Anatomy of The Eye and Vision Physiology

The eyes are paired sensory organs located in the **orbits** , which are bony cavities formed by seven skull bones: frontal, lacrimal, ethmoid, zygomatic, maxilla, sphenoid, and palatine. Humans have **binocular vision** , meaning both eyes work together to create a single three-dimensional image and enable depth perception.

A bony prominence above the orbit, the **supraorbital ridge** , offers protection against trauma and also serves as the site of the eyebrows.

The **retina** of the eye contains photoreceptors that detect light, initiating the process of vision.

What Is Vision?

Vision is the perception of objects in the environment by detecting the light they emit or reflect.

Types of Vision

- **Central vision** : Enables detailed perception of objects directly in front of the viewer.
- **Peripheral vision** : Enables awareness of objects at the edges of the visual field while looking straight ahead.

Components of the Visual System

The eye and vision involve three main components:

1. **Accessory structures of the eye**
2. **The eyeball itself**
3. **Neural pathways and centers involved in visual processing**

Accessory Structures of the Eye

1. Eyebrows

- Positioned along the supraorbital ridge.
- Function to shade the eyes from sunlight and to deflect sweat and debris away from the eye surface.

2. Eyelashes

- Trap dust and debris.
- Contain sebaceous glands that produce oily secretions to lubricate the eye.
- Inflammation of these glands leads to a condition known as a **sty** .

3. Eyelids (Palpebrae)

- Formed by skin, muscle, and connective tissue.
- Blink reflex lubricates and protects the eye from debris.
- **Orbicularis oculi** muscle closes the eyelid.
- **Levator palpebrae superioris** raises the upper eyelid.
- The inner surface is lined by the **conjunctiva** , a mucous membrane.

4. Conjunctiva

- Covers the inner eyelid surface and the anterior sclera (excluding the cornea).
- Secretes mucus to lubricate the eye and prevent drying.
- Inflammation of the conjunctiva is called **conjunctivitis** .

5. Lacrimal Apparatus

- Consists of the **lacrimal gland** , **lacrimal sac** , and **nasolacrimal duct** .
- Produces **tears** that moisten the eye and wash away foreign particles.
- Tears drain into the **nasal cavity** through the nasolacrimal duct.

6. Extrinsic Eye Muscles

- Six muscles attach to the eyeball and control its movement.
- They are arranged in three pairs:
  - **Superior and inferior rectus** : Move the eye up and down.
  - **Lateral and medial rectus** : Move the eye outward and inward.
  - **Superior and inferior oblique** : Rotate the eye clockwise and counterclockwise.

Cranial Nerve Innervation

- **Oculomotor nerve (CN III)** : Innervates the superior, inferior, medial rectus, and inferior oblique.
- **Trochlear nerve (CN IV)** : Innervates the superior oblique.
- **Abducens nerve (CN VI)** : Innervates the lateral rectus.

These muscles allow for precise eye movements because each motor axon typically controls only about 10 muscle fibers.

The Eyeball

The eyeball is an approximately 2.5 cm diameter sphere consisting of three main layers:

1. **Fibrous Tunic (Outer Layer)**
2. **Vascular Tunic (Middle Layer)**
3. **Sensory Tunic (Inner Layer or Retina)**

1. Fibrous Tunic

Sclera

- Dense connective tissue known as the "white of the eye."
- Provides shape and protection.
- Serves as an attachment site for extrinsic muscles.

Cornea

- Transparent anterior portion of the sclera.
- Allows light to enter the eye and contributes significantly to the eye’s focusing power.
- Lacks capillaries and is nourished by tears and aqueous humor.

2. Vascular Tunic

Choroid

- Richly vascularized dark layer beneath the sclera.
- Absorbs excess light and supplies oxygen and nutrients to the retina.

Ciliary Body

- Contains **ciliary muscle** and **ciliary processes** .
- Controls the shape of the lens via **suspensory ligaments** .
- Secretes aqueous humor into the anterior chamber.

Iris

- The colored part of the eye, composed of smooth muscle.
- Controls the diameter of the **pupil** , regulating the amount of light entering the eye.
    - **Radial muscles** (sympathetic control) dilate the pupil.
    - **Circular muscles** (parasympathetic via oculomotor nerve) constrict the pupil.

3. Sensory Tunic (Retina)

Retina

- Innermost layer of the eye containing **photoreceptor cells** (rods and cones).
    - **Rods** : Detect dim light and are essential for night vision.
    - **Cones** : Detect color and fine detail under bright light.
- Converts light into electrical signals that are transmitted via the **optic nerve (CN II)** to the brain.

Internal Compartments of the Eye

The lens divides the eye into two compartments:

Anterior Compartment

- Filled with **aqueous humor** , a clear fluid that maintains intraocular pressure and nourishes the lens and cornea.
- Produced by the ciliary body and drained via the canal of Schlemm.

Posterior Compartment

- Filled with **vitreous humor** , a jelly-like substance that helps maintain the shape of the eye and keeps the retina in place.

Clinical Correlations

Glaucoma

- Caused by impaired drainage of aqueous humor.
- Increased intraocular pressure compresses the retina and optic nerve, leading to vision loss if untreated.

Conjunctivitis

- Inflammation of the conjunctiva, often due to infection or allergy.

Cataracts

- Clouding of the lens that interferes with vision.

Sty (Hordeolum)

- Localized infection or inflammation of an eyelash follicle or sebaceous gland.