In this tutorial you will learn about the anatomy of the middle ear cleft. This information will be less familiar to you but it is important that you can accurately describe the middle ear cleft’s anatomy. Once the anatomy is understood the function of the middle ear will be easier to understand and you will also be able to understand pathology better.

ANATOMICAL OVERVIEW

The ear consists of three parts: the outer ear, the middle ear cleft and the inner ear. Each of these has a number of structures within it. The last tutorial looked at the outer ear – the pinna, the outer ear canal and eardrum. This tutorial is about the middle ear cleft.

The middle ear cleft lies mostly in the temporal bone of the skull. A little anatomy of the temporal bone is required.

The temporal bone is one of the bones of the skull.

In this picture it is shaded.

The middle and inner ears are within this bone.

The temporal bone is made of four different parts. Three of these are seen here.

The squamous part is large and flat.

The tympanic bone is short and curved.

The mastoid is a part that hangs down behind the ear canal.
The temporal bone seen from the medial side.

The squamous, tympanic and mastoid parts are still visible but the petrous part can now be seen.

Petrous comes from a Latin word meaning ‘stone’ because the bone is very hard. The petrous bone is shaped like a pyramid.

You should take a look at a human skull and try to identify the parts of it for yourself.

**The middle ear cleft** – This consists of: the middle ear, the Eustachian tube and the mastoid. Each is joined to the next and they share functions and are lined with the same epithelium. The cleft’s function is to amplify sound and deliver it to the inner ear.

**The middle ear**

The images below are those that a surgeon might see as they dissect an ear. The first one shows the middle ear through the eardrum. You have seen this picture before. The second image, however, shows what the middle ear looks like without the eardrum.

This is the right eardrum. Through it you can see a number of middle ear structures. In the next diagram the tympanic membrane has been removed to show the middle ear contents.
In the next picture some of the bone of the scutum has been drilled away to show into the attic. The scutum is the outer attic wall and is commonly eroded by cholesteatoma. This allows the body of the incus and the head of the malleus to be seen as they are usually hidden from view.

Manubrium means ‘handle’ in Latin so this is the handle of the hammer. Chorda comes from Greek meaning a cord (or string). Lenticular comes from Latin and means 'lentil shaped'. A lentil is a type of edible seed. Scutum comes from the word for a shield.

There are a few other terms that are commonly used when describing parts of the middle ear. These are mesotympanum, epitympanum and hypotympanum. The middle ear is bigger than you might expect when looking at the eardrum. It extends both to a lower and higher level than the eardrum. The following diagram shows this idea.
Clinicians and textbooks often talk about ‘epitympanic disease’ or ‘mesotympanic cholesteatoma’ (to mention two examples) to describe where the patient’s problems are. This is why you must know these terms.

The terms can be made more accurate by adding words like ‘anterior’ or ‘posterior’. Thus there is an anterior epitympanic recess that can be filled with cholesteatoma. A posterior mesotympanic retraction would be a drum retraction falling into the posterior part of the middle ear.

N.B. The middle ear cleft and the middle ear are not the same thing. The first is the whole of the air filled space in the temporal bone and includes the mastoid, the middle ear and the Eustachian tube.

The middle ear (a part of the middle ear cleft) consist of three areas: the epitympanum, the mesotympanum and the hypotympanum.
The Ossicles

The three bones of the middle ear are called the ossicles. From lateral to medial they are the malleus (hammer), the incus (anvil), and the stapes (stirrup). We will learn about their function at another time. Here we will simply learn the names of the various parts of the bones.

The head of malleus articulates with the body of the incus. The manubrium is also called the handle.

The body of the incus articulates with the head of the malleus. The short process of the incus is also called the short crus. The long process (crus) of incus ends in the lenticular process which joins with the head of the stapes.
The stapes head articulates with the lenticular process of the incus. The base is called the footplate.

**The Eustachian tube**

The Eustachian tube runs from the back of the nose into the anterior mesotympanum (anterior middle ear). It is a long thin tube whose job is to allow air to enter the middle ear. By doing this it ensures that the air pressure in the middle ear is the same as the pressure in the outer ear.

It is very important that these two pressures are the same because the ear works best when they are. When the air pressure in the middle ear is lower the eardrum and ossicles work less well and the patient feels a little deaf.

If the pressure in the middle ear stays low for a long time the middle ear may fill with fluid, become infected or develop cholesteatoma. In fact many of the diseases that you see can be blamed upon a poorly functioning Eustachian tube (e.g. glue ear, perforations, cholesteatoma, acute otitis media).

In adults the tube is long, thin and lies at an angle. In children it is short, wide and horizontal. The adult Eustachian tube works better than the child’s, which is one reason why children get more ear infections.

Diseases in the nose and sinuses such as rhinosinusitis, cancers and infected adenoids in children can affect the Eustachian tube. These all block it and stop it from working.

The Eustachian is long and thin in the adult. It ends in the nasopharynx where it may be affected by disease.

Nasopharynx – the space at the back of the nose.
The mastoid

The mastoid is the air filled space posterior to the middle ear and it lies in the mastoid bone. It is important because diseases from the middle ear sometimes spread into the mastoid.

For example cholesteatoma will often spread and fill the mastoid and infection, such as acute otitis media, can spread through the mastoid and into the brain or out under the skin.

Mastoidectomy is an operation that clears out the mastoid and removes large parts of it when they are diseased. It is one of the operations that we use for cholesteatoma.

In this picture of the left temporal bone the surface of the mastoid has been removed to show what it looks like inside.

The mastoid contains air cells – little pockets of air within the bone.

The mastoid is joined with the mesotympanum of the middle ear via the additus (his cant be seen in this picture).

We will look at this in more detail at a later time.

Part of the importance of the mastoid is that disease can spread from it into nearby areas. It is anatomically related to the middle and posterior cranial fossae and their contents (middle cranial fossa – temporal lobe of the brain; Posterior fossa – cerebellum).

When examining a patient with disease in the mastoid you should be careful to also examine for signs of disease in these two places. We will look at that at a later time as well.
QUIZ

This tutorial is a long and important one so be sure to read it carefully and understand its contents. The questions below relate to the anatomy of the temporal bone and the middle ear cleft.

1. Name the four main parts of the temporal bone.

2. What are the three parts of the middle ear cleft?

3. Name the bone shown and the four labeled parts.

4. What structures lie in the epitympanum?

5. What is the scutum?

6. What diseases can affect the Eustachian tube?

7. Posterior to the mastoid and petrous temporal bone lies a very important structure. What is it? You may have to look at an anatomy textbook to work this out.