



Unit-I Anatomy and physiology of an eye

Hemangini Parmar
GP,Ahmedabad

COURSE OUTCOME

- CO I: Identify parts of human eye along with its functions

LEARNING OUTCOME

- Draw and explain anatomy of an eye.
- Sketch accessory part of an eye with its significance.
- Describe visual pathway with proper diagram.
- Explain Schirmer's test of an eye.
- Elaborate ocular muscles and ocular movement.



Special Senses

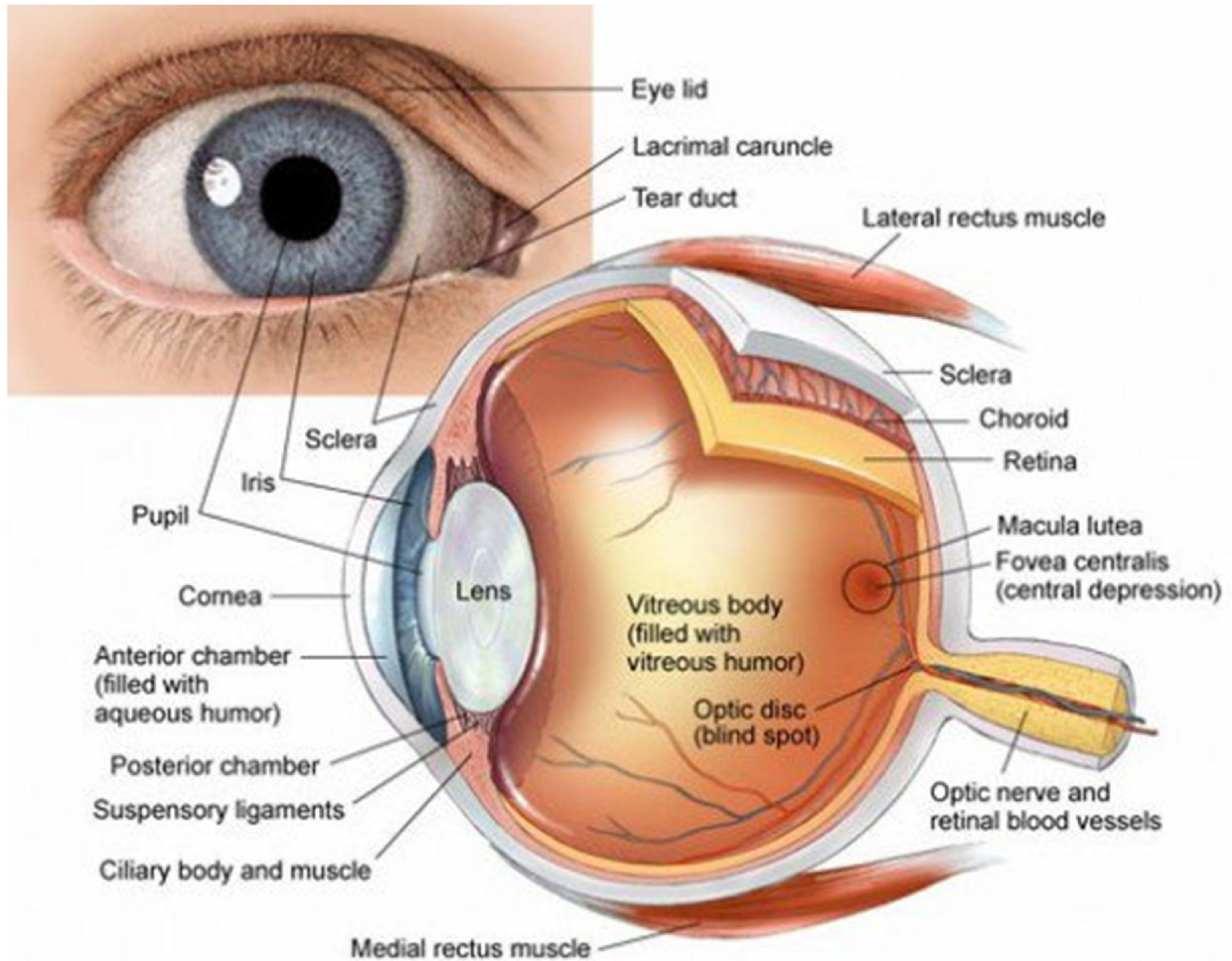
- Any of the physical processes by which stimuli are received, transduced, and conducted as impulses to be interpreted in the brain.
- The special senses consist of the eyes, ears, nose, throat and skin.
- Each of these organs have specialized functions that make it possible for us to experience our environment and to make that experience more pleasant.



Eye

- The eye is the photo-receptor organ.
- **Size and shape:** Human eye is spherical about 2.5 cm in diameter.
- **Location:** it is situated on an orbit of skull and is supplied by optic nerve.
- There are 6 sets of muscles attached to outer surface of eye ball which helps to rotate it in different direction.
- Four sets of these muscles are straight muscles; superior, inferior, medial and lateral rectal muscle and two sets are oblique muscles; superior and inferior oblique muscles.
- Structurally two eyes are separated but some of their activities are coordinated so that they functions as a pair.

Anatomy of Eye



Anatomy of Eye

Eye ball consists of three layers

- Outer fibrous layer: Sclera, cornea and conjunctiva
- Middle vascular layer: ciliary body, choroid and iris
- Inner layer: retina

Outer Layer

- **Sclera**
- **Cornea**
- **Conjunctiva**

Middle Layer

- **Choroid**
- **Ciliary body**
- **Iris**

Inner Layer

- **Retina**
 - Rod cell
 - Cone cell

Eye Lens

- **Eye Lens**
 - i. Aqueous chamber
 - ii. Vitreous chamber



Outer fibrous layer

1. Sclera:

- It is outermost supporting layer consists of thick membrane of tough fibrous connective tissue.
- It covers 5/6 parts of eye ball.
- It maintains the shape of eye and provide attachment to the extrinsic muscle of eye

2. Cornea:

- It is a thin transparent front part of sclera.
- It forms a slight bulge at the front and covers an anterior 1/6 part of sclera.
- Cornea is avascular and absorbs oxygen from air.
- It refracts light to focus on retina.

3. Conjunctiva:

- It is a thin transparent layer that covers the cornea.
- It is formed of single layer of stratified squamous epithelium
- It protects the cornea.



Middle vascular layer

1. Choroid:

- It is thick vascular and pigmented layer situated below sclera.
- The function of choroid is to provide nutrition and to prevent reflection of light.

2. Ciliary body:

- These are attached to choroid and present at the junction of sclera and cornea.
- Ciliary body is attached to lens and holds it in position
- Its function is to change the shape of lens by contraction or relaxation of muscle

3. Iris:

- It is muscular, pigmented and opaque diaphragm which hangs in the eye ball in front of lens.
- It has small circular opening called pupil.
- Pigment in iris gives color to eye.
- Iris control the amount of light entering into eye by controlling the size of pupil.

Inner layer

It consists of photoreceptor cells and photo sensitive elements.

I. Retina:

- Retina is innermost layer.
- Neuroretina contains highly specialized photoreceptor nerve cells; rods and cones
- Each eye ball has 125 millions of rod cells and 7 millions of cone cells.
- Fovea centralis is highly sensitive to light and forms magnified image and give sharp and acute vision.
- The optic nerve enter retina at a point called blind spot. It does not contains any rods or cone cells. It is least sensitive to light and forms no image when light falls on blind spot

Rod cell:

- **rods** are sensors for perception of black to white shades
- Night vision is almost rod vision.
- It function in dim light
- Contains a photosensitive pigment rhodopsin formed from vitamin A.

Cone cell:

- Cones are sensors for perception of colors.
- It functions in bright light and differentiate colors.
- Contains a photosensitive pigment iodopsin.

Eye lens and chambers

Eye Lens:

- It is a large, flexible, transparent biconvex and fibrous crystalline body situated behind iris.
- Lens is enclosed in a transparent elastic capsule.
- Ciliary muscles control the thickness of lens and its power of accommodation.
- It forms the image of the object on retina.
- Lens separates the eye ball into two chamber
 - i. Aqueous chamber
 - ii. Vitreous chamber

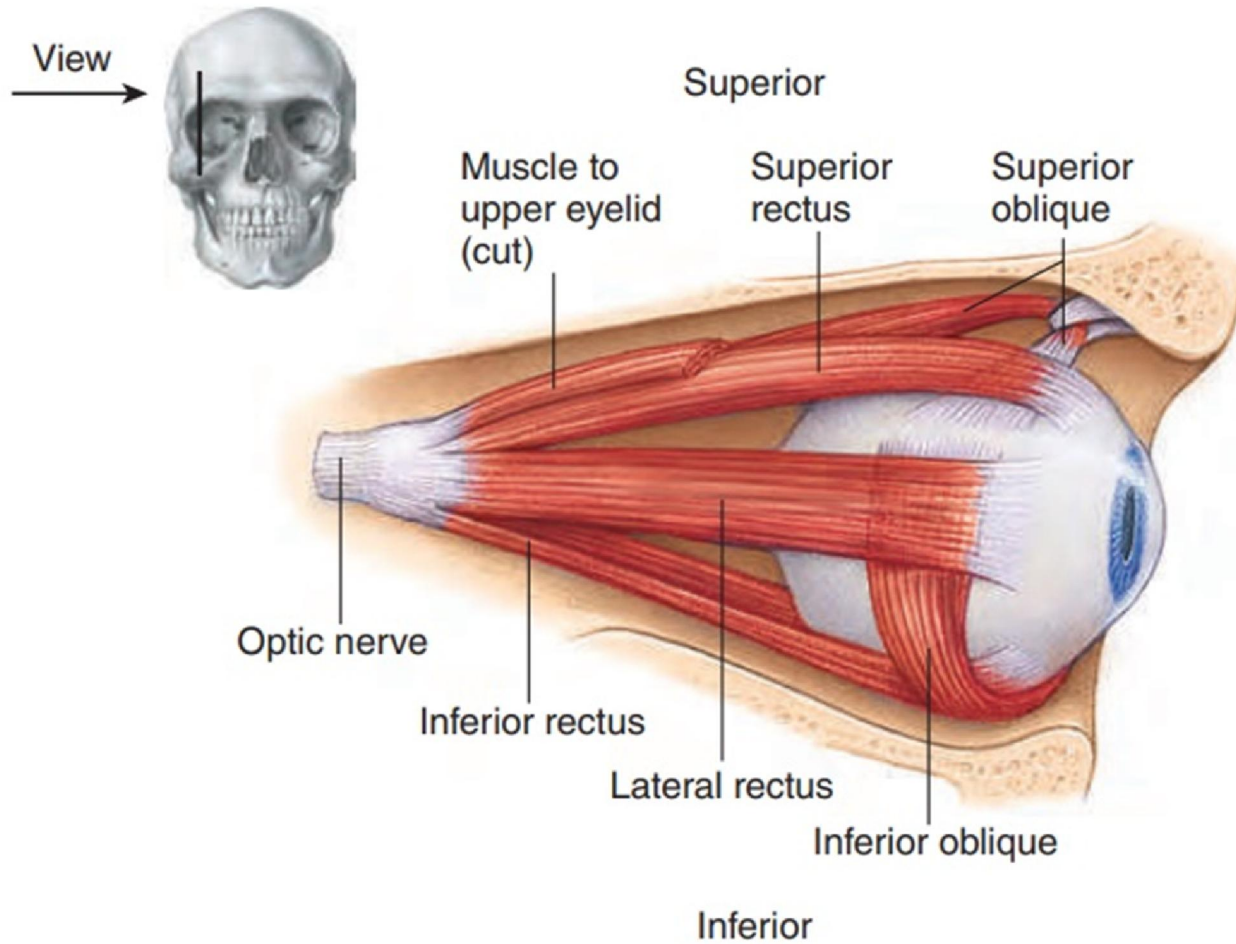
Aqueous chamber:

- It is a smaller fluid filled chamber between cornea and lens.
- It is filled with aqueous humour containing aminoacids, glucose, ascorbic acid, hyaluronic acid and respiratory gases.
- The aqueous humour nourishes the lens and cornea and refracts light rays to focus on retina.

Vitreous chamber:

- It is a larger fluid filled chamber between lens and retina.
- It is filled with gelatinous vitreous humour containing salts and muco proteins
- It supports retina and refracts light to focus on retina.

Accessory Structures of the Eye





Accessory Structures of the Eye

- The accessory (adnexal) parts of the eye include the eyelids, conjunctiva and lacrimal (tear) glands. They protect, lubricate and support the eyeball.

Eyelids

- The eyelid is a fold of skin that covers and protects the eye. Muscles around the eye raise and close the eyelid. The eyelid has sebaceous glands that make an oily secretion that prevents the watery film on the eye from evaporating and the eyelid from sticking together. The eyelid works like a windshield wiper that helps to lubricate the eye and keep the surface of the eye free of dust and other debris. The eyelashes grow from the edges of the eyelid. They also help protect the eye from dust and debris.



Accessory Structures of the Eye

Conjunctiva

- The conjunctiva is a clear
- mucous membrane
- that covers the inner surface of the eyelid and the outer surface of the eye. The conjunctiva secretes a watery fluid (mucus) that helps lubricate the eyeball and keep it moist.

Lacrimal gland and tears

- The lacrimal gland (also called the tear gland) is located at the upper, outer corner of the eye. It secretes a watery fluid that makes up tears. Small ducts drain tears from the lacrimal gland through very tiny openings inside the inner corner of the eyelid. When the eye blinks, the tears are swept across the surface of the eye. Tears lubricate the conjunctiva covering the surface of the eye and inner eyelid. Tears also remove dust and debris from the eye and help to prevent infection.



Mechanism of Sight/Vision

The human eye operates similar to a digital camera in several ways:

- Light focuses mainly on the cornea, which acts like a camera lens.
- The iris controls the light that reaches the eye by adjusting the size of the pupil, and thus it functions like the diaphragm of a camera.
- The lens of the eye is located behind the pupil, and it focuses light. This lens helps the eye to automatically focus on near and distant objects, and also the approaching objects, like an autofocus camera lens.
- The cornea and lens focus light to reach the retina, which is a light-sensitive zone present on the inner lining of the back of the eye.
- The retina converts optical images into electronic signals, and thus it acts as an electronic image sensor of a digital camera. These electric signals are then transmitted by the optic nerve to the visual cortex, which is responsible for the sense of sight.

Visual Pathway

The visual pathway refers to the anatomical structures responsible for the conversion of light energy into electrical action potential that can be interpreted by the brain. It begins at the retina and terminates at the primary visual cortex (with several intercortical tracts).

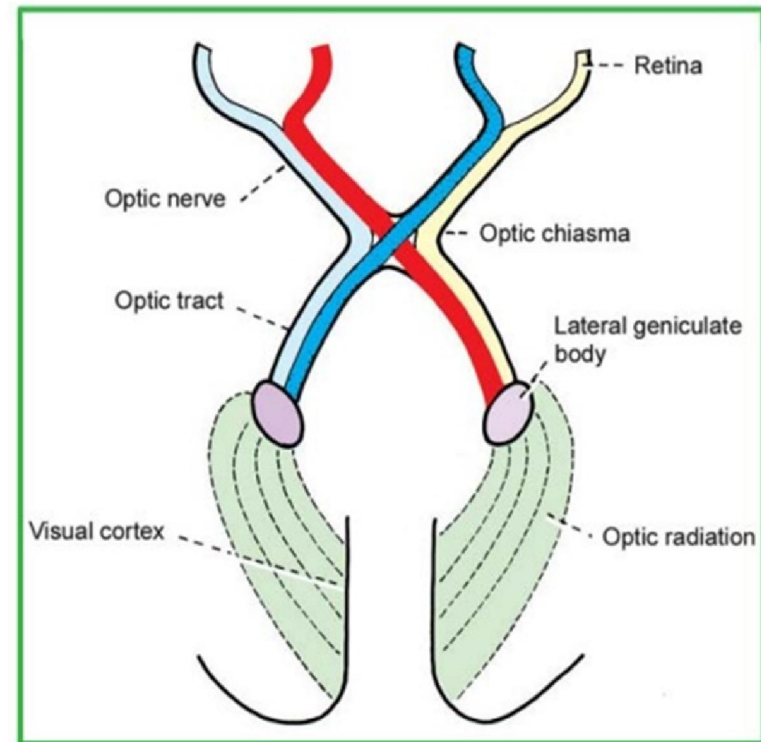


Fig. 18.1. The optic pathway. Note that the fibres from the medial (or nasal) half of each retina cross over to the optic tract of the opposite side.



Visual Pathway

- The peripheral receptors for light are situated in the **retina**. Nerve fibres arising in the retina constitute the **optic nerve**. The right and left optic nerves join to form the **optic chiasma** in which many of their fibres cross to the opposite side. The uncrossed fibres of the optic nerve, along with the fibres that have crossed over from the opposite side form the **optic tract**.
- The optic tract terminates predominantly in the **lateral geniculate body**. Fresh fibres arising in this body form the **geniculo-calcarine tract** or **optic radiation** which ends in the visual areas of the cerebral cortex

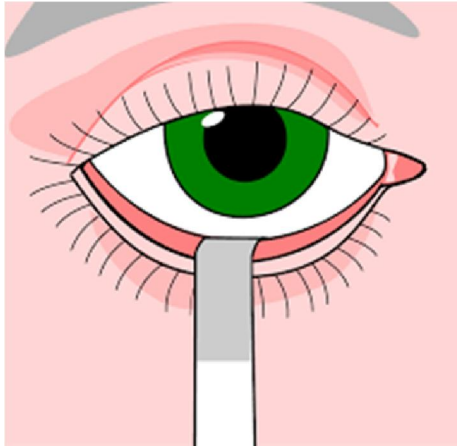


Visual Pathway

Processing of Visual Information

- The visual pathway comprises the following six components:
- Optic nerve – The axons of the retina's ganglionic cells form the optic nerve.
- Optic chiasma – Optic chiasma refers to the location where the fibres of the optic nerve cross.
- Optic tract – It is a continuation of the optic nerve. Information is transmitted from the optic chiasma to the lateral geniculate body via the optic tract.
- Lateral geniculate body – The majority of the optic tract's fibres come to an end in the lateral geniculate body, which serves as the brain's subcortical centre for visual perception.
- Optic radiation – Optic radiation is created when fibres from the lateral geniculate body pass through the internal capsule of the brain. It typically ends in the visual cortex.
- Visual cortex – The medial surface of the occipital lobe contains the visual cortex, the primary cortical centre for vision.

Schirmer's test



Schirmer's test,
placing the strip in
the lower eyelid
pouch

- A Schirmer's test determines whether a person's eye produces enough tears to keep their eye moist and healthy. To conduct a Schirmer's test, a doctor places a piece of filter paper inside the lower eyelid of both eyes and the person closes their eyes.
- In general, the smaller the amount of moisture on the paper, the fewer tears that person has produced. The test is mainly performed on people experiencing symptoms of dry eye.
- The test is noninvasive and has been used for around 100 years. Despite its long history of use, newer tests are being developed to catch additional cases of dry eye that the Schirmer's test cannot detect.



Schirmer's test

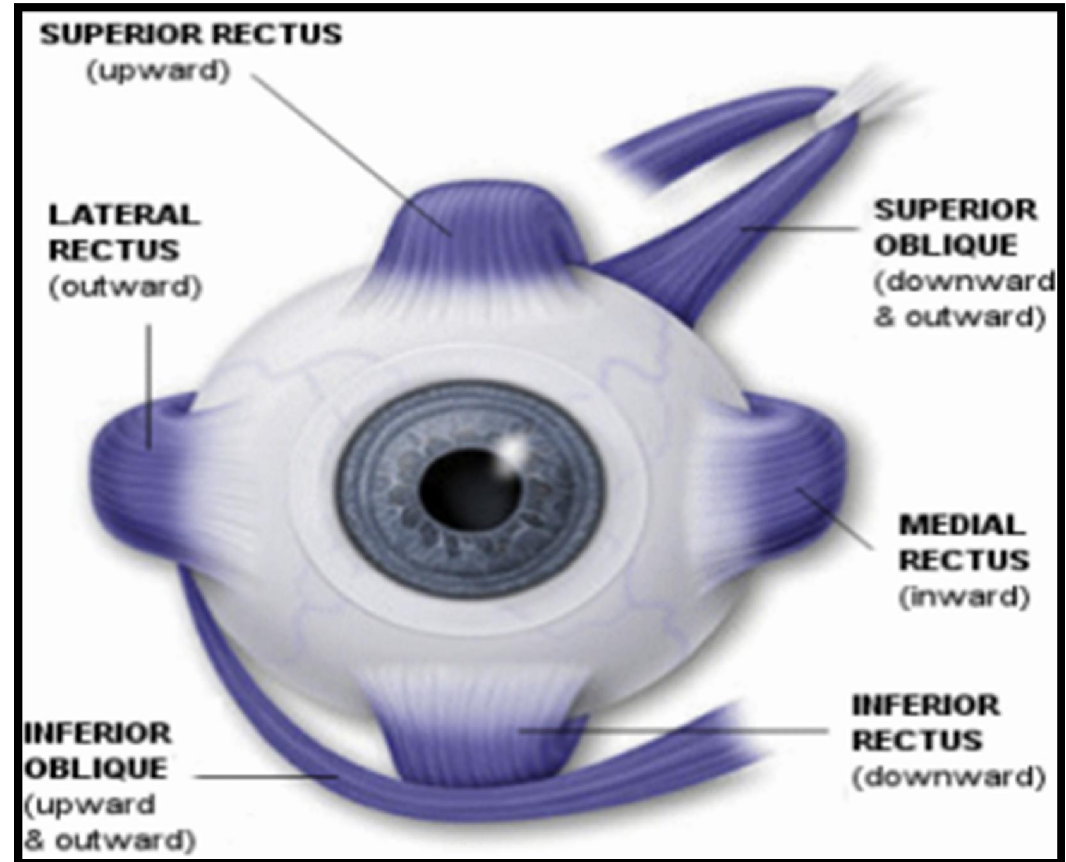
- A negative (more than 10 mm of moisture on the filter paper in 5 minutes) test result is normal. Both eyes normally secrete the same amount of tears.
- It is named for [Otto Schirmer](#).^[2]

The Schirmer's test confirms and determines the severity of dry eye. Symptoms of dry eye include the following:

- excessive dryness in the eye
- persistent watering or tearing of the eye
- pain in the eye area
- feeling of something being in the eye
- chronic eye irritation
- sensitivity to light

EXTRAOCULAR MUSCLES

The **extraocular muscles** (EOM) are responsible for controlling the movements of the eyeball and upper eyelid. These muscles are also known as the extrinsic eye muscles, distinguishing them from intrinsic eye muscles which are responsible for controlling the movement of the iris.





extraocular muscles

- There are the six extraocular muscles, which act to turn or rotate an eye about its vertical, horizontal, and antero-posterior axes:
- 1. Medial Rectus (MR)
- 2. Lateral Rectus (LR)
- 3. Superior Rectus (SR)
- 4. Inferior Rectus (IR)
- 5. Superior Oblique (SO)
- 6. Inferior Oblique (IO)

Eye Muscle Movements

A given extraocular muscle moves the pupil, at the front of the eye, in a specific direction or directions, as follows:

Extra-ocular muscles	Activities performed by muscles
Medial Rectus (MR)	Shift the eye inward and near to the nose.
Lateral Rectus (LR)	Moves eye outward and away from the nose.
Superior Rectus (SR)	Rotates the eye upward and top of the eye
Inferior Rectus (IR)	Revolve eye downward and away from the nose.
Superior Oblique (SO)	Turn around top of the eye near the nose and transfer eye outward
Inferior Oblique (IO)	Spin the top of the eye away from the nose, eye upward and eye outward.



EYE MOVEMENTS

There are four different types of eye movements, which are fall into two specific categories:

- I. Reflex Eye Movement: Eye movements that function to stabilize the position of the eye in space during head movements.
- II. Voluntary Eye Movement: Eye movements that function to redirect the line of sight to follow a moving target or to attend to a new target of interest.

There are four basic types of eye movements:

- i. Saccadic Movement
- ii. Smooth Pursuit Movement
- iii. Vergence Movement
- iv. Vestibulo-Ocular Movement

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