Evaluation of the Relationship between Age and Gender of Fossa Navicularis Magna with Cone-Beam Computed Tomography in Orthodontic Subpopulation

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Abstract

Introduction: Fossa navicularis magna (FNM) was defined as a notch-like defect on the inferior side of the clivus. The aim of this study was to evaluate the relationship between FNM with age and gender with cone-beam computed tomography (CBCT) in a Turkish orthodontic subpopulation. **Material and Methods:** The study group consisted of 195 patients (109 females and 86 males) having CBCT scans. The patients had no known syndromes, history of neurological diseases, or surgical intervention in the region of the interest. On FNM-detected patients, comparison of gender and age was performed. Descriptive statistics and Chi-square statistical analysis were made using the Statistical Package for the Social Sciences 20.0 (SPSS 20) program. $P < 0.05$ was accepted as statistically significant. **Results:** FNM was identified in 32 (17.4%) patients. Among these patients, 23 were female (21.1% of all female patients) and 9 were male (10.4% of all male patients), and the age ranged between 7 and 29 (mean age: 14 ± 3.3) years. There was no statistically significant relationship between the presence of FNM and gender. **Discussion and Conclusion:** FNM is an important anatomic variation of the skull base, and it should be monitored carefully by oral and maxillofacial radiologists. The presence of fossa navicularis should also be investigated in other communities throughout CBCT, and a wider database should be established.

Keywords: *Canalis basilaris medianus, cone-beam computed tomography, fossa navicularis magna*

Introduction

Clivus constitutes the rear segment of the base of the skull.[1] This bone has two parts as basisphenoid and basiocciput[1,2] disjointed by spheno-occipital synchondrosis which is one of the growth centers of the craniofacial skeleton. Although there is a controversy about the time of closure of spheno-occipital synchondrosis in reported articles, spheno-occipital synchondrosis has an important role in orthodontics as a guide for age estimation.[3] Clivus was reported as a potential course for spreading infections into cranium.[4,5] Furthermore, nasopharyngeal tumors can perfuse basisphenoid and basiocciput.[1] An anatomical variation named fossa navicularis magna (FNM) was defined as a notch-like defect on the inferior side of the clivus by Testut in 1921.[2,4]

In dental practice, the necessity of imaging of dentomaxillofacial structures with cranium-leaded clinicians to three-dimensional (3D) modalities. Cone-beam computed tomography (CBCT) is in first place for 3D imaging of the bone structures of related region owing to compact size and simple performance of machine, inexpensiveness, multiplanar views, and relatively low radiation dose.[6,7] There have been several articles on the clivus, FNM, and CBCT in recent years.[8-13] These articles were case reports or wide age range studies.

Despite the lack of knowledge about the clear timing of the closure of spheno-occipital synchondrosis, it was stated to extend to the 25th age.[14,15] According to the knowledge about the clivus and FNM mentioned above, we aimed to evaluate the relationship between demographic features and FNM in an orthodontic subpopulation using CBCT.

Material and Methods

A total of 195 patients (109 females and 86 males) who underwent CBCT examination for various reasons between

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the years 2016 and 2017 were included in the study. The CBCT images of patients were selected from archive of oral and maxillofacial radiology department. This retrospective study was conducted according to the principles of the Declaration of Helsinki of 1964 and later versions. The Clinical Research Ethics Committee of Eskisehir Osmangazi University, Faculty of Medicine, approved this study with decision no: 10 dated June 26, 2018.

Imaging procedure

Images were taken with the same CBCT device (Promax 3D Mid; Planmeca, Helsinki, Finland). The technical details were as follows: tube voltage: 94 kVp, X-ray tube current: 14 mA, 360° rotation, scan time: 27 s, and voxel size: 0.600 µm. CBCT data were sent to a computer workstation. Planmeca Romexis (Planmeca, Helsinki, Finland) imaging software was used to detect and measure FNM of all the patients.

All CBCT scans were evaluated by the same operator (F. A. K.) to preclude interobserver differences. To assess intra-examiner reliability, 10 randomly selected images were remeasured by the same investigator after a 2-week interval. Intra-examiner reliability was assessed for all variables by calculating intra-class correlation coefficients, which were between 0.85 and 0.96.

The detection of the width of FNM was made from the axial section; the depth and the length were made from the sagittal section. Then, the software's navigator is placed on the region of interest. The width, depth, and length of FNM were measured in the axial and sagittal planes. [Figures 1-3].

Statistical analysis

Continuous data are given as mean ± standard deviation; categorical data are given as percentage (%). Shapiro–Wilk test was used to investigate the appropriateness of the data to normal distribution. In the comparison of the groups with normal distribution, independent samples *t*-test analysis was used for the two groups. Spearman correlation coefficients were calculated for the variables that did not conform to the normal distribution, direction, and magnitude of the correlation between the variables. For analysis of cross tables, Pearson's (exact) Chi-square test was used.Statistical Package for the Social Sciences (ver.20; IBM Corporation, Armonk, NY, USA). $P < 0.05$ was accepted as statistically significant.

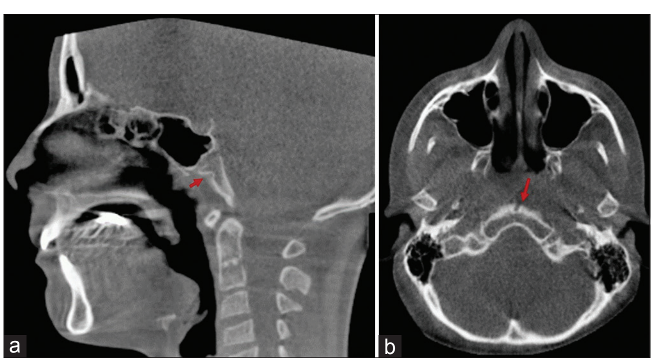

Figure 1: The appearance of fossa navicularis magna on the cone-beam computed tomography sagittal section (a) and axial section (b)

Results

The study group consisted of 195 patients (female: 109 and male: 86) with CBCT scans. FNM was identified in 32 (16.4%) patients. Among these patients, 23 were female (21.1% of all female patients), whereas 9 were male (10.4% of all male patients). The age of this group ranged between 7 and 29 (mean age: 14 ± 3.3) years. In our study group, the distribution of age and gender is homogeneous. The distribution of patients with FNM according to age groups and genders is summarized in Table 1. FNM depth varied from 1.0 mm to 5.1 mm, the length from 1.0 mm to 8.9 mm, and the width from 1.5 mm to 8.4 mm in the study group. No statistically significant relationship was found between the presence of FNM and gender. There is no statistically significant relationship between the presence of FNM and age. The comparison of depth, length, and width measurements of FNM according to age and gender groups is summarized in Table 2.

Discussion

There are two types of studies about FNM basically observed in literature: case reports and frequency studies. Case reports[4,5,11] were related either complication throughout FNM or incidentally detected FNM in asymptomatic patients.[10] Anatomical and radiological scanning studies give the rate of FNM in various populations.[2,8,9,16] CT

Table 1: Distribution of patients with a fossa navicularis magna according to age groups and gender

	7-13	14-19	20-29	7-29
Female (*n*=109)	11	10	2	23
Male (*n*=86)	5	3	1	9
Total (*n*=195)	16	13	3	32

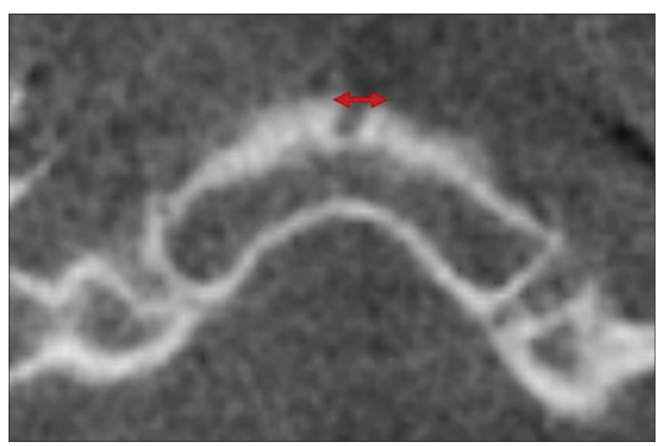

Figure 2: Measurement of width fossa navicularis magna on the axial plane

Table 2: Comparison of the depth, length and width measurements of fossa navicularis magna according to gender and age groups

	Min-Max(mm) Mean±SD				
	Female (*n*=109)	Male (*n*=86)	7-13 (*n*=18)	14-19 (*n*=13)	20-29 (*n*=3)
Depth	1.2-5.1 2.81±0.91	1.0-3.5 2.72±0.74	1-5.1 3.11±0.89	1.2-3.8 2.46±0.77	2.1-3.1 2.5±0.52
Length	1.2-8.9 4.68±1.78	1.0-8.3 4.95±2.43	1.0-8.9 4.85±2.02	1.2-7.5 4.33±1.88	4.8-8.3 6.13±1.89
Width	1.5-8.4 5.20±1.78	4.0-8.4 5.93±1.38	2.4-8.4 5.58±1.77	1.5-7.3 5.18±1.79	4.4-6.4 5.46±1.0

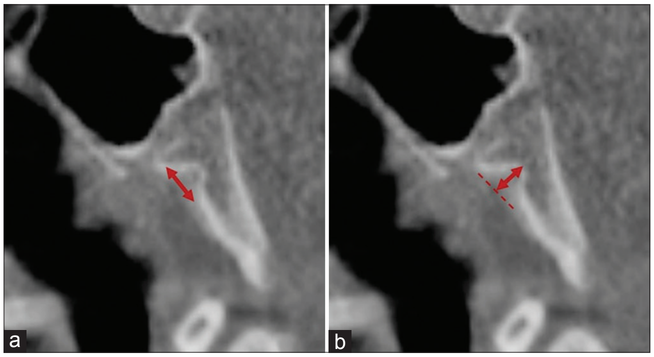

Figure 3: Measurement of length (a) and depth (b) fossa navicularis magna on the sagittal plane

and CBCT were used for the detection of this anatomical variant.[2,4,5,8,9,11,16-18] This research is also a retrospective study working on CBCT images of patients.

FNM prevalence was reported by Rossi in 55 (1.5%) of 3712 dried skulls,[19] by Romiti in 9 (0.9%) of 990 skulls,[20] by Rizzo in 7 (2.1%) of 335 skulls,[21] and by Ray *et al*. in 3 (1.49%) of 202 skulls,[6] whereas a study conducted by Cankal *et al*. was found in 26 (5.3%) of 492 dry skulls and in 16 (3%) of 525 CT scans.[7] A study by Ersan[9] was found 48 (6.6%) of 723 CBCT scans. Another study was made by Ersan,[16] and FNM ratio in CBCT scans was found 28.8% in patients with cleft palate. The percentage of fossa navicularis was identified as 17.4% in this study. It was found to be a higher percentage than reported previous studies[2] performed on dry skulls or CT images of the patients. In a previous study by Ersan,[9] FNM was studied in a wider population and the incidence was founded lower (6.6%) than our study. Nonetheless, they were working with a more limited population in other a study with cleft palate patients,[16] and they found a higher incidence (28.8%) than our study.

This study showed the prevalence and morphometric properties of FNM using CBCT in Turkish orthodontic subpopulation. Although there are studies about FNM in Turkish population, there were no studies showing the presence of FNM in the orthodontic subpopulation. The age range of previous studies was wider than our study. The preferred age group of our study may have an influence on the frequency of FNM. Craniofacial anomalies may be associated with this variation. This may be one of the reasons why our values are higher than previous studies.

In previous studies,[2,8,9] there was no relationship between the presence of FNM and the age and gender of patients. This finding is compatible with our study.

Ray *et al.* measured the depth as <0.5 mm in one skull and >0.5 mm in two skulls. They found the mean length and width as 5 mm and 3.66 mm,[22] respectively. Cankal *et al*. reported that the mean depth was 2.24 mm, the mean length 5.12 mm, and the mean width 2.85 mm on dry skulls.[2] Fossa navicularis measurements were not included in CT images. A study conducted by Ersan using CBCT on Turkish population was found that the mean depth was 2.2 mm, the mean length 5.8 mm, and the mean width 4.7 mm.[9] In our study, the depth varied from 1.0 mm to 5.1 mm, the length from 1.0 mm to 8.9 mm, and the width from 1.5 mm to 8.4 mm.

Bayrak *et al.*[8] reported the prevalence of FNM as 9.0% in CBCT images and 5.6% in CT images. They measured the average depth of FNM was 2.96 ± 1.07, the average length was 5.99 ± 2.16 and the average width was 5.08 ± 1.37 mm for patients aged between 20 and 29 years. Although they have studied more CBCT images in this age group compared to our study, the results are consistent with our results.[8]

Although there is no evidence that fossa navicularis is associated with clival pathology, some authors have reported that the defects will be filled with lymphoid tissue adjacent to the pharyngeal tonsils.[18] Further research in this subject can give more precise information about the likelihood of this phenomenon.

Conclusion

According to our knowledge, this is the first study about FNM in orthodontic subpopulation. The findings of this study and the previous knowledge about the clivus may give support for making future studies on the relationship between repeated upper respiratory diseases, nasal passage, and orthodontic anomalies in FNM-observed patients.

Oral and maxillofacial radiologists should take into consideration this anatomical variation because of its important clinical outcomes. CBCT images have to be carefully examined even if they were taken for orthodontic purposes.

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Conflicts of interest

There are no conflicts of interest.

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