Facial Recess Relations
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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 stapedius muscle (STM) based on their otoendoscopic, surgical, and radiologic anatomy and in relation to their development theories. (2) Evaluate the 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 retrotympanic 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 inferi orly, respectively) and LTS laterally. FR inlet located superolateral 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 approach FR and ST via combined transcanal and transmastoid approaches when they were extensively pneumatized posteriorly and laterally.

Conclusions: Relations between the FR and the retrotympanic 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.

Introduction
The aim of this study is to describe the relations of the facial recess (FR) to the other retrotympanic recesses, the sinus tympani (ST), the posterior tympanic sinus (PTS) and the lateral tympanic sinus (LTS) and to the mastoid segment of the facial nerve (FN), and stapedius muscle (STM). Also, is to describe the relations of the four retrotympanic recesses to each other. This would be based on the otoendoscopic, surgical microscopic and radiologic anatomy and in relation to the development and pneumatization theories. In addition, to evaluate the facial recess (FR) and the other retrotympanic recesses possible surgical approaches.

Material and Methods
The gross anatomy and anatomical variations of posterior mesotympanum and retrotympanic areas including the facial recess (FR) and the other retrotympanic recesses 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 0o, 30o and 70o 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 re-
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 septum (KS), lateral to the laberynthine 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 septum (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) inferiorly, the posterior tympanic sinus (PTS) superiorly and the lateral tympanic sinus (LTS) laterally.

The facial recess (FR) inlet could be located always superolateral to the other three sinuses.

The facial recess (FR) extended laterally to the other three recesses and in relation to the mastoid segment of the Facial nerve (FN) in 44% of the temporal bones specimens (TB).

The facial recess (FR) extended Posteriorly to the other three recesses and in relation to the mastoid segment of the Facial nerve (FN) in 20% of the temporal bones specimens (TB).

When the sinus tympani (ST) was extensively pneumatized, it showed a direct relation with the facial recess (FR) extension posterior to the Facial Nerve (FN).

Although it was possible to approach all the four recesses endoscopically via the trans-canal route, it was necessary to approach the facial recess (FR) and the sinus tympani (ST) via combined trans-canal and trans-mastoid approaches when they were extensively pneumatized.
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Discussion

The retrotympanum 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 sinus tympani (ST) medial and inferior.\(^1\)

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). The lateral tympanic sinus (LTS) is mainly bounded medially by the facial nerve (FN) and the pyramidal crest (PC), superiorly by the pyramidal Eminence (PE) and the chordal ridge (CR), laterally the chordal eminence (CE) and inferiorly by the styloid eminence (SE). The posterior tympanic sinus (PTS) is mainly bounded medially by the oval window (OW), superiorly by the tympanic segment of facial canal (tFN), laterally by the facial nerve (FN) and the pyramidal crest (PC) and inferiorly by the ponticulus (Po). The sinus tympani (ST) is mainly bounded medially by the promontory (Pro), superiorly by the ponticulus (Po), inferiorly by the subiculum (Su) and laterally by the pyramidal crest (PC).\(^1\)

The recesses are formed by the abutting of the primitive endotheial 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 styloidy 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 which ascends over the styloid complex through the posterior tympianic isthmus (PTI) to form the squamosal portion of the mastoid. The sinus tympani (ST), the posterior tympanic sinus (PTS) and the lateral tympanic sinus (LTS) develop from the saccus posticus which forms the hypotympanum (HyT), the round window niche (RW) and the inferior half of the oval window niche (OW).

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 pouchs originating from the primitive eustachian tube (ET) into the middle ear cleft.

The published data about the detailed anatomy of the retrotympanic recesses has three peaks, the microscope era, the CT scans era and the endoscopes era. Recently, many articles described detailed anatomy of the facial recess and sinus tympani and classified their types based on different criteria. Yet no work was published to describe the detailed relations of the recesses to each other.

conclusion:

The relations between the facial recess (FR) and retrotympanic 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.
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References


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