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Dimensions and morphology of the sinus tympani: an anatomical study

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ABSTRACT

Background: The sinus tympani is a deep pocket of varying dimensions and shape situated in the retrotympanum. The sinus tympani lies medial to the facial nerve. Hence surgical access is difficult. This area is frequently involved in chronic otitis media attico antral type. Removal of disease from this area is difficult leading to cholesteatoma recidivism. The anatomy has been well described in literature. Its dimensions and morphology has not been described in the Indian population. Knowledge of the endoscopic anatomy of this area will help to eradicate disease leading to better results.
Methods: A canal wall down mastoidectomy was performed on twenty wet temporal bones. A zero degree endoscope was introduced into the middle ear to view the sinus tympani. Using a graduated millimetre scale. The dimensions and morphology of the sinus tympani was studied.
Results: Twenty wet bones were dissected. The mean height of the sinus tympani was 3.55 mm. The mean width was 2.22 mm and mean depth was 1.72 mm. The morphology was as follows: 13 bones had a type A morphology (classical type), 6 had a type B morphology (confluent), 1 bone had a type D morphology (restricted type). We did not encounter a type C sinus tympani in our study.
Conclusions: The morphology and dimensions of the sinus tympani are variable. The otologist must have a complete knowledge of the anatomy of this area to successfully eradicate disease from this area.

Keywords: Sinus tympani, Cholesteatoma, Endoscopic, Dimensions, Morphology

INTRODUCTION

The sinus tympani (ST) is a space present in the posterior wall of the middle ear between the ponticulus superiorly and subiculum inferiorly. Marchioni, Molteni and Presutti[1] have described four morphological types of sinus tympani.

- Classical type (Type A): The sinus tympani is present between the ponticulus and subiculum and it does not communicate with the posterior tympanic sinus.
- Confluent type (Type B): The ponticulus is absent. The posterior tympanic space is continuous with the sinus tympani.
- Partitioned type (Type C): A ridge of bone runs from the vertical segment of the facial nerve to the promontory dividing the sinus tympani into an upper superior sinus tympani and lower inferior sinus tympani.
- Restricted type (Type D): A high jugular bulb Is present which the restricts the pneumatisation of the sinus tympani inferiorly.

This area is difficult to access during mastoidectomy because it lies medial to the vertical segment of facial nerve which prevents direct access to it. In patients with chronic suppurative otitis media atticoantral type, cholesteatoma, retraction Pocket's and granulation tissue will involve this space. Removal of disease is technically challenging because of the difficult access and varying depths of the ST. The depth can vary from 0.9-6.1 mm.[2] Incomplete removal of cholesteatoma matrix will lead to cholesteatoma recidivism neccessitating revision surgery. A good knowledge of the endoscopic anatomy of this space will help in better clearance of disease leading to better results. This study is being performed to study the morphology of the ST and its dimensions in the Indian population.

Aim of the study

- To determine the mean height, width, and depth of the sinus tympani
- To study the morphology (type) of the sinus tympani.

METHODS

Our study is a descriptive anatomical study performed between 15 June 2018 and 15 August 2018. This study was conducted at the Department of ENT, Mysore Medical College and Research Institute, Mysore, Karnataka, India. Institutional ethical committee approval was obtained for the study.

Figure 1: Photograph demonstrating canal wall down mastoidectomy with preservation of stapes.

This study was done on twenty wet adult temporal bones. The temporal bone was placed in the surgical position in the temporal bone holder. A canal wall down mastoidectomy was performed. The facial ridge was lowered up to the vertical segment of the facial nerve. The facial shelf which lies anterior to the mastoid segment of the facial nerve was removed up to the anterior margin of the facial nerve. The posterior buttress was completely removed. These steps enable a good access to the posterior wall of the middle ear. The tympanic membrane, malleus and incus were removed. The stapes was preserved (Figure 1).

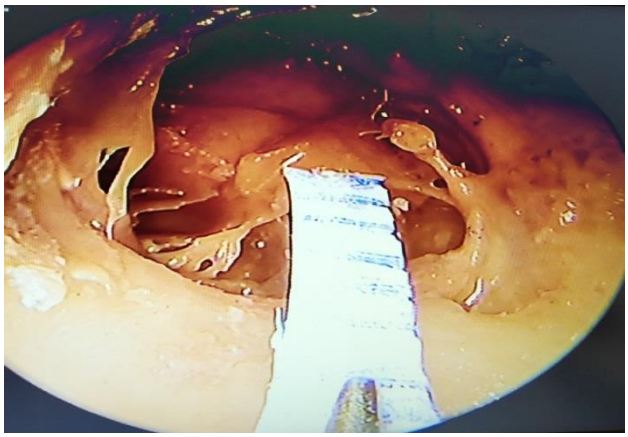

Figure 2: Photograph demonstrating height of sinus tympani.

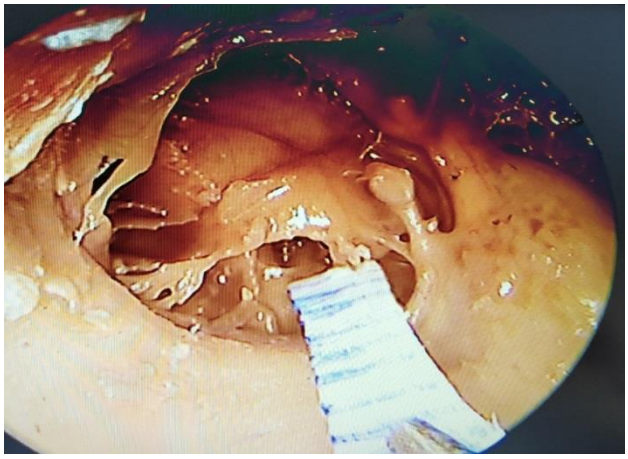

Figure 3: Photograph demonstrating the width of sinus tympani.

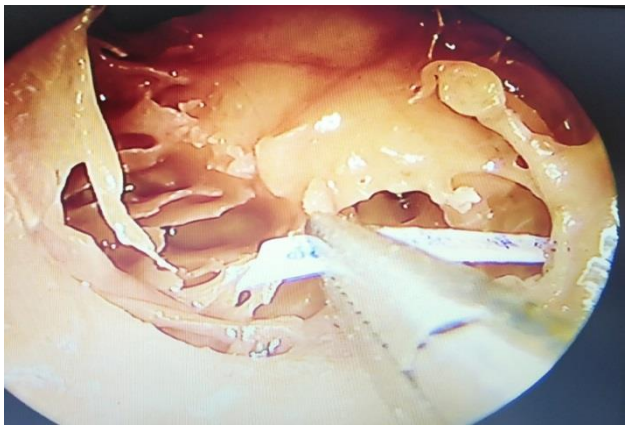

Figure 4: Photograph demonstrating the depth of sinus tympani.

A 4 mm zero degree endoscope was introduced into the middle ear and the sinus tympani was inspected and studied. A graduated millimetre scale was used to measure the height (Figure 2), width (Figure 3) and depth (Figure 4) of sinus tympani.

Next the morphology of the ST was noted. These findings were recorded in a proforma sheet.

RESULTS

Twenty wet temporal bones were dissected. Among the 20 bones, 10 were from the right and the rest were from the left side.

13 bones (65%) had a classical type of sinus tympani, In 6 bones (30%) a confluent type of sinus tympani was present. 1 bone (5%) had a restricted type of sinus tympani. We did not encounter partitioned type of sinus tympani in our study (Table 1).

Table 1: Types of sinus tympani.

Type	Frequency	Valid percentage (%)
Classical	13	65
Confluent	6	30
Partitioned	0	0
Restricted	1	5

Table 2: The dimensions and type of the sinus tympani.

No.	Height in mm	Width in mm	Depth in mm	Type
1	3.5	2	1.5	Classical
2	3	2.5	2.5	Classical
3	3	1.5	0.5	Classical
4	3.5	2	2	Confluent
5	3.5	2	0.5	Classical
6	3	2	4	Classical
7	5	2.5	1	Classical
8	4	2	1	Classical
9	3	3	5	Confluent
10	4	2	3	Classical
11	3	3	3	Classical
12	1	2	0.5	Restricted
13	4.5	1	2	Classical
14	3	2	2	Confluent
15	3.5	2	0.5	Classical
16	3.5	3	0.5	Classical
17	2.5	2	1	Confluent
18	6	3	2.5	Confluent
19	3.5	1.5	0.5	Classical
20	4	3	1	Confluent

The height of sinus tympani ranged from 1 mm to 6 mm with a mean of 3.5 mm.

The width ranged from 1mm to 3 mm with a mean of 2.2 mm.

The depth ranged from 0.5 mm to 5 mm with a mean of 1.72 mm (Table 2).

DISCUSSION

The sinus tympani was first decribed in 1820 by Meckel.[3] This space is known for its variations in morphology and dimensions. It can also be absent. Nitek noted an absence of 3.33% and in Amjad's study it was absent in 8.33% of bones.[4,5]

Marchioni in their study of 40 ears has described four types of sinus tympani classical, confluent, partitioned and restricted.[1] In our study we encountered the classical, confluent and restricted shapes. We did not find the partitioned type which may be due to small sample size. Other authors have described other types of ST.[6] Cheita has described five shapes– oval, rectangular, round, trapezoid and rhomboid. Nitek in their study on thirty temporal bones decribed four shapes – vertically oval, horizontally oval, round and polygonal.[4]

The mean height of the ST in our study was 3.5 mm (range 1-6 mm). In Nitek's study it was 2.73 mm (range 1- 4.45 mm).[4] Cheita reported a mean height of 2.74mm (range 1.52-3.96 mm).[6] The findings regarding the height of ST in our study does not agree with that of Nitek and Cheita, although the mean height of ST in the latter two studies are similar.

The mean width of the ST in our study was 2.2mm (range 1-3mm). In Nitek's study it was 2.23 mm (range 1-3.5 mm).[4] Ozturan reported a width of 1.49 mm (range 0.49-3.87mm).[3] Cheita reported a width of 2.00mm (range 1.24 -2.76 mm).[6] Baki reported a width of 2.4 mm.[2] The results with regard to the width are in concurrence with studies of NItek, Baki and Cheita.

The mean depth in our study was 1.72 mm (range 0.5-5 mm). Donaldson reported a mean depth of 3.75 mm.[7] In Saito's study it was 2.93 mm (range 0.61- 5.87 mm).[8] Ozturan reported a mean depth of 2.06 mm (0.2 -9.9 mm).[3] The findings in our study regarding depth are not in agreement with the above studies. This may be due to variations in the pneumatisation of the retrotympanum across specimens.

CONCLUSION

Cadaveric dissection and endoscopic study of the morphology and dimensions of the ST revealed a high variability in the shape and dimensions of the ST.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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