

## Chapter - 27

# Sensory Organs of Human; Sense Organs

Sensory organs are those organs present in the body by which human body acquire knowledge about changes occurring in external environment. Sensory organs are called sense organs. Human has five sense organs, These provide information to our body regarding touch, sight, sound, smell and taste ; i.e. feeling of thirst, hunger, taste of sweet and salt, hearing the barking of dog, sound of birds, feeling of cold, heat, sweet smell, foul smell etc. are received by sense organs and are sent or received through nervous system. Every sense organ has some special sensory cells which receive external stimuli and impulses produced from them. These stimuli are transmitted to brain or spinal cord. Brain classifies these impulses, explains and sends them for proper action. So, the organs which receive feelings are called **sensory organs**.

Human has following type of sensory organs and sense organs:-

1. Organ of sight – eye – By seeing
2. Organ of hearing – ear – By hearing
3. Organ of touch – Skin – By touching
4. Organ of taste – tongue – By tasting
5. Organ of smell – nose – By smelling

### Organ of Vision - Eye (Photoreceptor)

Human has one pair of eye. These are the form of sense organ receive the senses of sight and thus provide vision.

Eyes are almost rounded in shape. These are some what bulged in front and can move or rotate freely in a bony cavity (orbit). Eyes are like a hollow

ball that internally comprised of various structures.

### Internal structure of Eye–

The wall of eye ball has three layers- **Sclera**, **Choroid** and **Retina** (Fig. 27.1).

**(i) Sclera:-** It is the outermost, hard and white layer. It has two parts, Its  $1/5^{\text{th}}$  anterior part is transparent and attached with cornea. The remaining  $4/5^{\text{th}}$  posterior part consist of tough fibrous connective tissue. This part maintains the shape of eye ball and provides space for attachment of eye muscles. The eye muscles are necessary for the movement of eye ball. Cornea focuses light due to its curved shape.

**(ii) Choroid:-** Choroid is middle layer. It is made up of connective tissue, in which pleux of numerous blood vessels is present. Pigmented granules of blue, dark brown or black coloured are present in its inner layer. It controls reflection of light thus the clarity of image does not become bad.

**(iii) Retina:-** It is innermost sensory layer. Retina has two types of sensory cells **Rods** (these are sensitive for low intensity of light) and **Cones** (these are sensitive for colour). Layer of rods and cones are also called sensitive layer. Rods are rod shaped, long and cylindrical. These are more in number as compared to cones. Rods contain a photo sensitive pigment rhodopsin, which is formed by vitamin-A. It helps animal to see in dim light. Retina of Owl contains only rods (Fig. 27.2).

Human eye has about 115 million rods and 16.5 million cones. Therefore, human are able to differentiate between light. Cones have iodopsin

which helps animals to recognize different colours separately. Cones are helpful to see in bright light and different colours. Retina with only pure cones is found in hen.

**Yellow spot-** Yellow spot which is situated on optical axis, is that place where the clearest image is formed. Here, the sensory cells especially cone cells are available in maximum numbers. In the rest part of retina, rod cells are more and cone cells are less. This part appears yellow hence it is called **yellow spot** or **Macula lutea** too. In the middle of it a depression is present which is called **Fovea centralis**. It has only cone cells. Thus it forms most sensitive part of eye.

**Blind spot-** Blind spot is just below the yellow spot. This is the place where all the nerve fibers coming from all sensory cells of retina combine together to form optic nerve. This nerve comes out from this spot of eye ball. Rods and cones are absent at blind spot. Hence it does not take any part in image formation.

**Parts of Eye-** Internally the eye is divided into two chambers. These both chambers are separated from each other by a lens.

**(a) Fluid Chamber -** It is the anterior part in which aquatic liquid called Aqueous humour is filled and there is another back part in which dense vitreous humour is filled. Aqueous humour keeps the lens wet and save it from physical jerks. Vitreous humour maintains the shape of eye ball and protect retina.

**(b) Lens-** It is situated just behind the Iris. It is biconvex in shape and semi solid. It is made up of soft gelation tissue. It remains in its position by suspensory ligament which joints the lens with ciliary body. The contraction of ciliary body affects the shape of lens. The curvature of lens can be changed by contracting or relaxing the suspensory ligament by muscular activity of ciliary body, by which the accommodation in vision becomes possible.

**(c) Iris -** It is a kind of curtain in front of the lens. It may be black, brown or blue. The colour of eye is due to iris. It has two types of muscles-**circular muscles** for making the pupil small and **radial muscles** to dilate pupil. The involuntarily

accommodation of size of pupil controls the amount of light that enters the eye. Can you think when does pupil become wide and when it becomes narrow?

Six types of skeletal muscles are found to rotate each eye ball in eye orbit, out of these four are rectus and two are oblique. These are as follows:-

1. External rectus muscles
2. Internal rectus muscles
3. Superior rectus muscles
4. Inferior rectus muscles
5. Superior oblique muscles
6. Inferior oblique muscles.

With the help of these muscles the eye ball is movable in right-left and up-down and performs as per need.

**Plica semilunaris-** A vestigial organ, nictitating membrane is present on the inner corner of human eye which is known as **Plica semilunaris**.

**Eye Glands-** Three types of glands are found in eye.

**1. Meibomian Glands-** These glands are found at the margins of both eye lids and secrete oily substance by which cornea remains smooth. Due to it there is no resistance in moving eyelid up and down.

**2. Mall's Glands -** These are also known as ciliary glands. These are modified from sweat glands and open in follicle situated near eye lashes of corner of eye lids.

**3. Lacrymal glands or Tearglands -** Three glands are located on the corner of upper eye lid. They secrete salty liquid by which eyelids and cornea keep wet and keeps eye clean

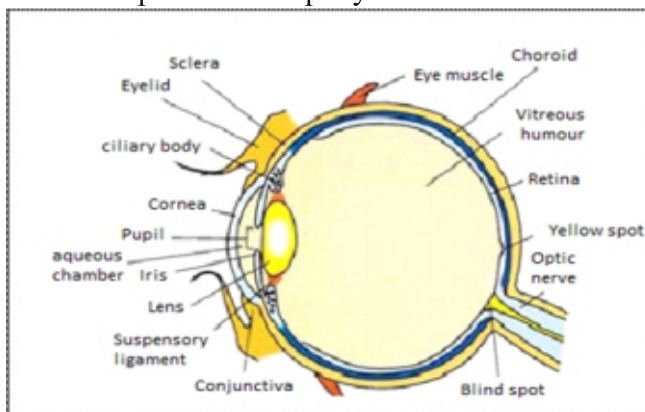


Fig. 27.1 Internal structure of Eye

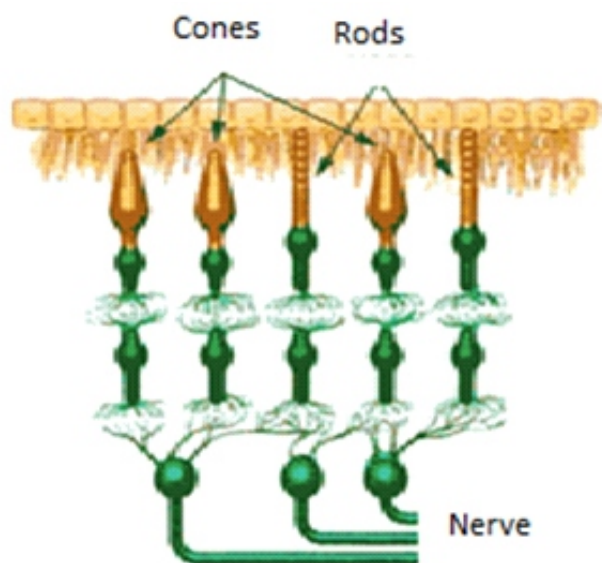


Fig. 27.2 Cones and Rods

**Working process of Eye-** The methodology of eye can be explained as follow:-

**Entrance of Light-** After reflection from an object the light rays enter the eye through transparent structures i.e. conjunctiva, cornea, aqueous humour, lens and vitreous humor.

**Formation of Image-** Due to convexity of cornea, the light rays bend to some extent and later on the lens converges them by which an image is formed on retina.

**Nature of Image-** The image is inverted and real.

**Formation and Transmission of Nerve-Impulse-** The light energy produces chemical changes in sensory cells (Rods and cones). Nerve-impulses are formed by these changes which reach to the brain through optic nerve.

**Recognition and Realization-** Our brain understands the image in many ways and guess its meaning i.e. it sees the object erect while the image formed on retina is inversely.

**Focusing-** The process of focusing the image on retina is known as accommodation or focusing. To focus means make changes in convexity of elastic lens.

- **Vision for distant objects** -The lens becomes much flat or thin, it is a normal condition of lens which remains stretch by suspensory ligaments.

- **Vision for nearer objects-** Ciliary muscles are circular; contracts and decreases the circumference of eye ball. Therefore the stretching becomes less on suspensory ligaments and the lens become thick (much spherical) due to its self-elasticity.

**Normal eye keeps continuous adjustment where any one is moving, playing or watching around.**

- **Binocular Vision** - In all primates including human both eyes are located in front. Overlapping (to come up with each other) of images occurs in this arrangement which gives feeling of deepness (Stereoscopic vision).

**Biochemistry of Vision-** Biochemical changes occur in rods and cones of human body for vision. Rhodopsin is present in rods of retina. It is very much photosensitive. It is called visual purple. It changes in the presence of light. It forms leumirhodopsin on breaking. Later on leumirhodopsin is changed into metarhodopsin which finally convert into a protein scotopsin and retinine. Rhodopsin is again formed in darkness by scotopsin and retinine.

Retinine is a derivative of Vitamin – A. Hence Vitamin A is essential for healthy eye. Rhodopsin is not formed in deficiency of Vitamin – A, by this the person is unable to see in dim light. This disease is known as **Night blindness**.

Another pigmented substance iodopsin is found in cones. It makes the difference between colour of any object. Different types of cones are present to differentiate primary colour red, green and blue. Among these, for red colour **Erythrolab**, green colour **Chlorolab** and for blue colour **Cyanolab** types of cones are found.

### Common eye diseases

- **Myopia-** Such person can see the object of short distance clearly but can't see the far object clearly. The image of distant object is formed before retina. This defect can be corrected by using proper concave lens. (This lens is either used in glass frame or as contact lens).

- ▶ **Hypermetropia** - Such a person can see distant objects clearly but cannot see near objects clearly. In this defect image of near object is formed after retina and it can be corrected by the use of proper convex lens.
- ▶ **Cataract**- In this disease, the lens become white and non-transparent with increase of age. Such type of lens is either removed by surgery and or intra ocular lens (I.O.L.) is transplanted on its place or proper spectacle is used.
- ▶ **Astigmatism**- The shape of cornea becomes abnormal in it. This disease can be corrected by cylindrical lens.
- ▶ **Conjunctivitis**- Inflammation is caused in conjunctiva by bacterial infection. This disease is commonly known as 'Ankh ka Ana'.
- ▶ **Colour blindness** - It is hereditary disease. This disease is caused due to lack of cone cells in eyes. Such person cannot differentiate between red and green colour.

### Ear -Stato- Acoustic Receptors

Ear has two main sensory functions; hearing and balancing the body. In human and other mammals, ear has been divided into three parts (Fig 27.3)

1. External ear
2. Middle ear
3. Internal ear.

#### 1. External ear

External ear mainly consists of two parts.

**(a) Ear Pinna or Auricle** - It is found in mammals only. It is made up of fibro-elastic cartilage. It is immovable in human because auricular muscles are vestigial in it. Its cavity is known as **Concha**. Ear pinna collects the sound waves and sends into external auditory meatus.

**(b) External Auditory Meatus** - Concha opens into a narrow canal which is called external auditory meatus which extends up to tympanic membrane (Tympanum). In auditory meatus sweat glands are modified into cerumen glands which secrete cerumen or earwax.

#### 2. Middle ear-

In mammals, middle ear remains closed in tympanic bulla. The cavity of middle ear is known as tympanic cavity. Tympanic cavity is jointed with nasopharynx by a narrow duct called pharyngo tympanic duct or eustachian tube. The function of eustachian tube is to maintain equal pressure on both sides of tympanic membrane.

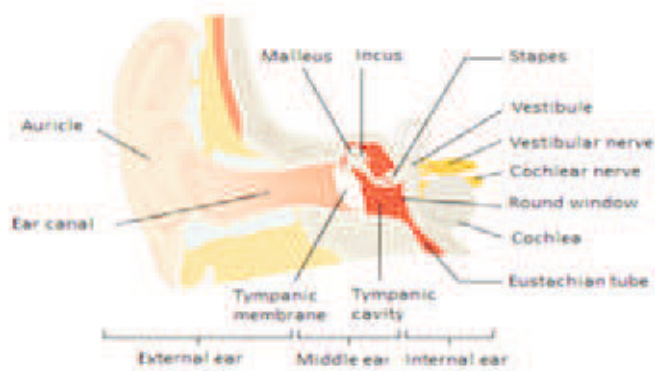


Fig. 27.3 Structure of human ear

**Ear Ossicles** - Three ear ossicles are found in tympanic cavity of mammals. These ossicles are attached together from outside to inside (from tympanic membrane to fenestra ovalis)

**(a) Malleus** - It is hammer shaped ear ossicle which is formed by modification of articular bone.

**(b) Incus** - It is anvil (Nihai) shaped ossicle. It is formed by modification of quadrate bone.

**(c) Stapes** - It is stirrup of horse – Jean shaped. It is formed by modification of hyo mandibular bone. Ear ossicles normally remain in hanging position from tympanic cavity wall. Malleus is attached with tympanic cavity wall with the help of strong tensor tympani muscle whose stretch keeps the tympanic membrane completely stretched.

#### 3. Internal Ear -

It is situated in the cavity of temporal bone that is called **bony labyrinth**. Basically it consists of two parts

**(a) Cochlea** - It is a long coiled structure which looks like the coils of snail shells. It has only two and half turns. Its terminal cycling cavity is divided into three parallel ducts which are separated by membranes. A liquid endolymph is filled in these ducts. Area with sensory cells related to hearing are



present in middle duct which is known as Corti hair organ or organ of Corti. Sensory hairs are found on one end of these cells.

**(b) Vestibule-** It is related to maintain body balance. It has three semicircular canals. These canals are situated at right angle to each other. Its one part is attached with cochlea, one with utriculus and other is differentiated into sacculus. One end of each canal becomes dilated and form ampulla in which sensory cells and nerve fibers emerging from them collectively form Auditory nerve.

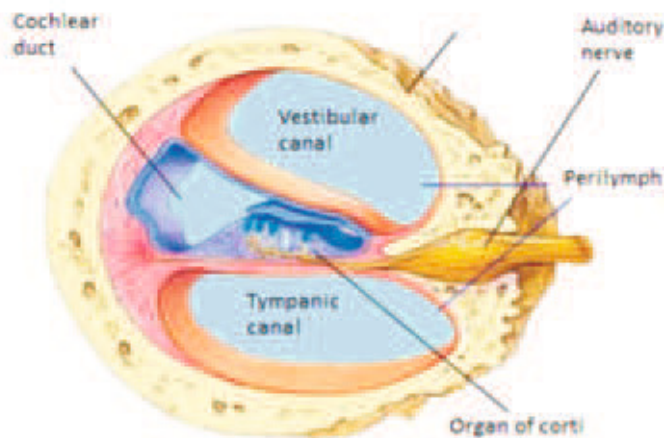


Fig. 27.4 Structure of human cochlea

Both of these structures collectively form membranous labyrinth. Five sensory points are found in mammals. Three cristae are found in each ampulla and one each in utriculus and sacculus. Sensory points of utriculus and sacculus are called macula.

Cochlea is attached by sacculus with a small duct which is called ductus reuniens. Cochlea is coiled like spring in mammals. Cochlear apparatus is divided into three chambers which are known as scalae.

**1. Scala vestibuli** - It is dorsal chamber filled with perilymph.

**2. Scala media** - It is middle chamber filled with endolymph. The roof of scala media or membrane between scala vestibuli and scala media is known as Reissner's membrane

**3. Scala tympani**- It is basal chamber filled with perilymph (Fig. 27.4).

At the end of cochlea the cavities of scala vestibuli and scala tympani are attached together by helicotrema.

From the side wall of cochlear duct has a thin jelly like structure tectorial membrane is hanging over organs of Corti. Sensory hairs of organs of Corti remain in its contact.

### Mechanism of Hearing-

- Ear pinna collects sound waves which then enter in external auditory meatus which produces vibrations in tympanic membrane.
- After this these vibrations reach internal ear through malleus, incus, stapes and fenestra ovalis.
- These vibrations provide movement to the liquid present in cochlea. Organs of Corti receive the vibrational movement of this fluid and send into cochlear nerves as nerve impulses. These nerves send the impulses to brain.

### Body- Balancing

**Static balance** - In vertical position of body or on bending downward, liquid begins to move in semicircular canals. These semicircular canals are arranged in different planes. The sensory cilia present in ampulla receive these movements and then impulses reach to auditory nerve, from there they are sent to brain.

## Diseases of Ear

Disease /disorder	Reason of ear disease	Symptoms
1. Labyrinthitis	<ol style="list-style-type: none"> <li>1. Viral infection in it</li> <li>2. Middle ear is affected</li> <li>3. Organs of corti are destroyed</li> <li>4. May be due to measles, influenza</li> </ol>	Permanent deafness.
2. Meniere's disease	<ol style="list-style-type: none"> <li>1. Sensory cells of ampulla and cochlea becomes destroyed</li> <li>2. Giddiness for longer time, Vomiting etc.</li> </ol>	<ol style="list-style-type: none"> <li>1. Sound of ringing bell</li> <li>2. Sometime feels deafness or may be permanent deafness</li> </ol>
3. Ear- Inflammation (i) External ear inflammation (ii) Middle ear inflammation	<ol style="list-style-type: none"> <li>1 Infection in ear by bacteria or fungi</li> <li>2 Sometimes may be due to allergy</li> </ol>	<ol style="list-style-type: none"> <li>1. Ear- flow</li> <li>2. Ear- Pain</li> <li>3. Torn of tympanic membrane</li> <li>4. Diseases like Mastoiditis encephalitis etc. may caused by infection</li> <li>5. Chronic inflammation</li> <li>6. Permanent perforation in tympanic membrane</li> </ol>

**Balance during movement :-** Utriculus and sacculus provide dynamic balance (while body is in movement). Whenever body have any type of movement, then tiny particles of calcium carbonate (otoconia) present in endolymph press sensory hairs. Such impulses are delivered to auditory nerve.

### Tongue and Nose (Sense organs of Taste and Smell)

The tongue provides feeling of taste and nose gives the sense of smell. Both these senses are chemical senses and it depends on the nature of chemical compounds coming in contact. The sense of taste is known by tongue. It is known when the substance comes in direct contact of taste buds which are found on tongue. The sense of smell is known when a chemical comes in contact of sensory epithelium cells of nose. When chemical molecules come in contact of epithelial cells through breathing air then sensory epithelium (schneiderian membrane) of nose excited and sense of smell is experienced.

### Skin (Touch and some other sense organs)

Skin has terminal ends of various types of nerves. Feeling of various kind of touch is

experienced by these nerves. Some nerves of them are related to sense very light touch some are related with deep pressure and other for cold, temperature and pain etc.

The receptors of sense of hunger are present in stomach wall; sensation of thrust is due to stimulation of pharyngeal nerves. Sensation of tiredness is present in muscles.

### Important Points

1. Five receptors for smell, taste, touch, vision and sound are found in human.
2. The papillae of sense for touch are present in dermis of skin.
3. Structure of eye consists of three layers i.e. sclera, choroid and Retina.
4. Human ear is divided into three parts: External ear, Middle ear and Internal ear.
5. Middle ear is made up of three bones: Malleus, Incus and stapes.
6. Internal ear has two functions: (i) cochlea provides sense of hearing and (ii) realization of disorder in body balance by semicircular canals, utriculus and sacculus.

7. Human body has rods and cones for vision sense.
8. Nose observes chemical senses of chemical molecules which are received with air, and tongue observes them by direct contact.

### Practice Questions

#### Multiple choice Questions

1. The shape of ear bone malleus is –  
 (a) Hammer like                      (b) Horse shoe shape  
 (c) Oval shaped                      (d) None of above
2. The function of visual cone is –  
 (a) Secretion and balance  
 (b) Vision in darkness  
 (c) Monocular vision  
 (d) Vision in bright light and colour differentiation.
3. The person in myopia is -  
 (a) Unable to see near object easily  
 (b) Unable to see far object easily  
 (c) Unable to accommodate for monocular vision  
 (d) None of above
4. The part of internal ear that establishes balance is :-  
 (a) Incus  
 (b) Saculus  
 (c) Sacculus, Utriculus, semicircular canals

(d) Organ of Corti

#### Very short Answer Questions

1. Write the names of bones present in middle ear.
2. Where tectorial membrane is found?
3. Write functions of rods and cones found in eye.
4. The function of body balance is performed by which structure of ear?

#### Short Answer Questions

1. What is the role of Eustachian tube in ear?
2. Name the places of retina in sequence where vision is the best and where nothing is seen.
3. Write the names of muscles found in our eyes.
4. What is myopia (short – sightedness defect)?
5. What is colour blindness?

#### Essay type Questions

1. Write in detail about different eye diseases.
2. Describe in detail the mechanism of hearing.
3. Name type of different sensory organs and describe them.
4. Explain the structure of internal ear.
5. Describe sense organs of taste and smell.
6. Describe the structure of eye with diagram.

#### Answer Key-

1. (a)      2. (d)      3. (b)      4. (c)