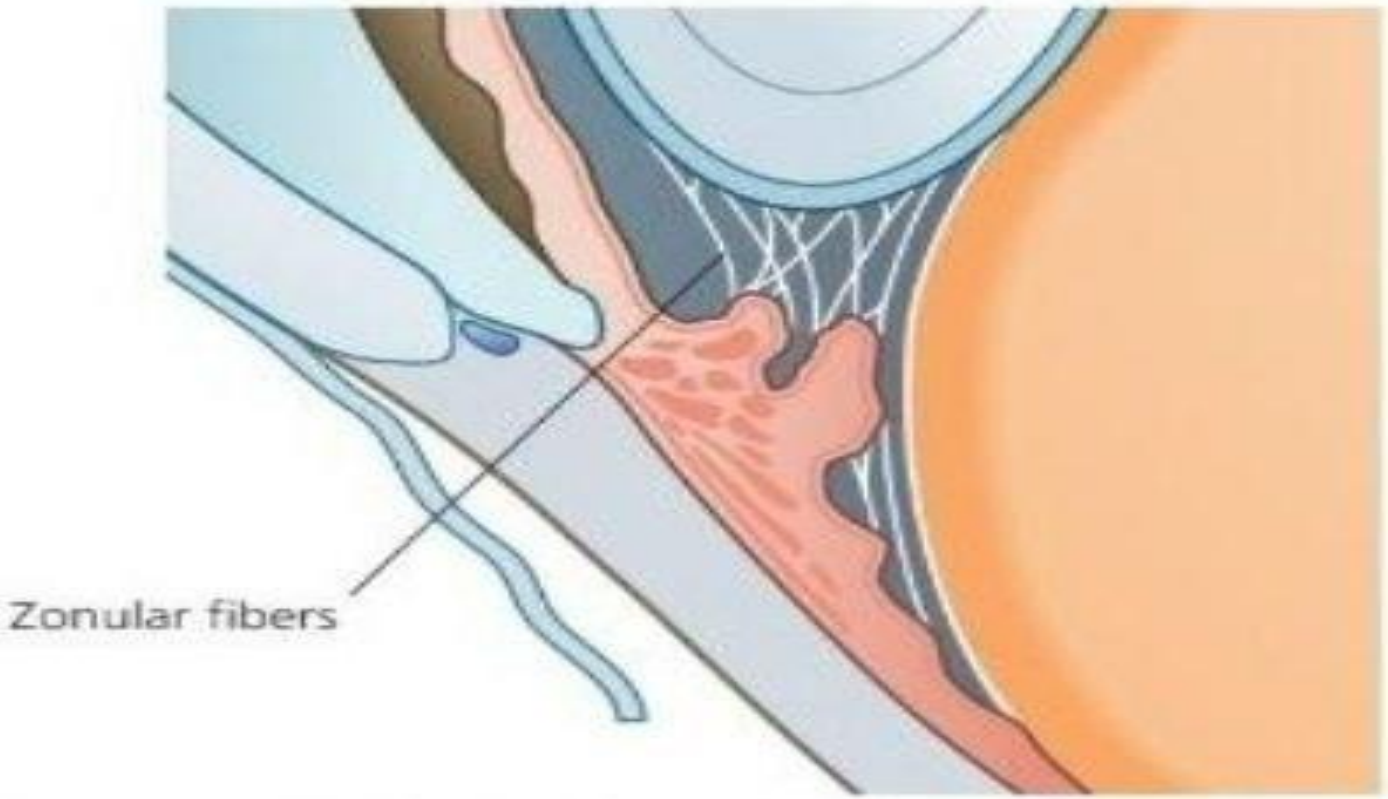


Figure 1.11 Distribution of zonular fibers. Zonular lamella forms the external layer of the lens capsule, consisting of the anterior insertion 1 mm from the equator and the posterior insertion 1.5 mm from the equator.

(Adapted from Jaffe NS: The vitreous in clinical ophthalmology. St Louis: Mosby, 1969.)

LENS

- The lens is surrounded by a capsule, which is a transparent, highly elastic envelope.
- The lens material within this elastic bag is rather soft and putty-like in infants. With age it tends to grow harder, especially toward the center of the lens.
- The harder central portion of the lens found in adults 30 years of age or older is called the *nucleus* of the lens, and the outer lens fibers form the lens *cortex*.
- The harder nucleus is a product of the normal developmental growth of the lens. As new lens fibers are produced, the older fibers are pushed more toward the center and are compressed in a concentric fashion.
- It is this constant lamination of lens fibers over a period of years that eventually produces the nucleus.

- **I. Angle Structures & Aqueous Outflow**
- **The Anatomy of the Angle:** Identification of the five key tissues:
  - Root of the iris.
  - Anterior ciliary body.
  - Scleral spur.
  - Canal of Schlemm.
  - Corneoscleral trabeculum (Trabecular Meshwork).
- **The Outflow Pathway:** The movement of aqueous humor from the meshwork pores to Schlemm's canal and eventually into the aqueous veins.
- **Clinical Correlation (Glaucoma):** How obstructions in this drainage system lead to elevated intraocular pressure (IOP) and optic nerve damage.

- **II. The Crystalline Lens**
- **Physical Properties:** The biconvex, transparent nature of the lens and its dimensions (9–10 mm diameter).
- **Positioning:** The relationship between the anterior pole, the cornea (3 mm distance), and the ciliary processes (0.5 mm distance).
- **Anatomical Components:**
  - **The Lens Capsule:** The highly elastic outer envelope.
  - **The Nucleus vs. Cortex:** The hardening of the center (nucleus) due to lifetime fiber lamination.
- **Suspensory Mechanism:** The role of the **zonular fibers** in anchoring the lens to the ciliary body.

Post test :-

- The transparent lens of the eye is attached to the ciliary body by fine suspensory ligaments called----------
- The relationship between the anterior pole, the cornea (3 mm distance), and the ciliary processes (0.5 mm distance). T OR F

UNIT

- This lecture explores the internal drainage systems and the major structural components of the posterior segment: the angle structures, the crystalline lens, and the vitreous humor.

VITREOUS

- The vitreous is a jelly-like structure, thick and viscous, that occupies the vitreous chamber in the posterior concavity of the globe.
- Actually, it fills the largest cavity of the eye, occupying two-thirds of its volume. It is surrounded mainly by retina.
- Anteriorly it forms a slight depression behind the lens and is attached to it around the circumference of this depression. Normally the vitreous is quite transparent.

VITREOUS

- The vitreous is not simply an inert jelly. Within the body of the vitreous, fine collagen fibers crisscross in a scaffolding manner.
- The resulting matrix is filled with a viscous mucopolysaccharide, called hyaluronic acid.
- Vitreous is almost 99% water. Hyaluronic acid is a great shock absorber and can compress slowly and rebound slowly.
- This is important in injuries to the eye from such things as a fast-moving squash ball.

VITREOUS

- The envelope that surrounds the vitreous is primarily a condensate of the gel and is anchored to the more forward part of the retina, the *ora serrata,* and at the head of the optic nerve along the major retinal blood vessels.
- If the vitreous shrinks, the resulting tension on its anchors can produce a tear in the retina. This may permit the adjacent vitreous to enter between the choroid and retina and produce a retinal detachment.

VITREOUS

- With age, some of the collagen fibers of the vitreous often break away from the main structure.
- These may condense into strands and float freely in the watery sections of the vitreous.
- Patients often see floating specks or webs that move as their eyes move and that are mildly annoying but usually harmless. These often disappear in time.

- **The Vitreous Humor**
- **Physical Volume:** The vitreous as the largest ocular cavity, filling two-thirds of the globe's volume.
- **Biochemical Composition:**
  - 99% water content.
  - The collagen fiber scaffold.
  - **Hyaluronic Acid:** Its role as a viscoelastic shock absorber.
- **Attachments & Anchors:** Connection points at the lens, the **ora serrata**, and the optic nerve head.
- **Age-Related Degeneration:**
  - **Vitreous Shrinkage:** The mechanics of retinal tears and detachment.
  - **Floaters:** The condensation of collagen fibers into visible specks or webs.

Post test :-

- **Q\ WHAT IS THE ora serrata?**
- **Q\DESCRIBE THE vitreous .**

UNIT

- This lecture explores the **Retina**, the innermost sensory layer of the eye that acts as a direct extension of the brain, converting light into the neural signals required for sight

RETINA

- The retina, which contains all the sensory receptors for the transmission of light, is really part of the brain.
- The retinal receptors are divided into two main populations:
- the *rods* and the *cones*.
- The rods function best in dim light; the cones function best under daylight conditions.
- The cones number only about 6 million, whereas the rods number 125 million. Cones enable us to see small visual angles with great acuity.

RETINA

- Vision with rods is relatively poor.
- Color vision is totally dependent on the integrity of the cones.
- The cones form a concentrated area in the retina known as the fovea, which lies in the center of the *macula lutea* .
- Damage to this area can severely reduce the ability to see directly ahead.
- The rods are distributed in the periphery of the retina (not in the macula).
- Damage to these structures results in night blindness but with retention of good visual acuity for objects straight ahead.

RETINA

- The junction of the periphery of the retina and the ciliary body is called the *ora serrata*.
- In the extreme periphery of the retina there are no cones and only a few rods.
- The retina is firmly attached to the choroid at the ora serrata. This is the reason that retinal detachments never extend beyond the ora serrata.
- The other site of firm attachment of the retina is at the circumference of the optic nerve.
- The posterior layer of the retina, called the *pigment epithelium*, is firmly secured to the choroid.
- Retinal detachment occurs as a result of cleavage between its anterior layers and the posterior pigment layer.

- **1. Photoreceptor Populations**
- The retina contains two distinct types of sensory receptors, each specialized for different lighting conditions and visual tasks:
- **The Cones (Daylight & Detail):**
  - **Quantity:** Approximately **6 million**.
  - **Function:** Responsible for high **visual acuity** (sharpness) and **color vision**.
  - **Location:** Highly concentrated in the **fovea**, which is the center of the **macula lutea**.
  - **Clinical Note:** Damage to the macula/fovea severely impairs "straight-ahead" (central) vision.
- **The Rods (Night & Periphery):**
  - **Quantity:** Approximately **125 million**.
  - **Function:** Specialized for **dim light** (scotopic vision). They provide poor sharpness compared to cones.
  - **Location:** Distributed in the **periphery** of the retina; they are absent in the macula.
  - **Clinical Note:** Damage to rods leads to **night blindness**, though central vision remains clear.

- **2. Anatomical Landmarks**
- **Ora Serrata:** The jagged junction where the peripheral retina meets the ciliary body. In this extreme periphery, there are no cones and very few rods.
- **Macula Lutea:** The central area of the retina specialized for high-acuity vision.
- **3. Retinal Attachment and Detachment**
- The structural integrity of the retina depends on specific attachment points to the underlying choroid.
- **Firm Attachments:**
  - The **Ora Serrata** (peripheral limit).
  - The circumference of the **Optic Nerve**.
- **Pigment Epithelium:** The posterior-most layer of the retina which is firmly secured to the choroid.
- **Mechanics of Detachment:** A **retinal detachment** occurs when a cleavage (separation) forms between the anterior sensory layers of the retina and the posterior pigment epithelium. Because of the firm attachment at the ora serrata, detachments cannot extend beyond that point.

Post test :-

- Discuss the functions of the rods and cones.

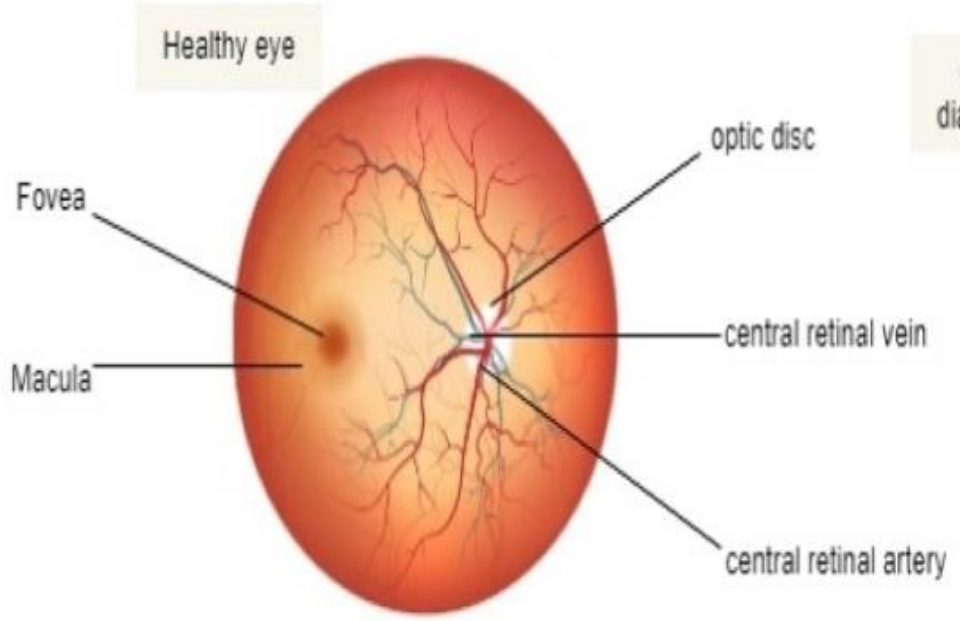
- The retina consists of rods and cones. The---------- function best in daylight.

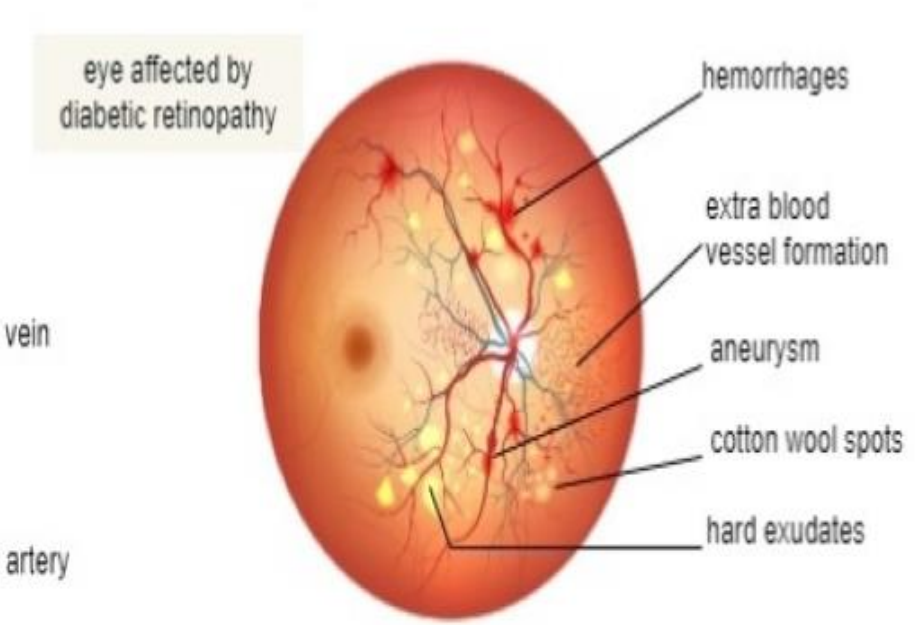
UNIT

- This lecture concludes the anatomical journey of the eye by focusing on the **Optic Nerve**, the vital communication link between the sensory retina and the brain.

OPTIC NERVE

- The optic nerve is located at the posterior portion of the globe and transmits visual impulses from the retina to the brain itself.
- Only the head of the optic nerve, called the *optic disc,* can be seen by ophthalmoscopic examination **(Figure 1.12).**
- The optic nerve contains no sensory receptors itself and therefore its position corresponds to the normal blind spot of the eye.
- Branching out from the surface of the optic disc are the *retinal arterioles* and *veins*, which divide soon after leaving the optic disc and extend out on the surface of the retina to supply the inner one-third with nutrients.





الفرق بين العين الطبيعية والعين المصابة باعتلال الشبكية السكري.

OPTIC NERVE

- As the optic disc enters the globe, it goes through a fibrous, sieve-like structure, visible on ophthalmoscopic examination, called the *lamina cribrosa*.
- When the lamina cribrosa is prominent, it forms the base of a depression. in the disc called the *physiologic cup*
- The optic nerve consists of 1 million axons arising from the ganglion cells of the retina.
- The nerve emerges from the back of the eye through a small circular opening. It extends for 25 to 30 mm and travels within the muscle cone to enter the bony optic foramen.
- From there it travels another 4 to 9 mm to pass into the intracranial cavity and joins its fellow optic nerve to form the optic chiasm.

- **1. Anatomy of the Optic Nerve**
- The optic nerve is a bundle of approximately **one million axons** that originate from the ganglion cells of the retina.
- **The Optic Disc (Optic Nerve Head):** This is the only part of the nerve visible during an ophthalmoscopic exam.
- **The Blind Spot:** Because the optic disc contains no photoreceptors (rods or cones), it creates a physiological "blind spot" in the visual field.
- **Neurovascular Entry:** The central retinal artery and vein emerge from the center of the optic disc, branching out to nourish the **inner one-third** of the retina.

- **2. Structural Landmarks**
- **Lamina Cribrosa:** As the nerve fibers exit the globe, they pass through this sieve-like fibrous structure in the sclera.
- **Physiologic Cup:** This is the central depression within the optic disc. Its appearance and depth are often determined by the prominence of the lamina cribrosa.
- **3. Pathway to the Brain**
- The nerve follows a specific trajectory to deliver visual information to the intracranial cavity:
- **Orbital Section:** After emerging from the back of the eye, it travels **25 to 30 mm** within the muscle cone.
- **Optic Foramen:** The nerve enters this bony opening in the skull.
- **Intracranial Section:** It travels another **4 to 9 mm** inside the skull.
- **Optic Chiasm:** This is the junction where the two optic nerves (left and right) meet and cross.

Post test :-

- Draw the pathway of fibers from the optic nerve to the visual cortex.

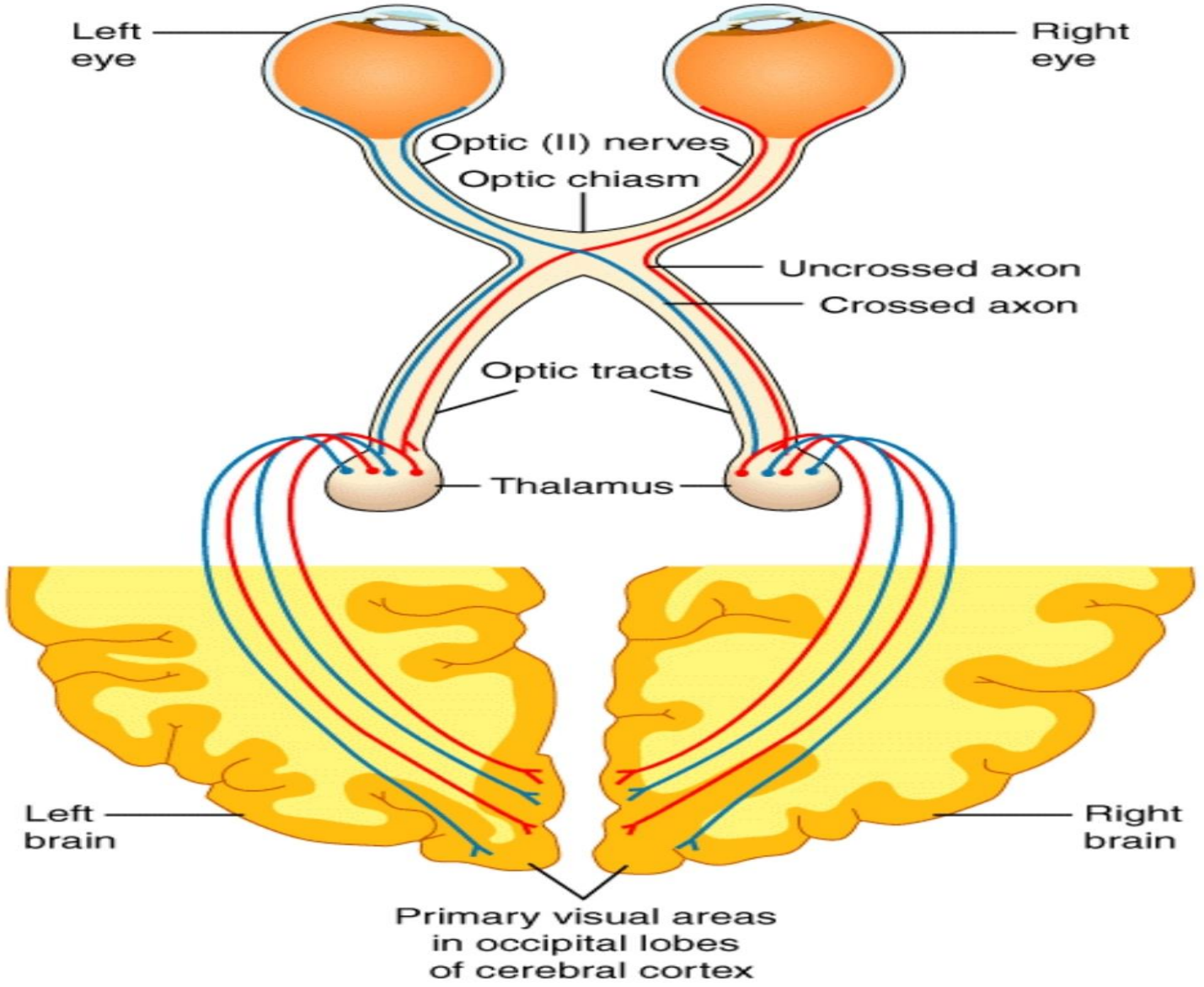
- The head of the optic nerve is called the----------

UNIT

- This lecture describes the complex "wiring" of the human visual system, tracing how light signals captured by the retina are transformed into conscious vision through a specific pathway from the eye to the back of the brain.

VISUAL PATHWAY

- As the retinal fibers leave the optic nerves, half of them cross to the opposite side **(Figure 1.13).**
- The fibers that cross are derived from the retinal receptors nasal to the macula. The structure so formed by the mutual crossing of nasal fibers by both optic nerves is the *optic chiasm*.
- From the optic chiasm, the nasal fibers emanating from the nasal half of the retina of one eye intermingle with the fibers derived from the temporal sector of the retina of the opposite eye, forming a band called the *optic tract*.


Left eye
Right eye
Optic (II) nerves
Optic chiasm
Uncrossed axon
Crossed axon
Optic tracts
Thalamus
Left brain
Right brain
Primary visual areas in occipital lobes of cerebral cortex

VISUAL PATHWAY

- Fibers in the optic tract continue toward a cell station in the brain called the *lateral geniculate body*, so named because it is shaped like a knee (Latin *genu*).
- The geniculate body is a relay station from which fibers spread out in a fanshaped manner and extend to the parietal and temporal lobes of the brain.
- They continue to their final destination, the posterior portion of the brain called the "occipital" lobe in an area denoted as the *visual striate area*.
- It is in this area of the brain that conscious recognition of visual impulses takes place.

- **1. The Optic Chiasm: The Great Crossing**
- The journey begins where the two optic nerves meet at the base of the brain.
- **Decussation (Crossing):** Not all fibers cross. Only the fibers from the **nasal half** of each retina (the side closer to the nose) cross to the opposite side.
- **Temporal Fibers:** Fibers from the **temporal half** (the side closer to the temple) remain on the same side.
- **Purpose:** This crossing ensures that the right half of the brain receives information from the left visual field of both eyes, and vice versa.

- **2. The Optic Tract and Relay Station**
- Once past the chiasm, the reorganized fibers form the **Optic Tract**.
- **Lateral Geniculate Body (LGB):** The optic tract ends at this relay station. It is named for its knee-like shape (*genu*).
- **Function:** The LGB acts as a "cell station" or processing hub that prepares the signals for their final journey through the brain's lobes.
- **3. Visual Radiations and the Occipital Lobe**
- From the Lateral Geniculate Body, the fibers spread out in a fan-shaped manner called **visual radiations**.
- **Path:** These fibers travel through the **parietal** and **temporal** lobes of the brain.
- **Final Destination:** The **Occipital Lobe**, specifically the **visual striate area** (Primary Visual Cortex).
- **Conscious Perception:** This is the specific region where the brain finally "sees"—translating electrical impulses into the conscious recognition of images

Post test :-

- Q. Draw the pathway of fibers from the optic nerve to the visual cortex.

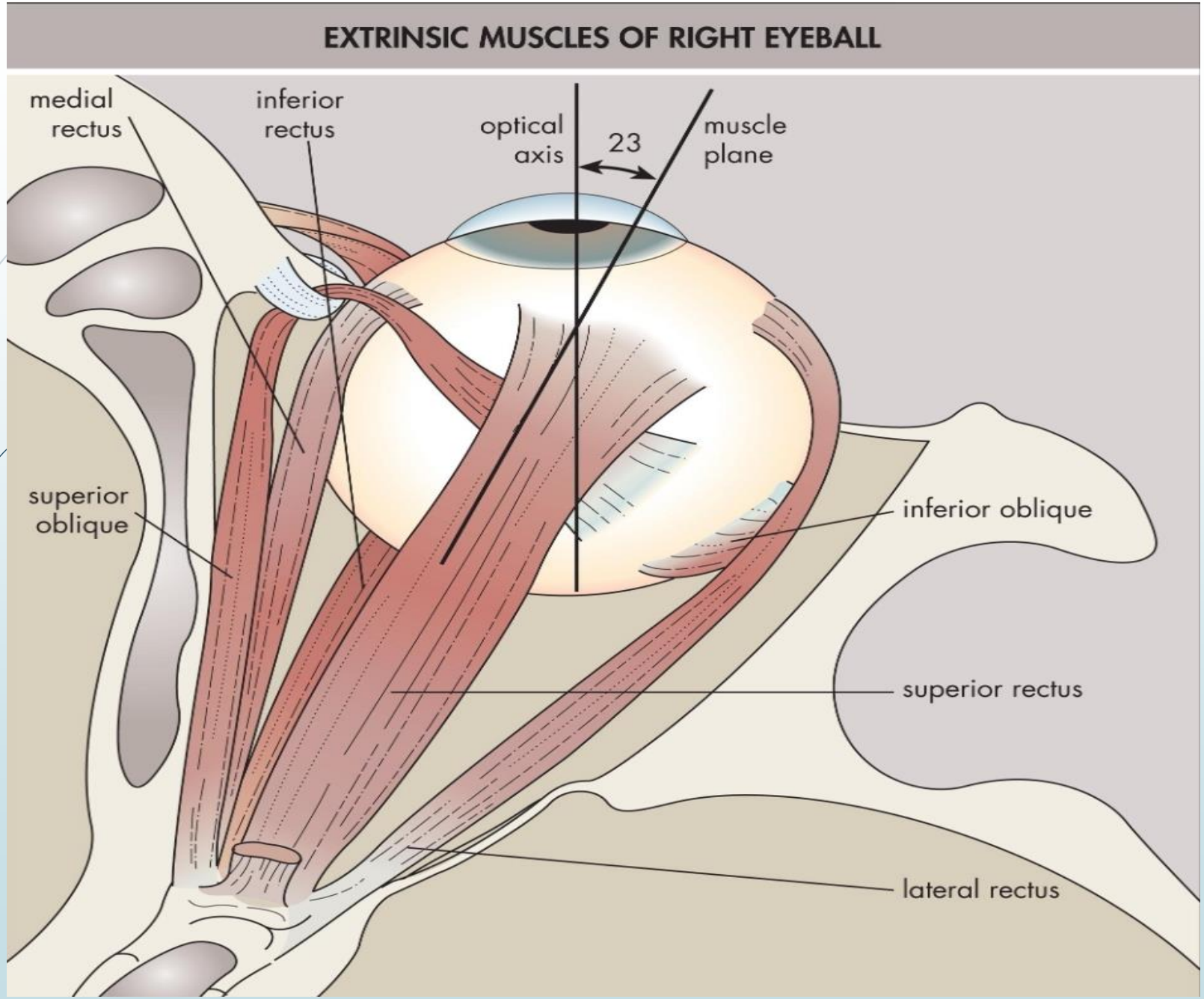
- Fibers in the optic tract continue toward a cell station in the brain called the *lateral geniculate body*, so named because it is shaped like a knee .**T** OR **F**

UNIT

- This lecture details the muscular anatomy responsible for both the movement of the eye globe and the functional mechanics of the eyelids.

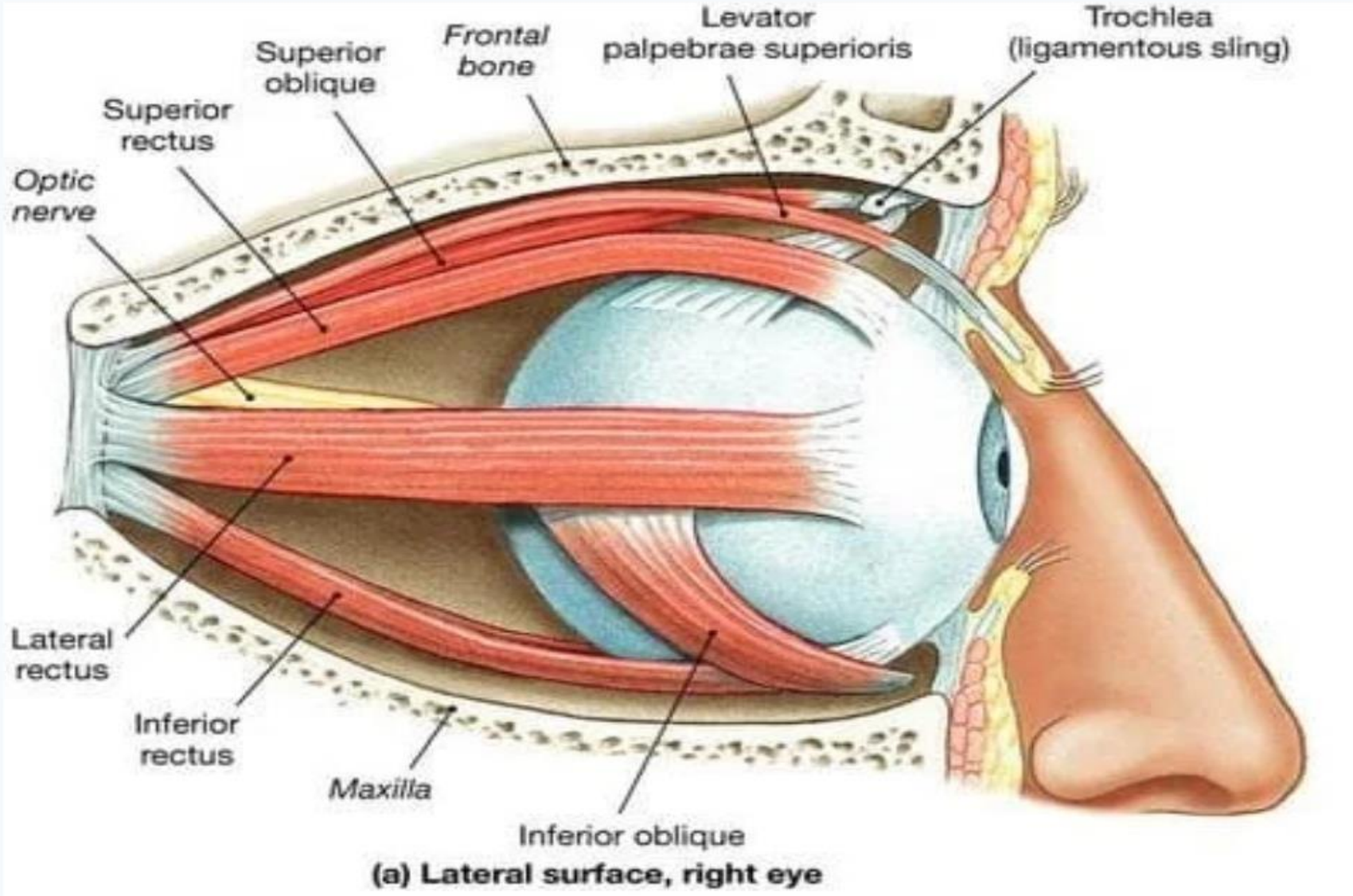
OCULAR MUSCLES

- Six ocular muscles move the globe: the *medial, lateral, superior*, and *inferior rectus muscles* and the *superior* and *inferior oblique muscles* **(Figure 1.14).**
- The medial rectus muscle moves the eye toward the nose or *adducts* the eye. The lateral rectus muscle moves the eye horizontally to the outer side or *abducts* the eye.
- The superior rectus muscle elevates the eye primarily, whereas the inferior rectus muscle depresses the eye.
- The rectus muscles are inserted very close to the limbus, the medial rectus lying approximately 5.5 mm and the lateral rectus approximately 7 mm from the limbus.
- The rectus muscles are not normally visible because they are covered with conjunctiva and subconjunctival tissue. Because they lie on the surface of the globe, they are readily accessible for muscle surgery.


EXTRINSIC MUSCLES OF RIGHT EYEBALL
medial rectus
inferior rectus
optical axis
23
muscle plane
superior oblique
inferior oblique
superior rectus
lateral rectus

OCULAR MUSCLES

- The superior oblique muscle functions primarily as an intorter by rotating the vertical and horizontal axis of the eye toward the nose; it also functions to depress the eye.
- The inferior oblique muscle acts to extort and elevate the eye. The oblique muscles are inserted behind the equator of the globe.
-

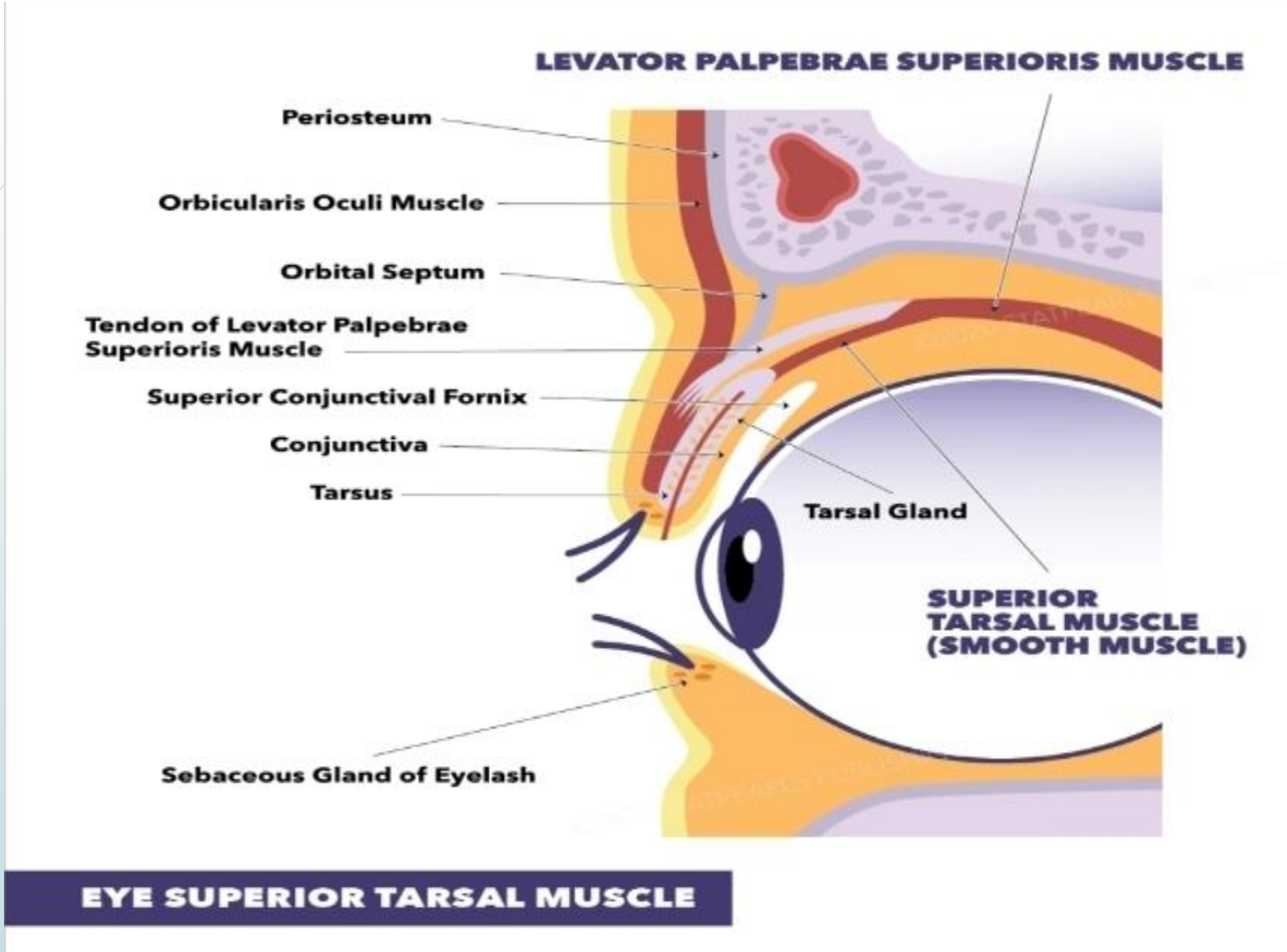


(a) Lateral surface, right eye

OCULAR MUSCLES

- In the lid the *levator palpebrae superioris* muscle serves to elevate the lid, whereas the *orbicularis oculi* muscle closes the eye during winking, blinking, or forced lid closure.

- If the levator muscle is weak or absent, the lid droops and *ptosis* results.


LEVATOR PALPEBRAE SUPERIORIS MUSCLE
Periosteum
Orbicularis Oculi Muscle
Orbital Septum
Tendon of Levator Palpebrae Superioris Muscle
Superior Conjunctival Fornix
Conjunctiva
Tarsus
Tarsal Gland
SUPERIOR TARSAL MUSCLE (SMOOTH MUSCLE)
Sebaceous Gland of Eyelash
EYE SUPERIOR TARSAL MUSCLE

- **1. The Extraocular Muscles**
- Six muscles are responsible for moving the globe in different directions. They are categorized into two groups based on their orientation and insertion points.
- **The Rectus Muscles**
- These four muscles insert near the **limbus** (the junction of the cornea and sclera).
- **Medial Rectus:** Moves the eye toward the nose (**adduction**). It is the closest to the limbus (5.5 mm).
- **Lateral Rectus:** Moves the eye toward the temple (**abduction**). It sits approximately 7 mm from the limbus.
- **Superior Rectus:** Primarily **elevates** the eye.
- **Inferior Rectus:** Primarily **depresses** the eye.

- **The Oblique Muscles**
- These two muscles insert **behind the equator** of the globe and involve more complex rotational movements.
- **Superior Oblique:** Functions primarily as an **intorter** (rotating the eye toward the nose) and a secondary **depressor**.
- **Inferior Oblique:** Functions to **extort** (rotating the eye away from the nose) and **elevate** the eye.
- **2. Eyelid Muscles**
- Two primary muscles control the opening and closing of the lids:
- **Levator Palpebrae Superioris:** Responsible for **lifting** the upper lid. A weakness or absence of this muscle leads to **ptosis** (drooping eyelid).
- **Orbicularis Oculi:** A circular muscle that **closes** the eye during blinking or forced closure.

3. Surgical & Clinical Significance

- **Accessibility:** Because the rectus muscles lie on the surface of the globe (though covered by conjunctiva), they are easily accessible for corrective muscle surgeries.

- **Ptosis:** This is a clinical condition where the upper lid droops due to levator muscle dysfunction.

Post test :-

- Q\How many ocular muscles are attached to the eye? Name them.

- Q\ Describe the muscles that open and close the eye.

- Q\The orbicularis oculi is the muscle that:
- a. dilates the pupil,
- b. affects accommodation.
- c. closes the eyelids.
- d. opens the lids.
- e. constricts the pupil.

SUMMARY

- A brief sketch of the anatomy of the eye and its surrounding structures has been presented.
- Each of these structures, when diseased, can give rise to problems, depending on its anatomic location and function. Because many diagnoses made in ophthalmology are formulated from anatomic terminology, familiarity with these structures is essential before any understanding of patients' problems can be realized.
- The foundation of any course in medicine is based on anatomy. The ophthalmic assistant is advised to learn this section well and use it as a foundation for further reading.