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Ears or Statoacoustic Organs:

The vertebrate ear is commonly regarded only as an organ of hearing (phonoreceptor), but at least in higher vertebrates, it serves the dual function of equilibrium and hearing.

The ear of a fish, is very different from the ear of a mammal. In mammals ear consists of an external pinna which funnels sound waves into the external auditory canal. At the inner end of this canal these waves strike the ear drum or tympanic membrane and are then transmitted across the middle ear or tympanic cavity by means of a chain of small bones to the cochlea or ventral part of the inner ear.

From this complicated structure sensory impulses pass to the brain by means of the auditory nerve. The dorsal part of the inner ear consists primarily of three semicircular canals which are essentially organs of balance or orientation. The ear of fish, however, is not suited for the reception of sound. There is no external or middle ear, nor is a cochlea present.

The inner ear of a fish consists of a dorsal utriculus, which is connected with the semicircular canals, and a ventral enlargement known as the sacculus. It is from the sacculus that the lagena of amphibians, reptiles and birds as well as

the cochlea of mammals arises to permit hearing in true sense. While certain fishes are definitely able to detect vibrations in the water. The ear of a fish is primarily an organ of balance, enabling it to maintain its equilibrium.

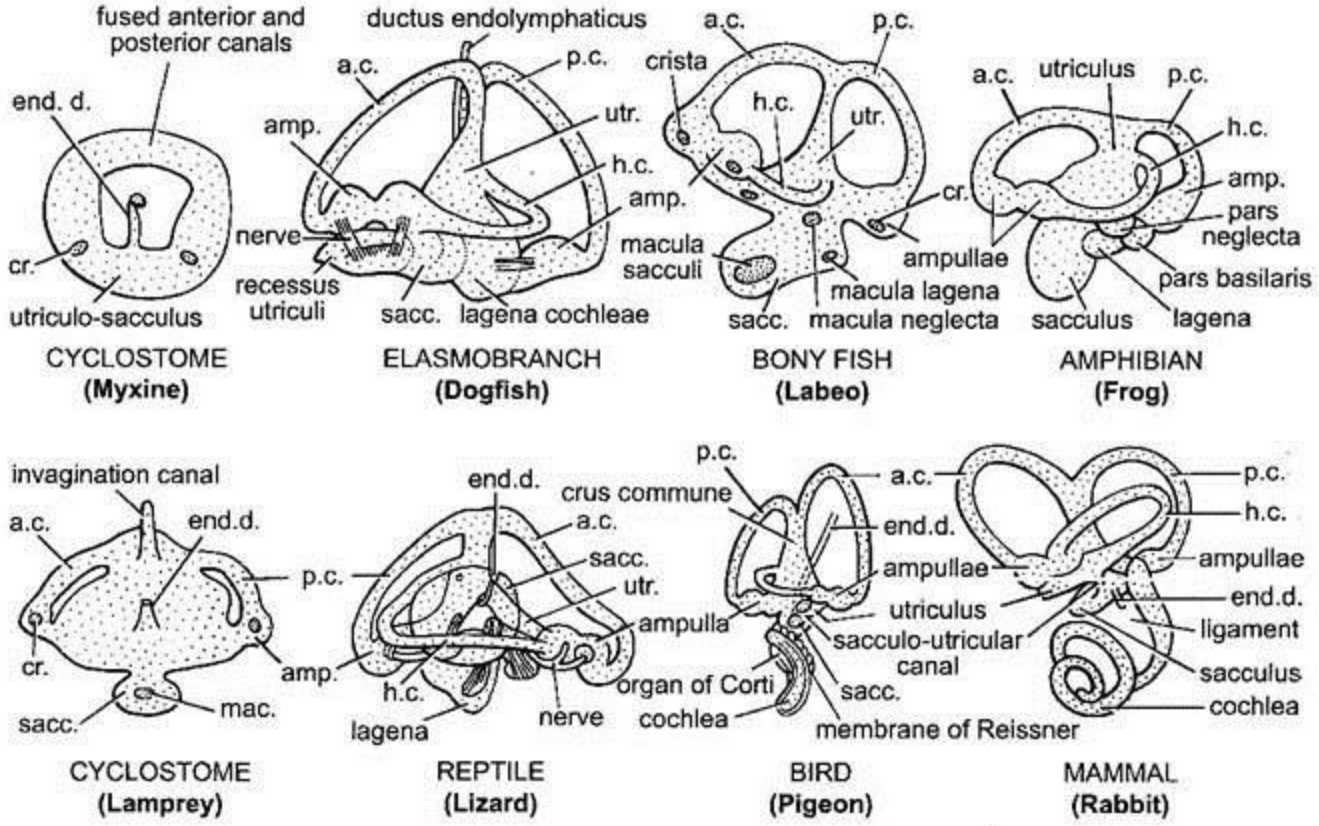

Fig. 47.4. Internal ears of representative types of vertebrates. a.c.–anterior vertical semicircular canal; amp.–ampulla; cr.–crista; end.d.–endolymphatic duct; h.c.–horizontal canal; mac.–macula; p.c.–posterior vertical canal; sacc.– sacculus; utr.–utriculus.

In cyclostomes, the membranous labyrinth is degenerate with only one (Myxine) or two (Petromyzon) semicircular canals. In fishes the membranous labyrinth is complete with three semicircular canals, and in many teleosts it is

connected to the air bladder by a duct or a chain of bony Weberian ossicles.

Amphibia:

There is considerable variation in the auditory apparatus of amphibians. Salamanders and their relatives lack any middle ear, although it is believed that they can detect vibration. Most frogs and toads, however, have a middle ear and an external ear drum. Sounds are transmitted from the ear drum across the tympanic cavity to the inner ear by means of a bone called the columella which is homologous with the hyomandibular element of the gill-arches of cartilaginous fishes.

The tympanic cavity, since it is derived eubryologically from the first pharyngeal or gill-pouch, is concerned with the pharynx by means of the eustachian tube. This permits equalisation of pressure on both sides of the tympanic membrane. From the ventral part of the sacculus of the inner ear there is a ventral out-pocketing called the lagena which is the forerunner of cochlea of mammals. This is believed to be concerned with the reception of sound vibrations.

Reptilia:

There is considerable variation in the structure of the ear in reptiles. Lizards have a well-developed middle ear and in

some forms the eardrum has sunk into a depression. Sound waves, thus, pass through a short canal known as the external auditory meatus in order to impinge upon the tympanic membrane. This is the first indication of an external ear in vertebrates.

In snakes the tympanic membrane, middle ear and eustachian tube are lacking. Vibrations are received by snakes are transmitted by way of the quadrate to the columella and then to the inner ear. The lagena is more elongate than in amphibians and in the crocodilians actually forms a cochlear duct rather similar to birds.

Aves:

The ear in most birds lacks an external pinna and has only an internal ear and a middle ear. In the barn owl (Tyto alba), the external pinna is well developed. As in reptiles there is but a single bone, the columella in the middle ear. A cochlea is present although it does not assume the complicated spiral form that is found in the higher mammals.

Barn owls are able to locate small mammals in total darkness by means of extremely acute hearing. Sounds are heard loudest in different sites in each ear, but the sensitivity is greatest along the line of vision. When the bird, by moving its head, hears the sound of moving prey the loudest, it is facing directly toward its potential food.

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Mammalia:

The ear in mammals shows several advances over the ears of other vertebrates. The middle ear contains three bony ossicles which transmit the vibrations from the tympanic membrane to the internal ear. An external auditory canal is present, and in the great majority of mammals, a well-developed pinna is present which aids in funneling sounds into the auditory canal. The cochlea is generally coiled to accommodate its increase in length.

The auditory apparatus of some mammals shows remarkable specialisation. Many bats, cetaceans and pinnipeds depend largely upon the echoes of sounds that they themselves produce to detect the presence of objects in their environment as they move about. Bats navigate by means of echo-location and they also come to know the size and shape of the object by echo.

Many kinds of cetaceans also produce underwater sounds with wider range of frequency than bats. In water, because of the similarity in density of the mammalian body and water, sound waves may be conducted through the body. They, therefore, could pass from one ear to another rather than be received independently. Cetaceans have tympanic bone, in which cochlea is located, suspended from the skull

by ligaments and surrounded by a cavity filled either with air or foam.

Sound waves, therefore, can only be transmitted in the cochlea by specially modified auditory ossicles. The sound itself is produced in nasal sacs just inside the blowhole, rather than in a larynx as in terrestrial mammals. Recent experiments also indicate that sound reception from the water to the middle and inner ear may be by way of lower jaw.

The mandibles of porpoises, dolphins and other toothed cetaceans are hollow and each is composed of an outer covering of very thin bone around an oil-filled cavity, which would favour sound transmission. The back of the mandible is very close to the middle ear.