

Study of foramen tympanicum with its clinical implications in North Indian Crania

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Abstract

Introduction: The foramen tympanicum also known as foramen Huschke is present in the anteroinferior wall of external auditory canal after 5 years of age. It has anatomical significance and in adult life it can be involved in different abnormalities of external auditory canal and various Otological complications ranging from salivary otorrhoea to temporomandibular joint herniation.

Methods: The current study was done on 100 dry adult north Indian crania to study the incidence, sex, sides and shape of foramen tympanicum.

Results: Out of 100 skulls studied foramen tympanicum was observed in 18 skulls (26 sides). The incidence of foramen tympanicum was found in 13% skulls and it was more in females as compared to males. The most common shape of foramen was found to be irregular.

Conclusions: The ENT as well as maxillofacial surgeons should be aware of persistent foramen tympanicum and should be careful while performing endoscopy of temporomandibular joint to prevent its accidental damage.

Keywords: Foramen Tympanicum, Crania, Otological complications, External auditory canal, Temporomandibular joint.

Introduction

The foramen tympanicum is an area of incomplete ossification of tympanic part of temporal bone. This deficiency is present in the anteroinferior wall of external auditory canal. This foramen was first described by a German anatomist and embryologist, Professor Emil Huschke (1797- 1858). Hence it is also known as foramen of Huschke.^{1,2} A persistent foramen tympanicum can be either asymptomatic or can lead to a variety of complications ranging from herniation of temporomandibular joint, formation of salivary otorrhoea or spread of infection and tumor from external auditory canal to infratemporal fossa and vice versa.^{3,4,5,6} It may also cause damage to temporomandibular joint due to inadvertent passage of endoscope into it.^{7,8} Presence of this foramen may make middle and inner ear structures more prone for injury during arthroscopy of Temporomandibular joint (TMJ).⁸

Material and Methods

This study was conducted in the department of Anatomy G.S.V.M. Medical College Kanpur. (U.P.) and Integral Institute of Medical Sciences & Research Lucknow (U.P.) on hundred dry Adult human crania. Only those crania whose tympanic plates were intact were involved in the study and any deficiency in the tympanic plate which was named as foramen of tympanicum was observed meticulously. The sex, side, number and shape of the foramen was studied noted carefully and photographed.

Observations and Results

The foramen tympanicum was observed in 18 dry adult human crania out of total of 100 crania examined. In males it was present unilaterally in 5 crania and bilaterally in 3 crania. In females it was present unilaterally in 5 crania and bilaterally in 5 crania (Table 1).

Table 1: Showing incidence of presence of foramen tympanicum in North Indian Crania

Foramina	Male	Female	Total
Unilateral	05	05	10
Bilateral	03	05	08
Total Incidence	08	10	18

In males single foramen was observed in 5 crania on right side and in 5 crania on left side. Double foramen was observed only on left side in one cranium. In females single foramen was observed in 5 crania on right side and in 7 crania on left side. Double foramen was observed in 2 crania on right side and in 1 cranium on left side (Table 2).

Table 2: Showing presence of foramen tympanicum in North Indian Crania in male, female on right and left side

No. of foramen	Male		Female		Total
	Right	Left	Right	Left	
Single	05	05	05	07	22
Double	00	01	02	01	04

The different shapes of foramen which were observed are Oval, Circular, Irregular and Pinpoint. Most common shape of foramen which was observed was Irregular shape as shown in (Table 3).

Table 3: Showing different shapes of foramen tympanicum in North Indian Crania on right and left side

Shape	Right		Left		Total
	Right	Left	Right	Left	
Oval	01	00	03	03	07
Circular	01	01	00	01	03
Irregular	03	03	06	04	16
Pin Point	00	03	00	01	04



Fig. 1: Showing bilateral foramen tympanicum in female North Indian Crania



Fig. 2: Showing bilateral foramen tympanicum in male North Indian Crania



Fig. 3: Showing unilateral foramen tympanicum in left side female North Indian Crania



Fig. 4: Showing unilateral foramen tympanicum in left side male North Indian Crania



Fig. 5: Showing unilateral foramen tympanicum in right side female North Indian Crania



Fig. 6: Showing unilateral foramen tympanicum in right side male North Indian Crania

Discussion

The foramen tympanicum is a bony defect observed after 5 years of age in the external auditory canal in its anteroinferior part which is formed by tympanic part of temporal bone developing from a membranous ossification process.^{9,10} after birth the tympanic ring extends posterolaterally to become cylindrical and grows into a fibrocartilagenous tympanic plate thus forming the adjacent part of

external acoustic meatus. The growth is more rapid in the anterior and posterior regions which meet and blend together. Thus temporarily an opening is formed in the floor of external acoustic meatus. Normally this opening closes by the age of 5 years but sometimes in 5 to 46 % of crania it persists.¹ An osteologic study on 377 skulls was conducted by Wang et al (1991) and they found persistence of foramen tympanicum to be about 7.2%. They studied different populations and found different rates of persistence of this foramen. They found the persistence of this foramen in Chinese skull to be 6.7% and in crania from Toronto 9.1%.¹¹

Shrimani et al (2013) studied 53 adult crania in Bengali population and observed foramen tympanicum in 7 of them (13%).¹² Yadav Yogesh et al (2014) found persistence of foramen tympanicum in 30% North Indian adult crania.¹³ Chauhan Renu et al (2014) found persistence of foramen tympanicum in 23% of Adult North Indian crania.¹⁴ Higher rate of persistence of foramen tympanicum in crania of Indian origin as compared to study of Wang et al could be due to ethnic variation.¹¹ Zaidi et al (2015) found persistence of this foramen in 10.7% of North Indian Adult crania.¹⁵ Berry AC in 1967 made a special study which shows the persistence of foramen tympanicum in different population groups.¹⁶

Table 4: Showing percentage of presence of Foramen tympanicum in different populations

Berry A. C.-1967	Egypt (summed) 250 skulls	69 sides out of 494 sides	14%
	Nigeria (Ashanti) 56 skulls	34 sides out of 112 sides	30.4%
	Palestine (Lachish) 54 skulls	18 sides out of 95 sides	18.9%
	Palestine (Modern) 18 skulls	02 sides out of 33 sides	6%
	India (Punjab) 53 skulls	24 sides out of 106 sides	22.6%
	Burma 51 skulls	25 sides out of 102 sides	24.5%
	North America (British Columbia) 50 skulls	32 sides out of 100 sides	32%
	South America (Peru) 53 skulls	49 sides out of 106 sides	46.3%
Lacout A. 2005	Netherlands (Eindhoven) 65 patients	06 sides out of 130 sides	4.6%
Reis HN. 2006	Brazil (Rio de Janeiro) 150 patients	28 sides out of 300 sides	9.3%
Tozoglu U 2012	Italy (Verona) 207 patients	50 sides out of 414 sides	12.07%
Chauhan R 2014	India (Delhi) 60 skulls	18 sides out of 120 sides	15%
Yadav Y. 2014	India (North India) 30 skulls	14 sides out of 60 sides	23.3%
Zaidi 2015	India (North India) 28 skulls		10.7%
Present current study 2016	India (North India) 100 skulls	26 sides out of 200 sides	13%

Tozoglu et al (2009) noted unilateral presentation of foramen tympanicum in most of the patients.⁴ Shrimani et al (2013) observed that this foramen was present on left side in all 7 crania out of the 53 crania studied, though it was unilateral in 3 crania only.¹² Yadav Yogesh et al (2014) observed that foramen tympanicum was present unilaterally in 4 crania and was bilateral in 5 crania.¹³

Chauhan Renu et al (2014) observed a higher grade of unilateral foramen. In her study this foramen was present unilaterally in 10 crania and bilaterally in 4 crania.¹⁴ The present study was also similar to the study of Chauhan Renu et al in which foramen of tympanicum was present unilaterally in 10 crania and bilaterally in 8 crania.

The shape of foramen tympanicum as studied by Shrimani et al in 2013 was pin head, circular, oval and irregular.¹² Yadav et al (2014) observed pin point, irregular and U-shaped foramen.¹³ Chauhan Renu et al (2014) observed pin point, pin head, circular, triangular, irregular and U-shaped foramen in their study. In the present study pin point, oval, circular and irregular shape of foramen tympanicum was noted.

The most common shape was found to be irregular shape. Ethnic variation can be the cause of different shapes of foramina observed in various studies.

Sharma and Dawkins (1987) and Haschimoto et al (2011) noted the difference in presence of foramen tympanicum between males (12%) and females (20%) with statistically female preponderance ($p < 0.001$) similarly in the present study also foramen tympanicum has female preponderance (10%) and males (8%).^{17,18}

Conclusion

The knowledge of foramen tympanicum is beneficial to anatomist, ENT surgeons, maxillofacial surgeons and radiologists. Persistent foramen tympanicum may result in complications such as Temporomandibular joint (TMJ) herniation and salivary fistula. Persistence ear discharge after mastication may be due to the connection of this foramen tympanicum with TMJ or Parotid gland and it may also lead to inadvertent passage of endoscope into the TMJ leading to its damage. Presence of this foramen tympanicum may make middle and inner ear structures more prone for injury during arthroscopy of TMJ and multiple, persistent foramen tympanicum varying in size can mimic the branchial cleft anomaly.

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