Indian J Otolaryngol Head Neck Surg
https://doi.org/10.1007/s12070-021-02675-w

ORIGINAL ARTICLE

Is There Any Racial Difference in Term of Anatomical Variations of Nasal and Paranasal Sinus Structures

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Received: 22 January 2021 / Accepted: 7 June 2021

Abstract The aim of our study was to determine the anatomical variations detected on computed tomography radiological imaging of the paranasal sinus between citizens and refugees patient groups and to reveal the differences between the two patient groups**.** In this study, the data from the files of 38 Turkish Citizens (Group 1), 41 Syrian Refugees (Group 2), a total of 79 patients who were admitted to the ENT Clinic of Adana City Training and Research Hospital due to rhinological complaints between 01.01.2019 and 01.01.2020 and had paranasal sinus tomography, were analyzed retrospectively**.** Due to the Syrian Civil War that started in 2011, more than 10 million Syrian have left their countries and immigrated to neighboring countries as refugees. The paranasal sinus area has a wide variety of variations. Congenital anomalies and normal anatomical variations in this area are important, although rarely, as they may have pathological consequences or may be a source of difficulty during surgery. In the study, 38 of 79 patients were in Group 1 (48.1%) and 41 were in Group 2 (51.9%). Of the patients, 30 were female (38%) and 49 were male (62%). The ages of the patients ranged from 9 to 78 years, with a mean age of 32.52 years. In our study, we could not find a statistically significant difference between Turkish Citizens and Syrian refugees in terms of anatomical variations detected on paranasal radiological imaging. We consider the number of patients in our study as a limitation of our study and we think that it is important to conduct studies with larger populations

Keywords Radiology · Anatomy · Otolaryngology · Tomography · Paranasal sinuses

Introduction

Due to the Syrian Civil War that started in 2011, more than 10 million Syrian have left their countries and immigrated to neighboring countries as refugees [1]. The plight of immigrants and the impact of their conditions on their health is of great concern today, and one way to treat people with dignity is to understand and respond to their health problems that result from their immigration status [2]. Turkey is among the first choice of Syrian refugees due to its geographical location. According to the data of the Republic of Turkey Ministry of Interior Disaster and Emergency Management Presidency (AFAD), the number of refugees in Turkey in March 2016 was 2,747,946 [3].

The paranasal sinus region has a wide range of anatomical variations. Although congenital anomalies and normal anatomical variations in this area are not common, it is very important to be aware of these variations as they may cause complications during surgery. Appropriate radiological imaging is important in detecting anatomical variations and reducing possible complications. The anatomical variations seen in the paranasal sinus may include the anatomical differences such as Agger nasi cell, haller cell, concha bullosa, septum deviation, maxillary

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Published online: 11 June 2021

sinus hypoplasia, frontal sinus hypoplasia, frontoethmoid cell types Onodi cell, sfenoid sinus pneumatization, anatomical differences such as the depth of the olfactory fossa.[4–9].

The aim of our study was to reveal these anatomical variations detected by computed tomography of the paranasal sinus between Turkish and Syrian patient groups.

Materials and Methods

In this study, the data from the files of patients, who were admitted to the ENT Clinic of Adana City Training and Research Hospital due to rhinological complaints between 01.01.2019 and 01.01.2020 and had paranasal sinus tomography, were analyzed retrospectively. Patients with a history of maxillofacial trauma and surgical operation, nasal polyposis, antrochoanal polyp, and premalignant-malignant mass were excluded from the study. A total of 79 patients were included in the study. The patients were classified into 2 groups based on their ethnicity as Group 1 (Turkish Citizens) and Group 2 (Syrian Refugees).

The Computed Tomography (CT) of these patients was performed using a 64-slice Philips Brilliance, Philips Healthcare Suzhou Co Ltd, China. The 3 mm axial images were acquired cranio-caudally from the highest point of frontal sinus to the lowest part of the maxillary sinus and then reconstructed into 0.6 mm slices multiplanar images.

The ethnicity, age, and gender of the patients, and anatomical variation information obtained from paranasal sinus computed tomography imaging of the patients, such as and septum deviation (SD), concha bullosa (CB), paradox concha (PC), Haller cell (HC), Onodi cell (OC), maxillary sinus hypoplasia (MSH), frontal sinus hypoplasia (FSH), Agger nasi (AN), frontoethmoid cell type (1-2-3-4 according to Kuhn classification), the depth of the olfactory fossa (1-2-3 according to Keros Classification), sphenoid sinus pneumatization (including conchal, sellar, presellar, postsellar) were recorded and the difference between the two groups was statistically analyzed.

Normality distribution of continuous variables was evaluated with the Shapiro–Wilk statistics. For normally distributed variables, the intergroup differences were analyzed using the independent two samples t-test. The Mann–Whitney U test was used to compare two non-normally distributed independent groups. The Chi-square test was used for categorical variables. Mean ± standard deviation values were given for numerical variables in summary statistics, while frequencies and percentages were used for categorical variables. The level of statistical significance was set at $p < 0.05$. All analyses were carried out with IBM SPSS 21 software package trial version.

The ethics committee approval for this study was obtained from the Clinical Research Ethics Committee of Adana City Training and Research Hospital with the decision number of 994 and date of 08.07.2020.

Results

A total of 79 patients, 38 in Group 1 (48.1%) and 41 in Group 2 (51.9%), were included in our study. Of the patients, 30 were female (38%) and 49 were male (62%). The ages of the patients ranged from 9 to 78 years, with a mean age of 32.52 years. Group 1 consisted of 17 females (44.7%) and 21 males (55.3%). Group 2 consisted of 13 females (31.7%) and 28 males (68.3%). In Group 1, the mean age of females was 43 years and the mean age of males was 33 years. In Group 2, the mean age of females was 23 years and the mean age of males was 23.5 years. There was no statistically significant difference between the groups in terms of gender ($p = 0.255$). A statistically significant difference was found between the groups in terms of age, and the patients in Group 1 were older ($p = 0.002$). No statistically significant difference was observed between the female and male patients in terms of age ($p = 0.681$).

Considering the anatomical variations on computed tomography imaging of the paranasal sinus, SD was detected in 43 patients (54.4%), CB in 20 patients (25.3%), PC in 3 patients (3.8%), HC in 11 patients (13.9%), OC in 50 patients (63.3%), no MSH in any patients, FSH in 5 patients (6.3%) and AN in 70 patients (88.6%). Kuhn Type 3 frontoethmoid cells were detected most frequently in the patients (54.4%). Keros Type 2 was the most common (81%). The most common sphenoid sinus pneumatization was found to be postsellar (63.3%). The most common anatomical variation was AN. The most common anatomic variation in Group 1 and Group 2 was AN. SD was detected in 55.3% of patients in Group 1 and in 53.7% of patients in Group 2. CB was detected in 23.7% of patients in Group 1 and in 26.8% of patients in Group 2. PC was detected in 2.6% of patients in Group 1 and in 4.9% of patients in Group 2. HC was detected in 21.1% of patients in Group 1 and in 7.3% of patients in Group 2.**(Fig. 1)** OC was detected in 65.8% of the patients in Group 1 and in 61% of the patients in Group 2.**(Fig. 2,3)**The least common frontoethmoid cell in both groups was Kuhn Type 4. The least common Keros type in both groups was Type 3. In Group 1, presellar sphenoid sinus pneumatization was not observed in any patient. The least common type of sphenoid sinus pneumatization in Group 2 was detected as conchal and presellar. (Table 1, 2) No statistically significant difference was found between Group 1 and Group 2 in terms of SD, CB, PC, HC, OC, MSH, FSH, AN, Kuhn cell

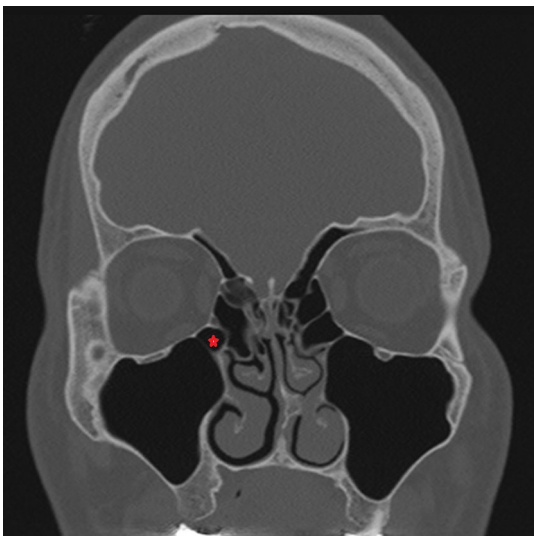

Fig. 1 Right Haller Cell

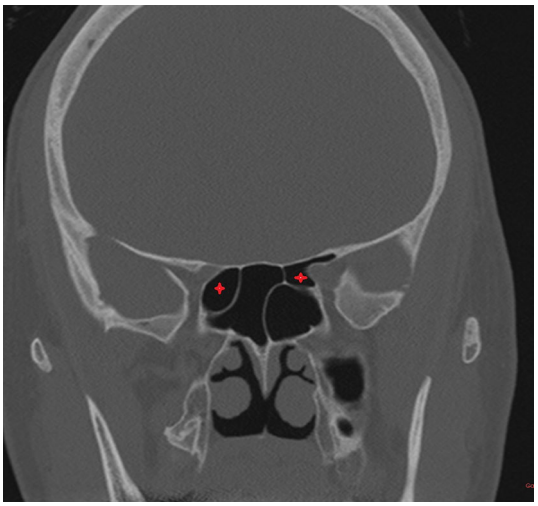

Fig. 2 Bilateral Onodi Cell

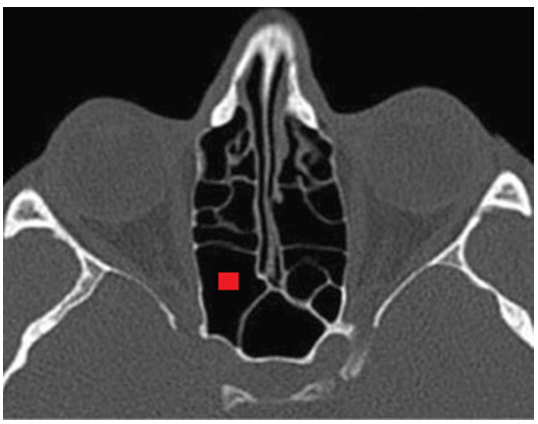

Fig. 3 Axial Section and Onodi Cell

type, Keros type, and sphenoid sinus pneumatization type. (Table 3).

No statistically significant difference was found between the genders in Group 1 and Group 2 in terms of anatomical variations.

Discussion

Anatomical characteristics of the nose and paranasal sinuses exhibit considerable variations. Many of those perturbations vary depending on age, gender, geography, race, and ethnicity, though some differences are not statistically significant [4–9].

In Gibelli's study, there were 50 males and 50 females with an age range of 25–99 years and a mean age of 47.75 years [4]. In Midilli's study, there were 206 males and 258 females with an age range of 4–87 years and a mean age of 37.5 years [5]. In our study, there were 49 males (62%) and 30 females (38%). Their ages ranged from 4–78 years with a mean of 32.5 years.

SD is an anatomical variation that can be detected in up to 79% of the population, pushing the middle concha, narrowing the middle meatus and occasionally making surgery difficult [6]. The frequency of SD was 88.5% in Farhan's study [7] and 59% in Midilli's study [5]. In our study, the frequency of SD was found to be 54.4%. There was no statistically significant difference between Group 1 and Group 2 in terms of SD ($p = 1.00$). No statistically significant difference was detected between the male and female patients in Group 1 and Group 2 in terms of SD ($p = 1.00$, $p = 0.737$).

Concha bullosa is pneumatization of the middle concha and is seen less commonly in the lower and upper conchae [8]. CB is usually bilateral, and its incidence in the population varies between 24% and 55% [6, 10]. The frequency of CB was 33.1% in Farhan's study and 37% in Midilli's study [5, 7]. In Farhan's study, CB was found to be unilateral with 16.2% and bilateral with 16.9% [7]. In our study, moderate CB was detected in 20 patients (25.3%). There were 9 XXX (45%), 11 XXXX (55%) patients. There was no statistically significant difference in the frequency of CB between Group 1 and Group 2 ($p = 0.800$).There was no statistically significant difference between the male and female patients in Group 1 and Group 2 in terms of the frequency of CB ($p = 0.703$, $p = 0.719$, respectively).

PC is caused by the reverse presentation of the middle concha and is an anatomic variation that narrows the osteomeatal complex. Farhan determined its frequency as 12.3% in his study [7]. The frequency of PC in our study was 3.8%. No statistically significant difference was found between Group 1 and Group 2 in terms of the frequency of

Table 1 *P* values in group 1

		Gender		*P* values
		Female	Male	
SD	No	8	9	1.00
		47,1%	42,9%	
	Yes	9	12	
		52,9%	57,1%	
CB	No	12	17	0.703
		70,6%	81,0%	
	Yes	5	4	
		29,4%	19,0%	
PC	No	17	20	1.00
		100,0%	95,2%	
	Yes	0	1	
		0,0%	4,8%	
HC	No	14	16	0.709
		82,4%	76,2%	
	Yes	3	5	
		17,6%	23,8%	
OC	No	5	8	0.734
		29,4%	38,1%	
	Yes	12	13	
		70,6%	61,9%	
Sinus hypoplasia	No Sinus hypoplasia	16	19	1.00
		94,1%	90,5%	
	FSH	1	2	
		5,9%	9,5%	
AN	No	1	3	0.613
		5,9%	14,3%	
	Yes	16	18	
		94,1%	85,7%	
Kuhn cell type	Type 1	1	1	0.716
		5,9%	4,8%	
	Type 2	6	6	
		35,3%	28,6%	
	Type 3	10	13	
		58,8%	61,9%	
	Type 4	0	1	
		0,0%	4,8%	
Keros type	Type 1	3	2	0.515
		17,6%	9,5%	
	Type 2	12	18	
		70,6%	85,7%	
	Type 3	2	1	
		11,8%	4,8%	
Sphenoid sinus pneumatization	Conchal	1	0	0.522
		5,9%	0,0%	
	Sellar	5	6	
		29,4%	28,6%	
	Postsellar	11	15	
		64,7%	71,4%	

Table 2 *P* values in group 2

		Gender		*P* values
		Female	Male	
SD	No	7	12	0.737
		53,8%	42,9%	
	Yes	6	16	
		46,2%	57,1%	
CB	No	9	21	0.719
		69,2%	75,0%	
	Yes	4	7	
		30,8%	25,0%	
PC	No	12	27	0.539
		92,3%	96,4%	
	Yes	1	1	
		7,7%	3,6%	
HC	No	12	26	1.00
		92,3%	92,9%	
	Yes	1	2	
		7,7%	7,1%	
OC	No	6	10	0.732
		46,2%	35,7%	
	Yes	7	18	
		53,8%	64,3%	
Sinus hypoplasia	No sinus hypoplasia	11	28	0.095
		84,6%	100,0%	
	FSH	2	0	
		15,4%	0,0%	
AN	No	1	4	1.00
		7,7%	14,3%	
	Yes	12	24	
		92,3%	85,7%	
Kuhn cell type	Type 1	2	5	0.539
		15,4%	17,9%	
	Type 2	6	7	
		46,2%	25,0%	
	Type 3	5	15	
		38,5%	53,6%	
	Type 4	0	1	
		0,0%	3,6%	
Keros type	Type 1	2	5	1.00
		15,4%	17,9%	
	Type 2	11	23	
		84,6%	82,1%	
Sphenoid sinus pneumatization	Conchal	2	1	0.263
		15,4%	3,6%	
	Presellar	2	1	
		15,4%	3,6%	
	Sellar	3	8	
		23,1%	28,6%	
	Postsellar	6	18	
		46,2%	64,3%	

Table 3 *P* values

		Ethnicity		*P* values
		Group 1	Group 2	
Gender	Female	17	13	0,255
		44,7%	31,7%	
	Male	21	28	
		55,3%	68,3%	
SD	No	17	19	1,00
		44,7%	46,3%	
	Yes	21	22	
		55,3%	53,7%	
CB	No	29	30	0,800
		76,3%	73,2%	
	Yes	9	11	
		23,7%	26,8%	
PC	No	37	39	1,00
		97,4%	95,1%	
	Yes	1	2	
		2,6%	4,9%	
HC	No	30	38	0,107
		78,9%	92,7%	
	Yes	8	3	
		21,1%	7,3%	
OC	No	13	16	0,816
		34,2%	39,0%	
	Yes	25	25	
		65,8%	61,0%	
Sinus hypoplasia	No sinus hypoplasia	35	39	0,667
		92,1%	95,1%	
	FSH	3	2	
		7,9%	4,9%	
AN	No	4	5	1,00
		10,5%	12,2%	
	Yes	34	36	
		89,5%	87,8%	
Kuhn cell type	Type 1	2	7	0,380
		5,3%	17,1%	
	Type 2	12	13	
		31,6%	31,7%	
	Type 3	23	20	
		60,5%	48,8%	
	Type 4	1	1	
		2,6%	2,4%	
Keros type	Type 1	5	7	0,099
		13,2%	17,1%	
	Type 2	30	34	
		78,9%	82,9%	
	Type 3	3	0	
		7,9%	0,0%	
Sphenoid sinus pneumatization	Conchal	1	3	0,160
		2,6%	7,3%	
	Presellar	0	3	
		0,0%	7,3%	
	Sellar	11	11	
		28,9%	26,8%	
	Postsellar	26	24	
		68,4%	58,5%	

PC. ($p = 1.00$) No statistically significant difference was found between the male and female patients in Group 1 and Group 2 in terms of the frequency of PC. ($p = 1.00$, $p = 0.539$).

There are articles in the literature reporting the frequency of HC as high as 45% [6, 11, 12]. The frequency of HC was reported by Kantarci as 18%, by Midilli as 28%[5, 8]. In our study, the frequency of HC was 13.9%. HC was detected in 8 patients (21.1%) in Group 1 and in 3 patients (7.3%) in Group 2. Although HC was observed more commonly in Group 1, there was no statistically significant difference between the two groups in terms of frequency (p = 0.107). There was no statistically significant difference between the male and female patients in Group 1 and Group 2 in terms of the frequency of HC. ($p = 0.709$, $p = 1.00$).

OC is the posterior ethmoid cell and its relationship with the sphenoid sinus is best seen on axial slices of radiological imaging [13]. In our study, the frequency of OC was 63.3%. No statistically significant difference was found between Group 1 and Group 2 in terms of the frequency of OC ($p = 0.816$).There was no significant difference between the female and male patients in Group 1 and Group 2 in terms of in terms of the frequency of OC ($p = 0.734$, $p = 0.732$).

Kantarci and Midilli reported the frequency of MSH as 7–4%, respectively [5, 8]. Midilli reported the frequency of frontal sinus agenesis as 4.2% and the frequency of FSH as 14.2% [5]. While MSH was not detected at all in our study, FSH was detected in 5 patients (6.3%). FSH was detected in 3 patients in Group 1 and in 2 patients in Group 2. All patients with FSH in Group 2 were female. There was no statistically significant difference between Group 1 and Group 2 in terms of the frequency of FSH ($p = 0.667$). No statistically significant difference was found between the female and male patients in Group 1 and Group 2 in terms of the frequency of FSH ($p = 1.00$, $p = 0.095$, respectively).

Farhan reported the frequency of AN as 67.7%, Alrumaih reported the frequency of AN in Saudi Arabian population as 97.5% with being bilateral in all patients, and the Indians reported the frequency of AN as 50% in their study [7, 14, 15]. In our study, the frequency of AN was 88.6%. There was no statistically significant difference in the detection of AN between XXXX patients and XXXXX refugees ($p = 1.00$).No statistically significant difference was found between the female and male patients in Group 1 and Group 2 in terms of the frequency of AN ($p = 0.613$, $p = 1.00$, respectively).

Frontoethmoid cells are classified into 4 types according to the Kuhn Classification and type 1 is the most common type [6]. Van Alyea detected frontoethmoid cells in 26% of the patients [16]. Lee and Kuhn found Type 1-2-3 cells between 20% and 45% [17–19]. In our study, the frequency of Type 1 was found as 11.4%, the frequency of Type 2 as 31.6%, the frequency of Type 3 as 54.4%, and the frequency of Type 4 as 2.5%. In Group 1 and Group 2, no Type 4 cells were found in female patients. The most common cell type in both groups was Type 3. There was no statistically significant difference between Group 1 and Group 2 in terms of cell types ($p = 0.380$). There was no statistically significant difference between the male and female patients in Group 1 and 2 in terms of the detection of Kuhn cell types and the difference of the types ($p = 0.716$, $p = 0.539$).

Hammer and Radberg classification for sphenoid sinus pneumatization has been adapted by Dias as apneumatic, conchal, presellar, sellar, and postsellar [20, 21]. In our study, no apneumatized sphenoid sinus was detected. The frequency of pneumatization types was conchal with 5.1%, presellar with 3.8%, sellar with 27.8%, and postsellar with 63.3%, respectively. Presellar pneumatization was not detected in Group 1, and conchal pneumatization was not detected in male patients in Group 1. The most common pneumatization type in both groups was postsellar. There was no statistically significant difference between Group 1 and Group 2 in terms of pneumatization types ($p = 0.160$). No statistically significant difference was found between the male and female patients in Group 1 and Group 2 in terms of sphenoid sinus pneumatization types ($p = 0.522$, $p = 0.263$).

In his study, Farhan reported the frequency of Keros 1 as 25.7%, the frequency of Keros 2 as 62.3%, and the frequency of Keros 3 as 11.9%.[7] Murthy reported the frequency of Keros 1 as 19.5%, the frequency of Keros 2 as 71.5%, and the frequency of Keros 3 as 11.9% in his study on Indian patients [22]. Sari found that the frequency of Keros 1 was 20.3%, the frequency of Keros 2 was 51.9%, and the frequency of Keros 3 was 27.7% in his study on Turkish patients [23]. In our study, the frequency of Keros 1 was found as 15.2%, the frequency of Keros 2 as 81%, and the frequency of Keros 3 as 3.8%. Keros 3 was not detected in Group 2. There was no statistically significant difference between Group 1 and Group 2 in terms of Keros Types ($p = 0.099$).No statistically significant difference was detected between the male and female patients in Group 1 and Group 2 in terms of Keros Types ($p = 0.515$, $p = 1.00$).

Conclusion

Refugees can change the incidence of anatomical variation in their country of residence. The frequency of anatomical variations can change the medical treatment and surgical treatment to be administered to the patient. In our study, we

could not find a statistically significant difference between XXXX and XXXX refugees in terms of anatomical variations detected on paranasal radiological imaging. We consider the number of patients in our study as a limitation of our study and we think that it is important to conduct studies with larger populations. Anatomical variations may always be present during surgery, and their detection by preoperative imaging methods will be useful in minimizing the complications that may occur.

Acknowledgements The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.The authors received no financial support for the research and/or authorship of this article.

Funding No funding source was achieved for this brief study.

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