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Original Article

Prevalence and characteristics of foramen huschke: Cone beam computed tomography study

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Abstract

Aim: Aim: Foramen Huschke (FH) is an anatomical variant seen on the anterior aspect of external auditory canal. Aim of this study is to define the prevalence and characteristics of FH in a group of patients using cone beam computed tomography (CBCT).
Materials and Methods: Study included 600 temporal bones of randomly selected 300 patients who had undergone CBCT examination. CBCT images were analyzed for the presence of FH. Patient's age, genderwhen FH was present, laterality, and dimensions of FH were recorded. Frequency of FH and the relationship between FH and, patient age, gender and FH dimensions were evaluated with statistical analysis.
Results: Of the evaluated 300 patients FH frequency was 18.7%. Thirteen percent of the evaluated 600 temporal bones had FH and a female predominance was observed ($p=0.016<0.05$). Average age of patients was found to be lower than patients without FH ($p<0.01$). Mean dimensions of FH was 2.19 ±0.66 mm and 2.37±0.73 mm on sagittal and axial planes, respectively. No statistically significant relationship between FH dimensions and gender and lesion laterality was observed. There was a weak negative correlation between patient age and FH dimensions on axial plane ($r=-0.253$; $p=0.025<0.05$).
Conclusion: FH is a common anatomical variation of the external auditory canal and is more common in females. Patient age is an important factor in FH presence. Average defect size is around 2mm and dimensions of FH may be related with patient age.

Keywords: Cone beam computed tomography; foramen huschke; foramen tympanicum

INTRODUCTION

Foramen Huschke (FH), aka foramen tympanicum, can be defined as a bony defect on the anterior wall of external auditory canal, posterior to temporomandibular joint (TMJ). Two structures are normally seperated by a thin bone formed by tympanic segment of temporal bone (1). Normally this bony defect closes around 5 years of age; however in some individuals it may continue to exist (2). Previous studies reported the prevalence of FH between 2.3% and 23.3% (2,3).

Clinical significance of FH varies; it may be asymptomatic or may cause problems around temporomandibular joint. Salivary fistula formation, temporomandibular joint herniation and related otalgia, tinnitus and sense of fullness, possibility of ear injury during arthroscopy may be seen due to its presence. Also, this defect may play role as a transmission point of infections and tumors, between temporomandibular joint, infratemporal fossa and external auditory canal (4-6).

Detection of these defects before surgical intervention of temporomandibular joint and ear is important. Complications such as tympanic membrane perforation and facial nerve injury during temporomandibular joint arthroscopy can be avoided with presurgical detection (6).

Cone beam computed tomography (CBCT) is recently used for various purposes in the field of dentistry and one of these purposes is imaging of osseous structures of temporomandibular joint. Also, field of view of CBCT scans, taken for different goals may include this area.

Aim of this study is to determine the prevalence and characteristics of FH in a group of patients with CBCT.

MATERIALS and METHODS

For this study ethical approval was taken from Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee (no: 10840098-604.01.01-E.65167). As a routine practice, informed consents declaring that their radiographic data may be used for research, were taken from every patient.

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Study included CBCT scans of randomly selected 300 patients, who had undergone CBCT examination for various reasons in University Dental Hospital. Patients below 18 years old, patients with a history of trauma and TMJ surgery and patients with maxillofacial deformities were excluded.

CBCT application is made using iCAT (Imaging Sciences International, Hatfield, PA, USA) with exposure parameters 80kVp, 5-7 mA and 14,7-17.8 seconds with a 0.25 mm voxel size. Vision (Imaging Sciences International, Hatfield, PA, USA) software is used for assessment.

Axial sections were used for detection of FH and confirmation for its presence is made on sagittal and coronal sections with the consensus of two dentomaxillofacial radiologists. FH was defined as a bony defect on the anterior wall of external auditory canal (Figure 1 and Figure 2). When FH was detected, location (right, left or bilateral), gender and patient age were recorded. Measurements for dimensions of the defect were made on sagittal and axial sections. For standardization, on sagittal sections Frankfurt horizontal plane was adjusted parallel to the horizontal plane and on coronal sections crista galli-spina nasalis anterior line was adjusted perpendicular to the horizontal plane. Inferosuperior dimensions of the defect were measured on sagittal sections and on axial sections mediolateral width of the defect was measured at its widest point.

Figure 1. Foramen Huschke on Axial Plane

Statistical analysis

For the statistical analysis of non-parametric data chi-square test was performed. Normal distribution of the data was determined with Kolmogorov-Smirnov test. For the analysis of parametric data, two group comparisons were performed with Student's - t test. Pearson correlation was used for the evaluation of the relationship between FH dimensions and age. For quantitive measures, analysis results were presented as average ± standard deviation, for cathegoric data frequency and percentages were presented. Statistical significance was set $p<0.05$.

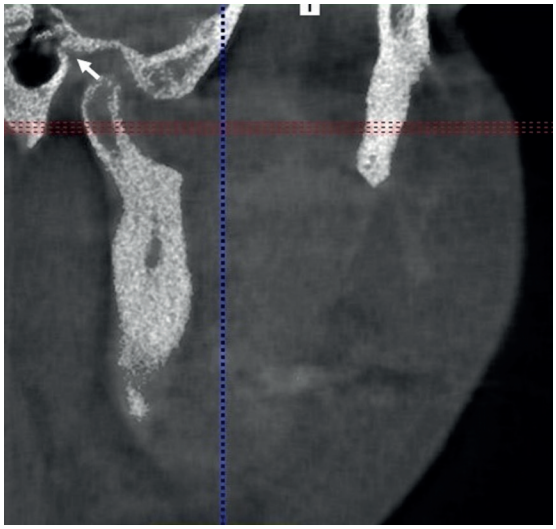

Figure 2. Foramen Huschke on Sagittal Plane

RESULTS

Of the evaluated 300 patients, 166 (55.3%) were female and 134 (44.7%) were male. Ages of patients ranged between 18 and 65 with an average patient age 39.25±14.91 (36.89±14.19 females and 42.18±15.30 males). FH was observed in 56 (18.7%) patients. Thirty-four (11.3%) patients consisting of 21 females and 13 males had unilateral, 22 (7.3%) patients consisting of 16 females and 6 males had bilateral FH.

For FH presence, 600 temporal bones were evaluated in 300 patients and FH was present in 78 (13%) of the evaluated temporal bones (38 (6.33%) on the right side and 40 (6.66%) on the left side). Table 1 demonstrates the gender distribution of FH and their relationship.

Table 1. Gender distribution of Foramen Huschke a) Foramen Huschke existence in whole patients b) Foramen Huschke existence in the evaluated temporal bones

		FH (+)	FH (-)	Total	p
a	Female	37 (22.3%)	129 (77.7%)	166 (100%)	0.073
	Male	19 (14.2%)	115 (85.8%)	134 (100%)	
	Total	56 (18.7%)	244 (81.3%)	300 (100%)	
b	Female	53 (16%)	279 (84%)	332 (100%)	0.016*
	Male	25 (9.3%)	243 (90.7%)	268 (100%)	
	Total	78 (13%)	522 (87%)	600 (100%)	

* p<0.05

According to the results, when all patients were taken in to consideration (a), no statistically significant differences between males and females was observed ($p=0.073>0.05$); however when evaluated 600 temporal bones were taken in to account (b), statistically significant relationship was observed. FH was seen more frequent on female patients ($p=0.016<0.05$). Relationship between FH presence and patient age is shown on Table 2.

Table 2. Patient age and Foramen Huschke presence				
	FH (+)	FH (-)	t	p
Patient Age±SD	33.14±14.63	40.65±14.65	3.45	<0.01*
Female	31.92±13.89	38.31±14.01	2.45	<0.01*
Male	35.53±16.08	43.28±14.96	2.06	0.02*
*p<0.05				

Statistically significant relationship between patient age and FH presence was observed. Mean age of patients with FH was lower than patients without (p=0.00031<0.05). Similar findings were observed when the genders are evaluated seperately in terms of age. Also, when the patients were grouped as below 40 years and above 40 years of age; it was found that, while 40 (25.8%) out of 155 (51.7%) patients below 40 years had FH, 16 (11%) of 145 (48.3%) patients above 40 years had FH. The relationship was statistically significant and FH was more frequent in patients below 40 years (p=0.001<0.05).

Dimensions of FH were measured on sagittal and axial planes. Average dimensions of FH were 2.19 ±0.66 mm and 2.37±0.73 mm on sagittal and axial planes, respectively. On Table 3, relationship between FH dimensions on both planes and gender and laterality is demonstrated.

Table 3. Foramen Huschke dimensions, gender and laterality				
	Sagittal	p	Axial	p
Female (n=53)	2.16±0.64	0.24	2.42±0.60	0.23
Male (n=25)	2.27±0.71		2.29±0.96	
Bilateral (n=44)	2.13±0.50	0.17	2.39±0.65	0.43
Unilateral (n=34)	2.28±0.82		2.36±0.84	

Although weak, statistically significant relationship between FH dimensions and age was observed on axial plane. There was a negative correlation between patient age and FH dimensions on axial plane (r=-0.253; p=0.025<0.05). Weaker and statistically insignificant correlation was observed between age and FH dimensions on sagittal plane (r=-0.057; p=0.62>0.05).

DISCUSSION

FH, although it is an anatomical variant, may lead complications during surgical procedures around temporomandibular joint and ear. Furthermore, because of its location, this bony defect may act as a gateway between important anatomical structures. Detection of this anatomical variant is of importance (4-6). This study aimed to define the prevalence, gender distribution, age relation and dimensions of FH, in a randomly selected study population.

A recent study, conducted by Ertuğrul and Keskin, investigated the prevalence, age distribution and temporomandibular joint herniation related to FH existence in 1025 patients with high resolution computed tomography (CT). They found that 13.7% of the patients and 8.7% of the evaluated temporal bones had FH (6). Same authors, in another research including 714 patients, reported a prevalence of 13.4% (1). Another CT research designed in a group of patients with otologic problems showed 4 (6%) FH in 65 patients and 4.6% FH of the evaluated 130 temporal bones (7). Park et al.'s (3) CT study with 985 patients defined a prevalence of 2.3%. FH was found in 20.4% of 632 temporal bones of females and in 11.7% of 1362 temporal bones of males in an anatomical study (4). Chauhan and Kanna (2) examined 60 human dry skulls and found 14 (23.3%) FH. CBCT research with 207 patients conducted by Tozoğlu et al. (8) reported that 17.9% of the patient group had FH. Another study with the same imaging method including 200 patients defined 11.5% FH prevalence (9). One hundred and fifty nine CBCT scans were evaluated in another study and 11 (6.9%) FH was identified (10). Akbulut et al. (5) described 42 (22.7%) FH in 185 patients in another CBCT study.

We found FH in 18.7% of our study group and in terms of evaluated 600 temporal bones FH was identified in 13% of the temporal bones evaluated. There is a wide range in context of frequency between above mentioned studies. However, if we consider the imaging method used in previous studies, an explanation can be made. It is known that, one of the greatest advantages of CBCT is that, CBCT is superior to CT in terms of hard tissue resolution (11). Results of CBCT researches are similar with anatomical studies which allow direct visualisation of temporal bone. Therefore, it may be claimed that, higher frequency values obtained in CBCT studies is the result of higher hard tissue resolution provided by CBCT. Also, effect of racial differences must be considered.

There are discrepancies between studies in context of gender predominance. While some studies showed female predominance (2,4,9), some studies resulted with no significant difference between genders (1,5).

Our results showed female predominance, when 600 temporal bones were taken in to consideration; however when 300 patients were considered, no difference was found between genders. This may be explained by the fact that, vast majority of bilateral FH were seen in female patients in our study. Various results mentioned above, may be the consequence of patient selection criteria; one of the studies (5) excluded patients with evidence of bone disease -especially osteoporosis- which is a common metabolic bone disorder in females. Osteoporosis was not excluded in other studies, as well as in our study. Further research may be helpful in order to explain the effect of osteoporosis in the formation of these defects.

Another controversy among the studies is the relationship of these defects with patient age. Ertuğrul and Keskin showed that average patient age with FH is higher than the patients without (6). However, Hashimato et al.'s (4) results were in contrast and stated that FH could close

with increasing age. Two reports found no correlation between these variables (1,10).

Our results are compatible with Hashimato et al.'s findings that average age of patients with FH were lower. Also, as we compared patients below and above 40 years old, prevalence of FH was significantly higher in patients below 40 years old. Another finding in our study was that there is a weak negative correlation between FH dimensions and age. However, this finding cannot prove Hashimato et al.'s suggestion that FH could close with increasing age.

Dimensions of FH were measured in previous investigations and measurements were made on axial and sagittal planes. Lowest mean diameters were found in Deniz et al.'s (9) study which were 1.13 and 1.44 mm on axial and sagittal planes, respectively. Highest values were observed in Chauhan and Khanna's anatomical research. They found average dimensions 9 mm on axial plane and 8.5 mm on sagittal plane (2).

According to our results, dimensions of FH were 2.37 mm. and 2.19 mm. on axial and sagittal planes, respectively. Our findings are compatible with previous reports that measured FH sizes (4-6,8,10). Although a negative correlation between defect size and patient age was observed, correlation was weak and insignificant for the measurements on sagittal plane. No relationship between defect laterality and defect size was observed. Also, size of the defects did not differ between genders. However, Akbulut et al. found that, the size of the defects were significantly higher in females on axial plane measurements (5).

LIMITATION

Limitations of this study may include limited number of patients and retrospective nature of the research. Limited number of the patients may be explained by the fact that, CBCT examinations of the patients included in this study were made for various reasons and, TMJ area is generally out of the limited imaging field of CBCT images. Although, total number of the patients investigated in this study is relatively low, no controversial results were observed compared to previous reports. Because of the retrospective nature of the study, relationship of these defects with clinical findings such as status of dental occlusion, masticatory muscles or other findings could not be assessed. Further studies including clinical observation of patients with FH may be useful.

CONCLUSION

According to the findings of the present study, about 19% of patients have FH and FH frequency is higher in patients below 40 years of age. Also, these bony defects are more prevalent in female patients. Average defect size is around 2 mm in axial and sagittal planes. Further studies investigating the effect of patient age on the presence and dimensions of FH will be helpful to determine the nature of these anatomical variants. Also, the impact of diseases affecting bone metabolism should be evaluated to define pathophysiological characteristics of FH.

Conflict of interest: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

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