

ORIGINAL PAPER

The recesses of the retro-tympanum

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Abstract

Objective: To study the anatomy of the posterior tympanic wall and to describe the four recesses (Sinus Tympani – ST, Lateral Tympanic Sinus – LTS, Posterior Tympanic Sinus – PTS, Facial Recess – FR) with their variations in shape, dimension, internal configuration. **Material and Methods:** Thirty-seven cadaver temporal bones were examined through the anterior dissection approach. The opening was enlarged by drilling to allow a good microscopic or rigid endoscopic view to the retro-tympanum. Measurements of the recesses were made with gradually millimeter wire, dial micrometric indicator (comparator clock), various right angled picks and sometimes by means of cast-impression – used in stomatology for dental impression (interior configuration). **Results:** Out of 37 specimens, we have found PTS in 64.86% (24 cases), ST in 94.59% (35 cases), and LTS in 59.45% (22 cases). For FR, we have found four types. The most constant cell, located in the inferior external part of FR and in the same time, the biggest one was suprapyramidal Sappey's fossa, which we have found in 75.67% (28 cases) of all specimens. Sinus entrance of each recess was very variable, but in the most cases, we have found that the long diameter of ST and LTS was usually directed vertically and of PTS usually horizontally. The deeper recess was ST – 2.74 mm (range 0.5 to 6.2 mm). Pyramidal eminence was visualized in 100% of cases, the pyramidal ridge in 89.18%, the chordal ridge in 78.37%, the suprapyramidal ridge in 35.13%, ponticulus in 83.78% and subiculum in 75.67%. In many cases, the inner configuration of each sinus was irregular, presenting either small recesses (0.2 to 1 mm) under the bone borders at the entrance in the sinuses or communication between the two sinuses. **Conclusions:** Presence of the all four recess is not a rule. Marked variation in the size and shape and especially in the internal configuration of all recesses is a rule. All recesses of the retro-tympanum can be recognized more easily, if we identify at first all elements of positive projection (pyramidal eminence, chordal ridge, styloid eminence, styloid ridge, pyramidal ridge, suprapyramidal ridge, ponticulus, subiculum).

Keywords: temporal bones, retro-tympanum recesses, dimensions, shape, internal configuration.

Introduction

A number of structures are lodged within the posterior wall of the tympanic cavity, also known as the retro-tympanum.

The most important structures of the retro-tympanum are its four recesses (Sinus Tympani – ST, Lateral Tympanic Sinus – LTS, Posterior Tympanic Sinus – PTS, and Facial Recess – FR). Knowledge of these is essential for the otosurgeon, because each recess is considered as one of the hidden places in the tympanic cavity making it a potential site for recurrent cholesteatoma, granulation tissue or retracted epithelium.

Anatomical considerations about ST have been reported by other authors, but a detailed anatomical description of all recesses of the retro-tympanum is lacking and is relatively unfamiliar to the ENT surgeon.

From the pyramidal eminence – PE, that is the main and central anatomical mark of the retro-tympanum, more prominences detach in several directions under the way of small bony ridges (external, chordal ridge – cr; inferiorly, pyramidal ridge – pr; superiorly, suprapyramidal ridge – sPR; internal, ponticulus – P)

that shape between the tympanic groove and the promontory the four distinct recesses [1].

The PTS is the depression of the retro-tympanum located in the supero-internal dial, the ST in the infero-internal dial, the LTS in the infero-external dial and the FR in the supero-external dial. Legent F *et al.* in 1975 [2] and Espinoza J in 1989 [3], defined the PTS's limits: internal – posterior commissure of oval window, supero-external – facial canal and inferiorly – ponticulus.

Most studies define ST as the most constant depression of the retro-tympanum, lying between ponticulus (superiorly) and subiculum (inferiorly), pyramidal ridge (externally) and promontory (internally).

Proctor B, in 1969 [4], described LTS as the interval among the three eminences of the styloid complex (pyramidal eminence – PE, styloid eminence – SE, chordal eminence – CE). The FR limits have become better known, with the presentation of the surgical approach of this recess performed by Jensen C in 1968 [5]. It was compared to a triangle, with the superior angle at the level of the fossa incudis and the two sides formed by chorda tympani nerve and the facial nerve.

☐ Material and Methods

The material consists of 37 temporal bones taken from adult cadavers of both sexes obtained from the Department of Anatomy, “Carol Davila” University of Medicine and Pharmacy, Bucharest. It is to be mentioned that the preparation of the samples was made with respect to ethical criteria.

All temporal bones were examined by the anterior dissection approach. The opening was enlarged by drilling to allow a good microscopic or rigid endoscopic view to the retro-tympanum (OP-C12 Optomic microscope + Sony photo digital camera or FlexiScope 180X-CC Schoolly + rigid endoscopes 4 mm, 2.7 mm; 0° , 30°).

After each recess of the retro-tympanum had been identified, both its morphological features and those of the surrounding structures were evaluated. The study investigated the presence or absence of the structures that form the sinus limits, the shape of the sinus entrance and their interior configuration. Significant findings were photographed. Next, measurements of short and long diameter of the sinus entrance and the sinus height were taken.

Measurements of the recesses were made with gradual millimeter wire (width and height) (Figure 1), comparator clock (height) (Figure 2), and various right angle picks (Figures 3 and 4).

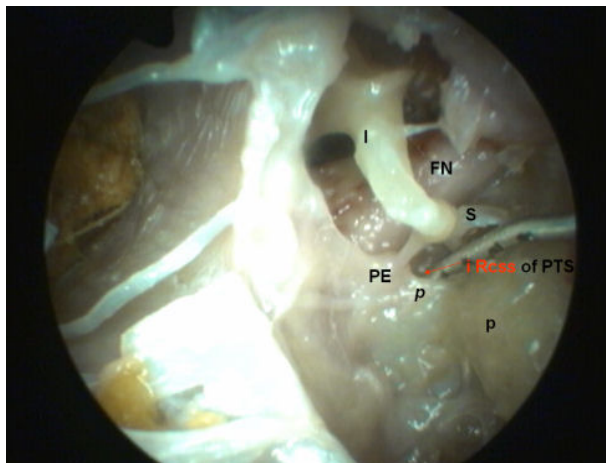


Figure 1 – Endoscopic view of the right retro-tympanum. Photograph showing the bending of the gradually millimeter wire to observe and measure the inferior small recess of the posterior tympanic sinus. Sinus tympani on this image is absent. FN – facial nerve, I – incus, S – stapes, PTS – posterior tympanic sinus, P – promontory, PE – pyramidal eminence, p – ponticulus.

Comparator clock can be used only when the perpendicular axes of the view of the microscope reached the bottom of the sinus. In the rest of the cases, the bending of the wire and the right angle picks with different dimensions permitted the measurements of the recesses. To study the interior configuration and measure its small recesses of each sinus, we used the same various right angle picks or sometimes by means of cast-impression – used in stomatology for dental impression.

All measurements were made three times.



Figure 2 – Photograph showing the comparator clock (dial micrometric indicator) which was used with an adapted system for the microscope to measure the depth of the recess (only in the cases when the perpendicular axes of the microscope's view reached the bottom of the sinus).

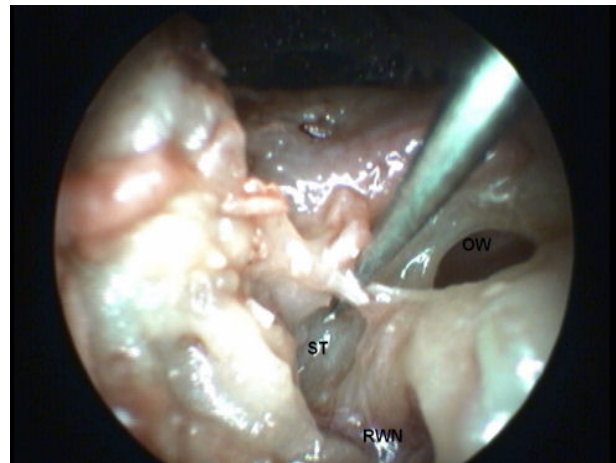


Figure 3 – Endoscopic view of the right retro-tympanum. Photograph showing the usage of the right angle pick to observe the communication between sinus tympani and posterior tympanic sinus. ST – sinus tympani, OW – oval window, RWN – round window niche.

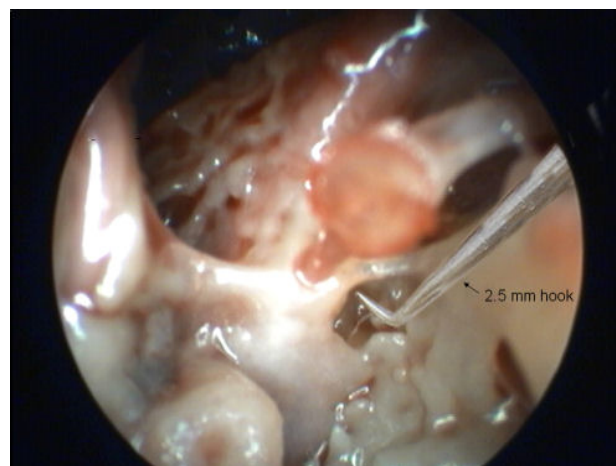


Figure 4 – Endoscopic view of the right retro-tympanum. Photograph showing the usage of the right angle pick (2.5 mm; 90°) to measure the sinus entrance of the tympani sinus.

Results

In 24 specimens (64, 86%), we have found PTS (lies between the posterior commissure of oval window, facial canal and the ponticulus). The results of the morphological study revealed that in most cases the posterior tympanic sinus entrance (Figure 5) was triangular (with the base towards the oval window – 10 cases) or oval (eight cases).

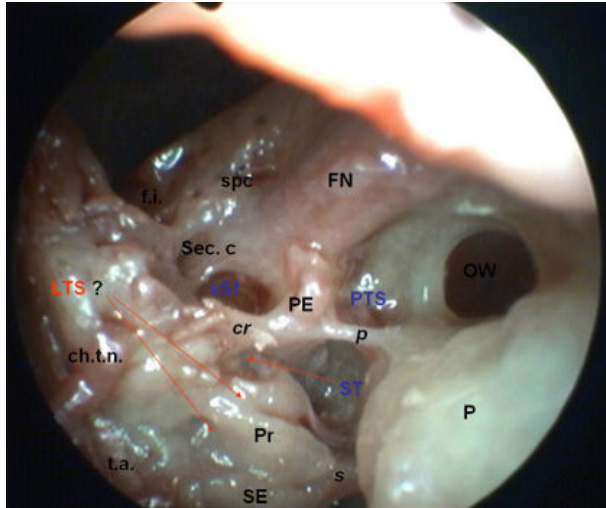


Figure 5 – Endoscopic view of the right retro-tympanum. Photograph showing a posterior tympanic sinus which looks like a triangle with the base towards the oval window, a deeper sinus tympani with a lateral recess over an incomplete pyramidal ridge, the absence of the lateral tympanic sinus and a facial recess (type II) made up of two medium cavities (one is the suprapyramidal Sappey's fossa located in the inferior external part of FR, the second cavity is localized superior externally) and small pneumatic cells located in the superior internal part of FR. FN – facial nerve, PTS – posterior tympanic sinus, ST – sinus tympani, LTS – lateral tympanic sinus, sSt – suprapyramidal Sappey's fossa, P – promontory, PE – pyramidal eminence, SE – styloid eminence, p – ponticulus, s – subiculum, cr – chordal ridge, pr – pyramidal ridge, ch.t.n. – chorda tympani nerve, t.a. – tympanic annulus, sec.c – second cavity of facial recess, spc – small pneumatic cell, f.i. – incudis fosa.

We much less frequently observed a round or polygonal posterior tympanic sinus entrance. The long diameter of the sinus entrance was usually directed horizontally. In two cases out of 24, the study revealed the incidence of a posterior tympanic sinus penetrating under the facial canal and suprapyramidal ridge (Figure 6). Moreover, a small inferior recess under ponticulus towards the sinus tympani was revealed in 17 cases (Figure 1). We found the communication between both sinuses, in 10 cases (Figures 3 and 7).

Suprapyramidal ridge we was found in 13 cases. In 12 cases, it represented the supero-external limit of the sinus being thin and starting from the basis of the pyramidal eminence to facial canal and in one case, it divided the posterior tympanic sinus into two depressions. Facial canal was dehiscent in two cases superiorly by the posterior tympanic sinus and oval window (Figure 8).

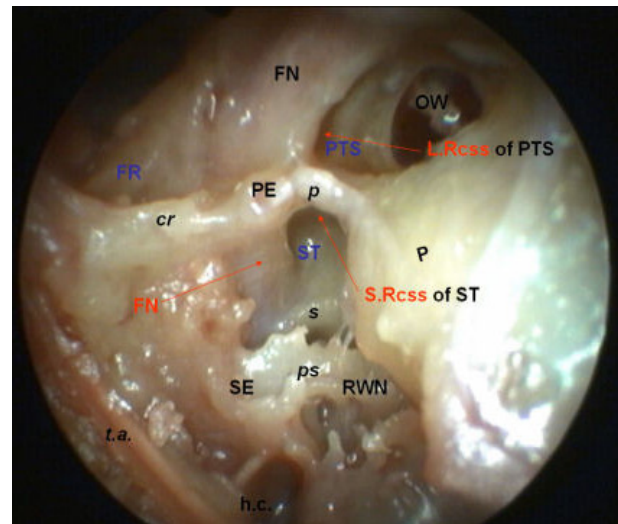


Figure 6 – Endoscopic view of the right retro-tympanum. Photograph showing a posterior tympanic sinus with a lateral small recess under the facial nerve, a large sinus tympani which in its lateral half is traversed by an intact and prominent facial canal; the medial half is very deep and presents a superior recess under ponticulus; a facial recess (type III), the absence of the lateral tympanic sinus, the absence of the pyramidal ridge. Subiculum is not very high; that's why the space between subiculum and pseudosubiculum allows the communication between sinus tympani and round window niche. FN – facial nerve, L.Rcss – lateral recess, PTS – posterior tympanic sinus, S.Rcss – superior recess, ST – sinus tympani, FR – facial recess, P – promontory, PE – pyramidal eminence, SE – styloid eminence, OW – oval window, RWN – round window niche, p – ponticulus, s – subiculum, ps – pseudosubiculum, cr – chordal ridge, t.a. – tympanic annulus, hc – a large hypotympanic cell.

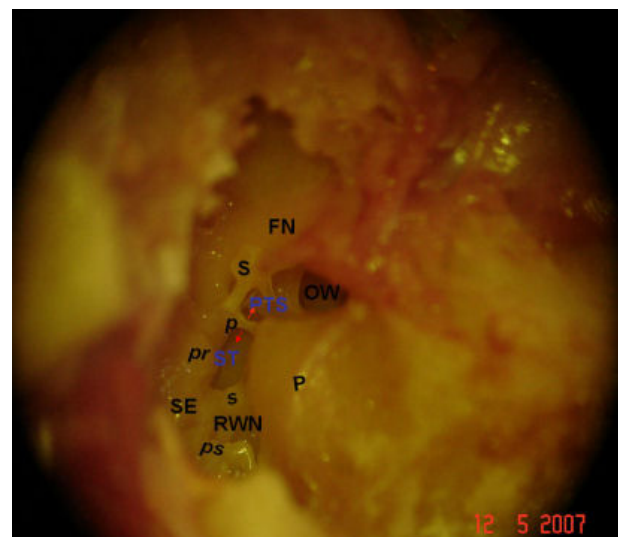


Figure 7 – Microscope view of the right retro-tympanum. Photograph showing the communication between sinus tympani (rectangular) and posterior tympanic sinus under a thin ponticulus like a bridge. FN – facial nerve, PTS – posterior tympanic sinus, ST – sinus tympani, P – promontory, SE – styloid eminence, OW – oval window, RWN – round window niche, p – ponticulus, s – subiculum, ps – pseudosubiculum, pr – pyramidal ridge, S – stapes (fragment).

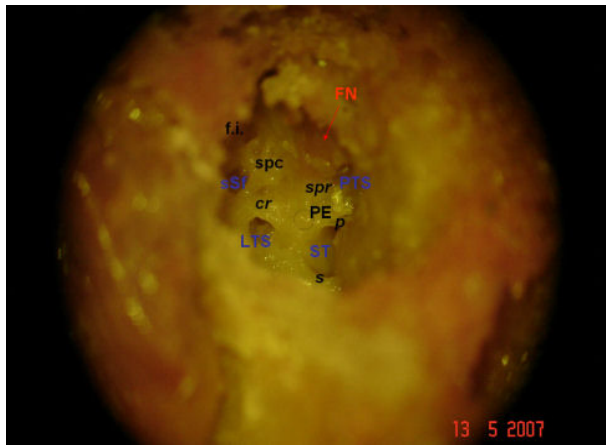


Figure 8 – Microscope view of the right retro-tympanum. Photograph showing a facial nerve, which is dehiscent above the posterior tympanic sinus, a narrow and deeper lateral tympanic sinus, a sinus tympani with superior and medial small recesses under the ponticulus and the promontory respectively. FN – facial nerve, PTS – posterior tympanic sinus, ST – sinus tympani, LTS – lateral tympanic sinus, P – promontory, p – ponticulus, s – subiculum, cr – chordal ridge, spr – suprapyramidal ridge, sSf – supra-pyramidal Sappey's fossa, spc – small pneumatic cell, f.i. – incudis fossa.

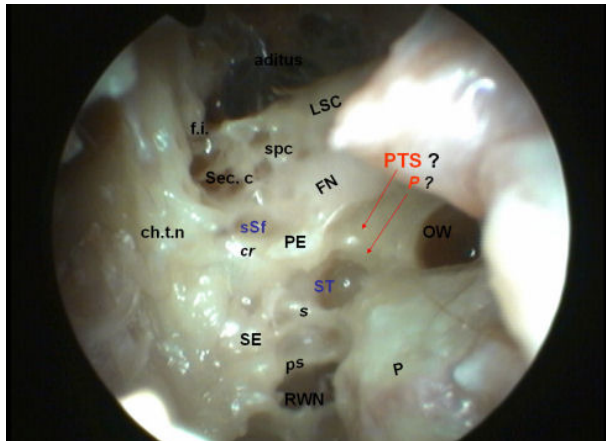


Figure 9 – Endoscopic view of the right retro-tympanum. Photograph showing an oval sinus tympani, the absence of the posterior tympanic sinus, ponticulus and lateral tympanic sinus, a facial recess (type II). The separation between sinus tympani and round window niche is made by a prominent subiculum and pseudosubiculum. FN – facial nerve, PTS – posterior tympanic sinus, ST – sinus tympani, P – promontory, PE – pyramidal eminence, SE – styloid eminence, OW – oval window, RWN – round window niche, p – ponticulus, s – subiculum, ps – pseudosubiculum, cr – chordal ridge, ch.t.n – chorda tympani nerve, sSf – supra-pyramidal Sappey's fossa, sec.c – second cavity of facial recess, spc – small pneumatic cell, f.i. – incudis fossa, LSC – lateral semicircular canal.

Table 1 presents the variability of the posterior tympanic sinus observed in this study.

Table 2 presents the measurements resulted from all the four recesses of the retro-tympanum. The study revealed that the posterior tympanic sinus was less deep than had than the other sinuses. The mean height was 1.47 mm.

Table 1 – Morphology of the posterior tympanic sinus and the suprapyramidal ridge

Shape of the sinus entrance				
Feature	Triangular	Oval	Round	Polygonal
%	41.66	33.33	16.66	8.33
Interior configuration and small recesses of the sinus				
Feature	Recess under ponticulus	Recess under ponticulus with communication to ST	Recess under facial canal	Recess-absent
%	29.16	41.66		
Supra-pyramidal ridge				
Feature	Present		Absent	
Number	13		24	

Table 2 – Sinus measurements (all measurements in millimeters)

	Posterior tympanic synus	Sinus tympani	Lateral tympanic sinus	Supra-pyramidal Sappey's fossa [†]
MLD*	1.62±0.44	2.77±1.05	1.89±1.17	1.85±0.84
MSD**	1.25±0.36	2.00±0.76	1.27±0.63	1.62±0.71
MH***	1.47±0.80	2.74±1.22	1.58±0.63	2.28±0.83

[†]The biggest and the most constant cell of the facial recess.

*Mean long diameter [mm].

**Mean short diameter [mm].

***Mean height [mm].

In 35 specimens (94.59%), we have found ST (lies between ponticulus, subiculum, pyramidal ridge and promontory). The results of the morphological study revealed that most cases the posterior tympanic sinus entrance was oval (13 cases) (Figure 9), rectangular (10 cases) or round (eight cases). We much less frequently observed (four cases) a trapezium or rhombus tympanic sinus entrance. The long diameter of the sinus entrance was usually directed vertically. In 24 cases out of 35, the study revealed a superior recess under the ponticulus to the posterior tympanic sinus (Figure 6). We found the communication between both sinuses in 10 cases (Figures 3, 7 and 10).

Moreover, in seven cases we observed a medial recess under the promontory (Figure 8) and in four cases an inferior recess under or over the subiculum (Figure 6). When subiculum was incomplete, this inferior recess realized a communication between sinus tympani and round window niche. In three cases, a prominent and intact facial canal traversed the sinus tympani and it made its external wall (Figure 6). We found ponticulus in 31 cases, subiculum in 28, pyramidal ridge in 33 and pyramidal eminence in all the cases.

Table 3 presents the variability of the sinus tympani observed in this present study.

The mean long diameter and the mean short diameter of the tympani sinus were 2.77 and 2.00 mm respectively. The depth of the sinus tympani ranged from 0.5 to 6.2 mm (average 2.74 mm).

In 22 specimens (59.45%), we have found LTS (corresponding to the area of styloid triangle). The results of the morphological study revealed that most cases the lateral tympanic sinus entrance was extended or medium (Figures 11–14) and it was narrow

much less frequently (five cases) (Figure 8). The long diameter of the sinus entrance was usually directed vertically. In six cases, the lateral tympanic sinus presented a superior recess and in five cases a lateral recess under the styloid ridge or under the tympanic annulus when styloid ridge was absent. We found the

communication between the lateral tympanic sinus and the suprapyramidal Sappey's fossa under the chordal ridge in three cases (Figures 11 and 13) and over the chordal ridge when this latter was absent or incomplete, in two cases (Figure 14).

Figure 10 – Endoscopic view of the right retro-tympanum. Photograph showing the communication between sinus tympani (trapezium) and posterior tympanic sinus under a thin ponticulus like a bridge, a superficial and small lateral tympanic sinus, a facial recess (type I) – Sappey's fossa, located in the inferior external part of FR + small pneumatic cells (0.2–1 mm), located in the superior internal part of FR, a large aditus ad antrum. FN – facial nerve, PTS – posterior tympanic sinus, ST – sinus tympani, PE – pyramidal eminence, ES – styloid eminence, p – ponticulus.

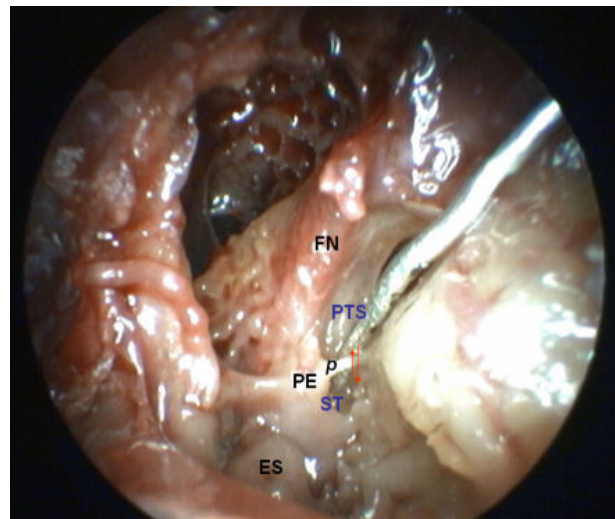


Table 3 – Morphology of the sinus tympani, ponticulus, subiculum and pyramidal ridge

Shape of the sinus entrance					
Feature	Oval	Rectangular	Round	Trapezium	Rhombus
%	37.14	28.57	22.85	8.57	2.85
Interior configuration and small recesses of the sinus					
Feature	Recess under ponticulus ± communication to PTS	Recess under/over pyramidal ridge	Recess under promontory	Recess under/over subiculum	
%	68.57	31.42	20	11.42	
Ponticulus					
Feature	Absent	Present			
		Like a ridge	Like a bridge	Incomplete	
Number	6	31			
%	16.21	16	12	3	
					83.78
Subiculum					
Feature	Absent	Present			
Number	9	28			
%	24.32	75.67			
Pyramidal ridge					
Feature	Absent	Present		Incomplete	
Number	2	33		2	
%	5.40	89.18		5.40	

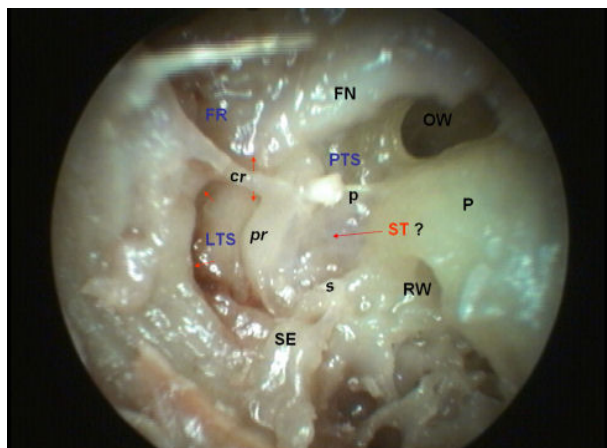


Figure 11 – Endoscopic view of the right retro-tympanum. Photograph showing the absence of the sinus tympani, posterior tympanic sinus, a facial recess (type III), an extended lateral tympanic sinus with a superior recess under a chordal ridge like a bridge and a lateral recess under styloid ridge to the external auditory wall. Ponticulus is thin and incomplete and subiculum is prominent. FN – facial nerve, PTS – posterior tympanic sinus, ST – sinus tympani, FR – facial recess, PE – pyramidal eminence, SE – styloid eminence, p – ponticulus, s – subiculum, pr – pyramidal ridge, P – promontory, OW – oval window, RW – round window.

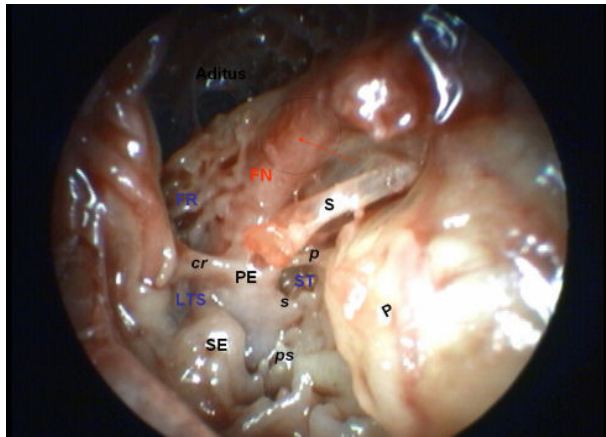


Figure 12 – Endoscopic view of the right retro-tympanum. Photograph showing a facial nerve which is dehiscence above oval fossa, a superficial and small lateral tympanic sinus, a facial recess (type I) – Sappey's fossa, located in the inferior external part of FR + small pneumatic cells (0.2–1 mm) located in the superior internal part of FR, a large aditus ad antrum. FN – facial nerve, LTS – lateral tympanic sinus, ST – sinus tympani, PE – pyramidal eminence, SE – styloid eminence, p – ponticulus, s – subiculum, ps – pseudosubiculum, cr – chordal ridge, S – stapes.

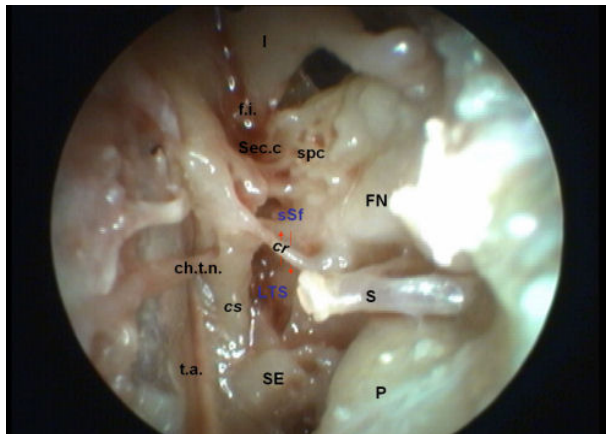


Figure 13 – Endoscopic view of the right retro-tympanum. Photograph showing a facial recess (type II) which communicates with the lateral tympanic sinus under chordal ridge like a bridge. FN – facial nerve, P – promontory, SE – styloid eminence, cr – chordal ridge, ch.t.n. – chorda tympani nerve, sSf – supra-pyramidal Sappey's fossa, sec.c – second cavity of facial recess, spc – small pneumatic cell, f.i. – incudis fossa, t.a. – tympanic annulus, cs – styloid crest (ridge), I – incus, S – stapes.

When this communication was realized under the chordal ridge, the lateral tympanic sinus entrance was usually narrow and when the chordal ridge was absent, the lateral tympanic sinus and suprapyramidal Sappey's fossa formed a huge external recess of the retro-tympanum (Figure 14).

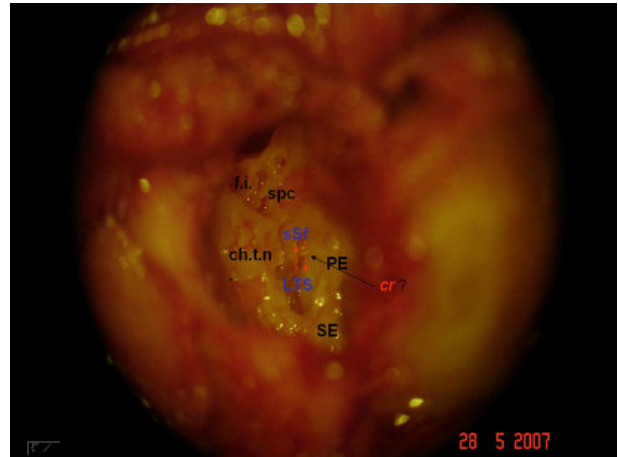


Figure 14 – Microscope view of the right retro-tympanum. Photograph showing a facial recess (type IV) – extended suprapyramidal Sappey's fossa to lateral tympanic sinus, when chordal ridge is absent. PE – pyramidal eminence, SE – styloid eminence, cr – chordal ridge, ch.t.n. – chorda tympani nerve, sSf – suprapyramidal Sappey's fossa, spc – small pneumatic cell, f.i. – incudis fossa.

Table 4 presents the variability of the lateral tympanic sinus observed in this present study.

We have found four types of facial recess: I. (59.45%) (Figures 8 and 12) suprapyramidal Sappey's fossa – Sf, located in the inferior external part of FR + small pneumatic cells (0.2–1 mm), located in the superior internal part of FR; II. (16.21%) (Figures 5, 9 and 13) two medium-sized cavities (one is Sf, the second cavity is localized superior externally) + small pneumatic cells; III. (18.91%) (Figures 6, 11 and 15) a “V” shaped single large or narrow depression placed between two walls (1 – facial nerve + lateral semi-circular canal and 2 – tympanal wall) and under a virtual horizontal plane formed by the short apophysis of incus; IV. (5.40%) (Figure 14) extended Sf to LTS, when chordal ridge is absent. Out of 37 specimens, we have found 28 Sf (75.67%), 10 of which had had a deep cone shaped Sf, parallel to the facial canal (Figure 5).

Table 4 – Morphology of the lateral tympanic sinus and the chordal ridge

		Shape of the sinus entrance		
Feature	Extended	Medium	Narrow	
%	36.39	40.90	22.72	
Interior configuration and small recesses of the sinus				
Feature	Superior recess over or under cordal ridge ± communication to suprapyramidal Sappey's fossa	Lateral recess under styloid ridge to external auditory wall	Recess-absent	
%	27.27	50.00	20	
Chordal ridge				
Feature	Absent	Present		
		Like a ridge	Like a bridge	Incomplete
Number	8	29		
%	21.62	22	4	3
		78.37		

Discussion

The complex anatomy of the retro-tympanum has important clinical significance with respect to the management of cholesteatoma in this location. Our study showed that the shape, dimension and interior configuration were very variable. Presence of the all four recesses is not a rule. The most frequent recess that we found in our specimens was sinus tympani. Absence of the sinus tympani was observed by Amjad AH *et al.* [6] in 8.33%, by Parlier-Cuau C *et al.* [7] in 5%, by Nitek S *et al.* [8] in 3.33% and in our study (Figures 11 and 15) in 5.41%. Significantly, in eight cases (21.62%) out of 37 the study revealed the incidence of sinus tympani, which was over 4 mm in depth. A similar depth over 4 mm was observed surgically by Niemczyk K *et al.* [9], in 30% of his surgical patients. Amjad AH *et al.* [6] reports that the sinus may even reach 10 mm in depth. It was noted that a prominent facial canal correlated with a deeper sinus tympani. Abdel Baki F *et al.* [10] reported that the sinus tympani are in most cases bounded laterally by a constant ledge of bone anterior to the facial nerve. Our study revealed that in three cases, a prominent and intact facial canal traversed sinus tympani or it formed its lateral wall.

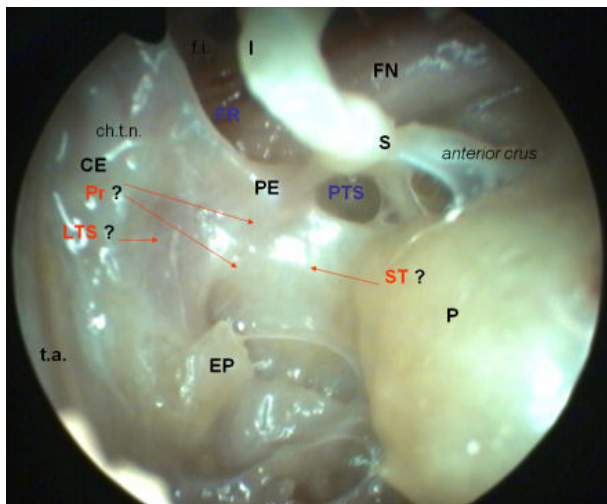


Figure 15 – Endoscopic view of the right retro-tympanum. Photograph showing the absence of the sinus tympani, lateral tympanic sinus, subiculum, pyramidal ridge and chordal ridge – a facial recess (type III) – as a “V” shaped depression localized between two walls (1. facial nerve + lateral semicircular canal and 2. tympanal wall). FN – facial nerve, PTS – posterior tympanic sinus, ST – sinus tympani, LTS – lateral tympanic sinus, FR – facial recess, P – promontory, PE – pyramidal eminence, SE – styloid eminence, CE – chordal eminence, ch.t.n. – chorda tympani nerve, t.a. – tympanic annulus, I – incus, S – stape.

The measurement results of the sinus tympani obtained in this study correspond to those attained by the other authors. The mean depth of the sinus tympani observed by Ozturan O *et al.* [11] was 2.06 mm, by Nitek S *et al.* [8] was 2.73 mm, by Parlier-Cuau C *et al.* [7] was 2.7 mm, and in our study 2.74 mm. Maximum depth reported by Holt JJ [12] was 8 mm and in our study was 6.2 mm. The mean long and short

diameter of the sinus tympani entrance observed by Espinoza J *et al.* [3] were 3 mm and 2 mm respectively, and in our study 2.77 mm and 2.0 mm respectively.

The presence of the posterior tympanic sinus was reported by Parlier-Cuau C *et al.* [7] in 38% of his study. Holt JJ [13] observed that this sinus is located just posteriorly to the oval window and in 8% the sinus tympani and posterior tympanic sinus formed one confluent recess. Our study revealed that in 10 cases out of 37, the communication between both the sinuses under ponticulus (or if the latter is absent) was present. The width of the opening and the depth of the posterior tympanic sinus found by Holt JJ [13] was 1.5 mm or less, and 1 mm or less respectively, similar to our data, 1.8 mm, respectively 2 mm.

Parlier-Cuau C *et al.* [7] reported an occurrence of the lateral tympanic sinus in 47% with a mean depth of 2.1 mm. Our study revealed that recess incidence in 59% cases, with a mean depth of 1.58 mm.

Many authors make confusion between the facial recess or sinus recess and the suprapyramidal Sappey's fossa. We found four morphological types of facial recess in our study. We observed a round or oval cell, usually situated in the inferior-external part of the facial recess, in three types. That cell was the biggest and the most constant depression of facial recess and we considered it as being the suprapyramidal Sappey's fossa. In 2006, Măru N [14] reported in her PhD research three types of facial recess (Sappey's fossa was found in all three types of facial recess with the same location).

All recesses of the retro-tympanum can be recognized more easily, if we identify at first all elements of positive projection (pyramidal eminence, chordal ridge, projection, styloid eminence, styloid ridge, pyramidal ridge, suprapyramidal ridge, ponticulus, subiculum).

As Ciuchi V [1], Parlier-Cuau C *et al.* [7] and Măru N [14] noted, the only structure of the retro-tympanum that we found in 100% of the cases is the pyramidal eminence. Our findings agree with this.

Proctor B [15] defined ponticulus either a bony ridge or a bridge between pyramidal eminence and promontory. Holt JJ [16], consider that ponticulus is best considered as a bridge. Complete absence of the ponticulus was observed by Holt JJ [16] in 20% out of 50 cases, by Măru N [14] in 10% out of 50 cases, and in our study 16.21% out of 37 cases.

The subiculum promontorii is described by Proctor B as a prominent ridge that extends from the styloid eminence to the posterior lip of the round window niche. Our study agrees with Măru's findings, observing a true subiculum between posterior part of round window and pyramidal ridge and also a pseudo-subiculum like a bony ridge arising from the styloid eminence to posterior lip of round window (Figures 6 and 12). Between those two bony structures, it appears the round window niche. When the subiculum is incomplete or a bony ridge less evident, a large communication between sinus tympani and round window niche is permitted. Smaller sinus tympani appear when the distance between ponticulus and

subiculum is short (Figure 12). For many times, (Figures 9 and 12) subiculum detached from pyramidal ridge (but not from styloid eminence). Subiculum was completely absent in 18% out of 50 cases observed by Măru N [14] and also in 24.32% out of our 37 cases.

In our study, the pyramidal ridge and chordal ridge, prominent ridges between the pyramidal eminence and the styloid eminence, and the pyramidal eminence and chordal eminence respectively, were present in 89.19% and 78.37% of all cases respectively. Măru N [14] observed the pyramidal ridge in 86% out of 50 cases. Parlier-Cuau C *et al.* [7] observed the chordal ridge in 52%. As concerning the chordal ridge, Măru N [14] reported that it could be as a ridge (42%) or a bridge (58%) in many cases. Our findings agree with this.

In the present study, we discovered a marked variation in the size and shape and especially in interior configuration of all recesses. Figure 16 tries to design the possible small recesses of all four recesses (sinuses) of the retro-tympanum than we found in our study.

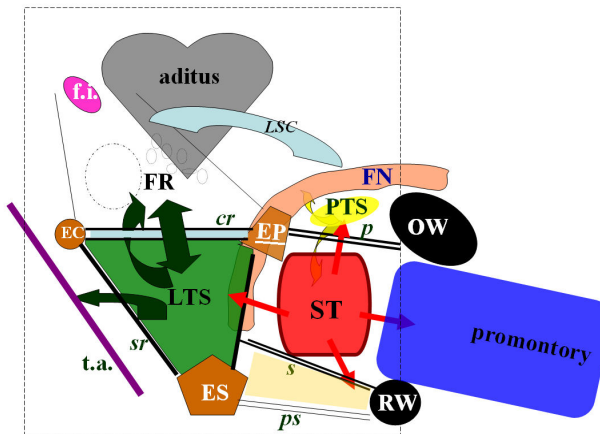


Figure 16 – Diagram of the retro-tympanum showing its four recesses (ST, PTS, LTS, FR) with the possible extensions or small recesses of these big four depressions of the retro-tympanum.

☒ Conclusions

The presence of the all four recess is not a rule. Marked variation in the size and shape and especially in the internal configuration of all recesses is a rule. All recesses of the retro-tympanum can be recognized more easily, if we identify at first all elements of positive projection (pyramidal eminence, chordal ridge, styloid eminence, styloid ridge, pyramidal ridge, supra-pyramidal ridge, ponticulus, subiculum).

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