

Foramen of Huschke persistence in Brazilian adult temporal bones: a morphometric study

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Abstract:

Foramen of Huschke (FH) is a normal anatomical structure performed until the total maturation of the cranium skeleton, which obliterates by a natural process about the 5-year-old. However, it may persist in adult life and can be rarely associated with complications in the temporomandibular joint (TMJ) and external auditory canal apparatus as well as a higher risk of tympanic injury during surgical procedures such as TMJ arthroscopy. The aim of this study was to report the prevalence and morphometric features of persistent FH in a Brazilian adult temporal bones sample. The methods included an anatomic and morphometric analysis of 146 dried temporal bones obtained from adult cadavers. Twenty-two (15.0%) of the temporal bones presented persistent FH. Unilateral FH accounted for 4 (30.8%) and bilateral foramina for 18 (69.2%) of the 13 affected craniums. Forms varied, including 2 (7.8%) circular, 12 (46.1%) oval and 12 (46.1%) irregular FH. Ten (45.4%) of the temporal bones presenting FH were observed in the right side and 12 (54.6%) in the left. Mean size of FH was 3,00 mm in the transversal and 2,52 mm in the longitudinal axis. Additionally, the mean anterior and posterior distances from two adjacent anatomical structures, petrotympanic fissure, and styloid process were 4,23 mm and 9,9 mm respectively. In conclusion, there seemed to be a considerable morphological heterogeneity when comparing the persistent FH specimens. We, additionally, highlight the importance of clinicians and oral and maxillofacial surgeons know this condition and its anatomical implications.

Keywords: Temporal bone; Temporomandibular joint; Ear Canal; Anatomy

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Article received on July 1, 2018.

Article accepted on July 10, 2018.

DOI: 10.5935/2525-5711.20180015



INTRODUCTION

The temporal bone comprises a cluster of three distinct parts: petrous, squamous and tympanic. The development of the tympanic plate remains incomplete at birth and continues in the extrauterine life. At the end of the first year, two prominences have grown towards each other from the tympanic ring and become fused. In this physiological process, an ostium called foramen of Huschke (FH) remains unclosed medially and only obliterates around 5-year-old by a natural process of calcification¹.

A defect on this mechanism may lead to persistence of the FH in the anteroinferior aspect of the external auditory canal (EAC) and posterior wall of the mandibular fossa in adult temporal bones^{2,3}. The permanence of FH in adult life have been scarcely associated with disturbances in the regions of temporomandibular joint (TMJ) and EAC, which include spontaneous TMJ herniation through the EAC, salivary fistula to the ear, purulent secretion drainage from the EAC, as well as an increased risk to ear injury during TMJ arthroscopy procedures⁴⁻¹¹.

Since Emil Huschke's initial description in 1844, few studies using computed tomography (CT) scans or dry skull bones have focused on the frequency, demographic and morphometric profile of FH in the worldwide population¹²⁻¹⁹, and only two Brazilian studies are available. Therefore, the aim of the present study was to report the persistence of FH in a sample of temporal bones from Brazilian adults and to analyze its morphology.

MATERIAL AND METHODS

It was assessed 146 adult temporal bones (73 dry skulls) obtained from Brazilian adults cadavers (≥ 18 year-old) with unknown gender or cause of death. The bones collection belongs to the Anatomy Department of the State University of Rio de Janeiro (Biology Institute). After rigorous cleaning, the skulls were analyzed and subjected to photographic study. The specimens were analyzed for the persistence of the FH; form of the foramen (oval, circular or irregular); longitudinal and transverse measures as well as topographic location.

The measures of the foramen were obtained by the largest distance in a straight line in both longitudinal and transverse axis. The locations of FH were considered by the shortest distances between two

anatomical structures, petrotympanic fissure and styloid process, in anterior and posterior portions of cranium bases (Figure 1). A calibrated examiner with a precision digital caliper (Standard Gage, Poughkeepsie, NY, USA) obtained three consecutive measures and the mean values were considered.

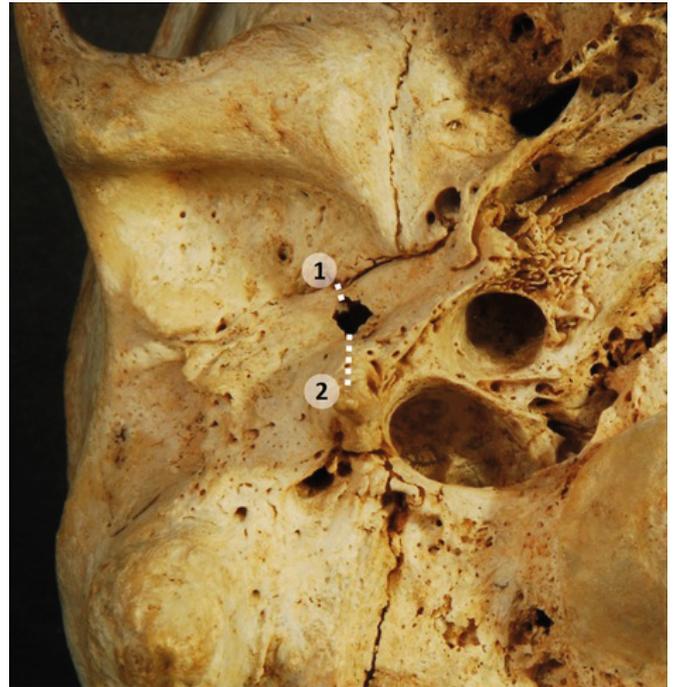


Figure 1. Anterior and posterior distances of a FH from the petrotympanic fissure (1) and styloid process (2).

RESULTS

From the 146 analyzed temporal bones, persistent FH were observed in 22 (15%) of the cases. Unilateral FH accounted for 4 (30.8%) and bilateral foramina for 18 (69.2%) from the 13 affected skulls. Forms varied, including 2 (7.8%) circular, 12 (46.1%) oval and 12 (46.1%) irregular foramina. Ten (45.4%) of the temporal bones presenting persistent FH were observed in the right side and 12 (54.6%) in the left and all of the 4 temporal bones that presented more than one foramen in the same side were located in the left temporal bone of cranium (Figure 2). Mean transversal measure was 3,00 mm and the longitudinal measure was 2,52 mm. The mean distances from the two adjacent anatomical structures, petrotympanic fissure and styloid process, were 4,23 mm and 9,9 mm, respectively.

Morphometric features of persistent FH are presented in Table 1.

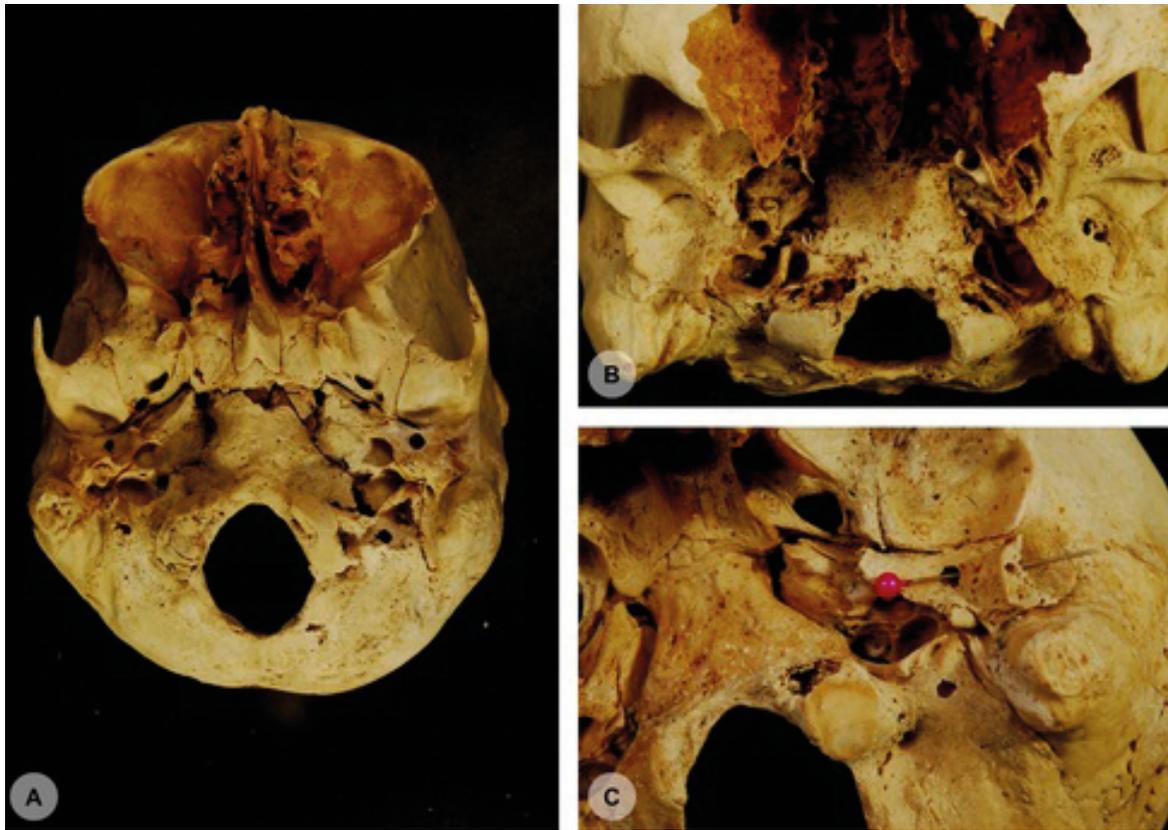


Figure 2. (A) An adult cranium showing bilateral round-shaped FH. (B) Unilateral and irregular FH separated by thin bone septa affecting the left temporal bone. (C) Note the communication between the FH and the internal part of the EAC.

DISCUSSION

FH is a normal anatomical structure performed until the total maturation of the cranium skeleton, which usually obliterates by a natural process in the childhood. Its permanence in adult life can be rarely associated with complications in the TMJ and EAC apparatus, although most likely it tends to be an asymptomatic condition⁴⁻¹¹. The etiology involving these defects remains not well understood, and it has been associated with abnormal development of the first branchial arch², an anomaly of the tympanic ring during embryogenesis³ and genetic factors that may lead to delay and alteration in the ossification¹⁵.

The literature shows a variable prevalence of persistent FH depending on the methods used in the studies. Studies using dry bones showed a prevalence that varied from 0.7% to 38.2%¹²⁻¹⁶; and between four different CT-based (spiral or cone beam) studies, the variation of persistent FH was 4.6-22.7%^{1,16-18}. Additionally, Brazilian publications revealed persistent FH in 9.9% and 11.3% of the cases on cranium- and

CT-based studies respectively^{20,21}. Although the lower sample size in our study, the frequency of 15% was compatible with previous results in the literature. The majority of the previous studies found a higher frequency of unilateral persistent FH¹⁵⁻¹⁷. However, we showed a predominance of bilateral cases as Wang et al.¹⁴, in which approximately 52% of the cases were bilateral. The variability observed between these studies may result from geographic and differential distribution in the population, besides the sample sizes and differences between the applied methods (CT sections or post-mortem specimens).

This osseous defect seems to be higher in the second decade of life, decreasing gradually in the subsequent years. This feature proposes that there is a regression process of the persistent FH, which can close over the time^{15,17}. Multi-fenestrated FH could be observed in 4 of our cases and this corroborate with the theory that FH probably tend to close, forming thin bone septa in a single foramen that failed to fully calcify. FH after 10-year-old was estimated 1.7-fold higher in women than in men, representing a female predominance¹⁵.

Table 1. Morphometric features of persistent FH.

Case	Side	Number of FH	Form	Size (mm)	
				Transverse	Longitudinal
1	R	1	Irregular	4,34	3,79
	L	1	Irregular	3,57	2,47
2	R	-	-	-	-
	L	1	Oval	3,70	1,93
3	R	1	Irregular	3,76	5,31
	L	2	I. Irregular II. Oval	3,45 4,28	7,4 1,57
4	R	1	Irregular	5,36	4,65
	L	1	Oval	0,90	1,03
5	R	1	Irregular	3,53	2,62
	L	-	-	-	-
6	R	1	Circular	0,96	0,96
	L	4	I. Oval* II. Oval*	1,18 1,78	0,76 0,89
7	R	-	-	-	-
	L	1	Irregular	1,66	3,33
8	R	-	-	-	-
	L	2	I. Oval II. Irregular	3,55 3,63	1,7 4,09
9	R	1	Oval	4,6	2,49
	L	1	Oval	5,89	4,36
10	R	1	Oval	1,82	0,95
	L	1	Irregular	2,45	1,62
11	R	1	Oval	4,69	3,64
	L	1	Oval	4,06	3,43
12	R	1	Circular	1,16	1,16
	L	2	I. Irregular II. Irregular	0,98 1,82	0,47 1,13
13	R	1	Oval	3,05	2,09
	L	1	Irregular	1,95	1,76

R=Right; L=Left

*Data were obtained from the two largest foramens

Additionally, most of the symptomatic persistent FH that have been published affected women^{2,4-9}, which reinforces the idea of a higher prevalence of persistent FH in the female population and the preference of complications associated with persistence of FH in adult women^{2,15,19}. In our analysis, this prevalence could not be estimated as a consequence of the lack of gender information from anatomy laboratory records.

Data from some studies showed greater transversal (axial) than longitudinal (sagittal) measures, which support the observed higher dimensions in transversal measures of persistent FH presented in our results, and ovoid or circular forms predominance^{2,18}. The right

temporal bones have been demonstrated slightly more affected by FH in the available studies¹²⁻¹⁷, even though in our cases the left side comprised 54.6% of all FH cases.

In advance to better determine the distance of FH from surrounding important anatomical structures, we performed evaluations of two different locations. The lower distance of FH from petrotympanic fissure endorses the critical close relation with the tympanic membrane wherein it is inserted. This feature is strongly relevant since persistence of FH in adults have been related to a higher risk of tympanic damage during arthroscopic procedures which may cause tympanic membrane rupture, dislocation of the incus, injury to the tympanic segment of the facial nerve, labyrinthine disruption and ear infection^{2,22}.

In the previously reported symptomatic cases of persistent FH, the presence of the ostium in adult life has caused disturbances in both EAC and TMJ structures. The most frequent FH-related complications were spontaneous TMJ herniation^{7,8,11} through the EAC, salivary fistula^{5,6,9} as well as inflammatory fistula with purulent secretion coming from the EAC¹⁰. These cases have been mainly associated with otalgia, otorrhea, clicking or abnormal sound from the ear and hypoacusia^{2,5-7,9,11}.

There is no indication for surgical approach on asymptomatic cases. However, for the persistent FH showing alterations, surgical closure with tragal cartilage graft as well as surgical repair with polyethylene implants, and titanium meshes via preauricular external approaches have been used with success and no expected recurrences^{2,6,7,9,11,20}.

In summary, the results obtained in the present study showed that FH present considerable morphological heterogeneity when compared. Moreover, the frequency, percentage of foramens by side and forms seemed to be in accordance with the previous literature data. We finally emphasize the importance of clinicians and oral and maxillofacial surgeons know this condition and its anatomical implications, concerning to recognize symptomatic persistent cases and to avoid risks during surgical procedures as TMJ arthroscopy in patients with persistent FH.

ACKNOWLEDGMENTS

We, authors, thank the Dental School and the Anatomy Department (Biology Institute) of the State University of Rio de Janeiro, and the technical support in the photographic study of the samples provided by Vitor Kruter Quintanilha.

Conflicts of interests

We, the authors of this manuscript, declare that there is no financial relationship with the organization that sponsored the research, authorship, or others.

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