**ABSTRACT**

**Objectives:** (1) Describe the relations of the facial recess (FR) to the sinus tympani (ST), posterior tympanic sinus (PTS), lateral tympanic sinus (LTS), mastoid segment of the facial nerve (FN), and stapediaus muscle (STM) based on their otoendoscopic, surgical, and radiologic anatomy and in relation to their development theories. (2) Evaluate their possible surgical approaches.

**Methods:** Fifty-five temporal bones were dissected, and the anatomic details were studied utilizing an operating microscope and otoendoscopes of different angles. In addition, the recesses anatomy and relations were studied in 200 temporal bones computed tomography scans.

**Results:** The retro tympanic recesses pneumatization could be classified as axial (FR) and sagittal (ST, PTS, and LTS). The 3 sagittal recesses showed fixed relations to each other, with ST and PTS medially (superiorly and inferiorly, respectively) and LTS laterally. FR inlet located superolaterally to the other sinuses while the recess itself extended laterally (44%) and posteriorly (20%) to them and in relation to the FN and SM. When ST was extensively pneumatized, it showed a direct relation with the FR extension posterior to the FN. Although it was possible to approach all 4 recesses endoscopically via the transcanal route, it was necessary to use a combined trans-neural and mastoid approach when the others were extensively pneumatized posteriorly and laterally.

**Conclusions:** Relations between the FR and the retro tympanic structures are significantly variable and influenced mainly by the type and extent of the pneumatization. Extensively or unusually pneumatized types need special or combined approaches.

**CONTACT**

Alaa Ali Abou-Bieh
Mansoura Faculty of Medicine
Email: abibinr@mans.edu.eg
Website: http://medfac.mans.edu.eg
Phone: +2001129826985

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**INTRODUCTION**

The retro tympanic has four recesses, facial recess (FR), lateral tympanic sinus proper (LTS), sinus tympani (ST) and posterior tympanic sinus (PTS). Authors usually classify the recesses according to their relations to the facial nerve canal (FN) into Lateral recesses and medial recesses with the facial recess (FR) lateral and superior, the lateral tympanic sinus proper (LTS) lateral and inferior, the posterior tympanic sinus (PTS) medial and superior and the sinuses tympani medial and inferior.\(^1\)\(^,\)\(^,\)\(^,\)\(^,\)\(^3\)

The facial recess (FR) is mainly bounded medially by the mastoid segment of the facial nerve (FN), superiorly by the incus buttress (In) and laterally by the annulus (An) or the chorda tympani (CT).\(^4\) The lateral tympanic sinus (LTS) is bounded medially by the facial nerve (FN) and the pyramid crest (PC), superiorly by the pyramid Emilein (PE) and the chordal ridge (CR), laterally the chordal eminence (CE) and inferiorly by the styloid eminence (SE).\(^5\) The posterior tympanic sinus (PTS) is bounded medially by the oval window (OW), superiorly by the tympanic segment of facial canal (TFN), laterally by the facial nerve (FN) and the pyramid crest (PC) and inferiorly by the ponticulus (Po).\(^1\)

The sinus tympani (ST) is bounded medially by the promontory (Pr), superiorly by the ponticulus (Po), inferiorly by the subiculum (Su) and laterally by the pyramid crest (PC).\(^6\)\(^,\)\(^6\)

The recesses are torned by the abutting of the primitive endothelial pouches of the eustachian tube (ET) origin as they develop the middle ear (ME) air cell system against the solid upper portion of the Reichert’s cartilage of the second branchial arch which ossifies to develop the styloid complex of the Posterior tympanic wall and already ossified lateral semicircular canal (otic capsule) (LSCC) around the developing facial nerve (FN).\(^1\)

The facial recess (FR) develops from the saccus superior (red arrow) which ascends over the styloid complex through the posterior tympanic isthmus (PMI) to form the squamosal portion of the mastoid.\(^10\)

The sinus tympani (ST), the posterior tympanic sinus (PTS) and the lateral tympanic sinus (LTS) develop from the saccus posticus (green arrow) which forms the hypotympanum (HYT), the round window niche (RW) and the inferior half of the oval window niche (OW).\(^11\) After birth and during childhood, the neck grows at a more rapid pace compared to the skull, so that the inferior portion of the tympanic membrane (TM) rotates outward, enlarging the hypotympanum (HYT) while the mastoid is pulled down and out by the growth of the sternomastoid muscle which facilitates the expansion of the endothelial-lined pouches originating from the primitive eustachian tube (ET) into the middle ear cleft.\(^12\)\(^,\)\(^14\)

**METHODS AND MATERIALS**

The anatomical variations of the posterior mesotympanum and the retro tympanic including the facial recess (FR) were studied in 55 Fresh frozen temporal bones (TBs). To the best of our knowledge, all bones came from adult cadavers. There were 31 right temporal bones and 24 left. All bones were dissected by the same approach and all were studied utilizing an operating microscope and otoendoscopes with \(0^\circ\), \(30^\circ\) and \(70^\circ\) angles and 2.7 and 3 mm diameters. In addition, the recesses anatomy and relations were studied in two hundred temporal bones CT scans (= 400 sides). These scans were randomly chosen regard less they were of normal individuals or showing any type of temporal bone pathology, but all were for adults.

The published anatomy of the retro tympanum data have passed by four peaks, the microsurgical era,\(^1\)\(^,\)\(^7\)\(^,\)\(^8\) the CT scans era,\(^9\)\(^,\)\(^15\) the endoscopes era,\(^16\)\(^,\)\(^18\) and the cochlear implantation revision era.\(^19\)\(^–\)\(^21\) Many articles described and classified the anatomy of the facial recess (FR) and sinus tympani (ST) based on different criteria.\(^1\)\(^,\)\(^2\)\(^,\)\(^24\)\(^–\)\(^25\) Yet, none have described the detailed relations of the recesses to each other. This study is to investigate the relations of the facial recess (FR) to the other retro tympanic recesses, the facial nerve (FN), and the stapediaus muscle (STM) and also to describe the relations of the four retro tympanic recesses based on otoendoscopic, surgical microscopic and radiologic anatomy and in relation to the development and pneumatization theories. In addition, is to evaluate the possible surgical approaches to the facial recess (FR) and the other retro tympanic recesses.\(^7\)\(^,\)\(^16\)\(^–\)\(^20\)

**RESULTS**

To better study the recesses pneumatization it is important to describe them according to their main 2D plane of pneumatization according to the point with maximum diameter. The facial recess (FR) could be better described as an axially oriented recess with or without extension in the coronal direction while the sinus tympani (ST), lateral tympanic sinus (LTS) and posterior tympanic sinus (PTS) were sagittally oriented recesses.

The sinus tympani (ST), the lateral tympanic sinus (LTS) and the posterior tympanic sinus (PTS) were all located in the petrous bone (PTB), medial to the squamous bone (STB) and koronors septom (KS), lateral to the laberyntone bone (ITB) and above and around the styloid bone (STB). The facial recess (FR) was located in the squamous bone (STB) either medial to koronors septom (KS) or the septum (KS) was ending in the recess posterior bony cover.

The three sagittal recesses showed fixed relations to each other with the sinus tympani (ST) always inferiorly, the posterior tympanic sinus (PTS) superiority and the lateral tympanic sinus (LTS) laterally. The facial recess (FR) inlet could always be located superolateral or superior to the other three retro tympanic sinuses regardless their pattern or extent of pneumatization.

**CONCLUSIONS**

The relations between the facial recess (FR) and retro tympanic recesses and also the relations between the recesses and each other are variable. These relations depend mainly on the type and extent of their pneumatization which are the main determine the anatomical relations between the structures in the retro tympanic area.

Extensively or unusually pneumatized types of the recesses need special or combined approaches.

**REFERENCES**

[References provided in the document]