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Effect of Concha Bullosa on Skull Base

Konka Büllozanın Kafatası Tabanı Üzerine Etkisi

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ABSTRACT

Introduction: To demonstrate the effect of concha bullosa (CB) on the height of the skull base.

Methods: We retrospectively scanned the files of 1022 patients who had undergone paranasal sinus tomography for sinusitis in our hospital. Three hundred thirty patients had bilateral, and 330 had unilateral CB, but 330 patients did not have CB. Patients with inappropriate sections and positions were excluded from the study. A total of 990 patients aged between 18 and 72 years were included in the study. Five hundred sixty-seven of the patients were female, and 423 were male. In each group, the heights of the right and left skull base of male and female patients were compared within themselves and between each other. The height of the skull base was measured in the coronal plane along the lateral lamella between the cribriform plate and the fovea ethmoidalis, and these measurements were classified as Keros classification. (Keros type 1: 1-3 mm, Keros type 2: 4-7 mm, Keros type 3: 8-16 mm).

Results: There was no statistically significant difference in the comparison between right and left skull base heights of female and male patients in bilateral CB group. Also, there was no statistically significant difference between the comparison of women and men within themselves. There was a statistically significant difference between CB side and non-CB side skull base heights of female and male patients in unilateral CB group, although there was no statistically significant difference between the comparison of women and men within themselves.

Conclusion: In patients with unilateral CB, there is skull base asymmetry between the sides of CB and non-CB, and this should be taken into consideration to prevent complications.

Keywords: Concha bullosa, skull base, paranasal sinus tomography

ÖZ

Amaç: Konka büllozanın (KB) kafa tabanı yüksekliği üzerindeki etkisini göstermektir.

Yöntemler: Hastanemizde sinüzit nedeniyle paranazal sinüs tomografisi çekilen 1022 hastanın dosyaları retrospektif olarak tarandı. Üç yüz otuz hastada bilateral, 330 hastada unilateral KB vardı, ancak 330 hastada KB yoktu. Kesitleri ve pozisyonları uygun olmayan hastalar çalışma dışı bırakıldı. Çalışmaya 18-72 yaş arası toplam 990 hasta dahil edildi. Hastaların beşyüz altmış yedisi kadın, 423'ü erkekti. Her grupta erkek ve kadın hastaların sağ ve sol kafatası tabanının yükseklikleri kendi içlerinde ve birbirleri arasında karşılaştırıldı. Kafatası tabanının yüksekliği, kribriform plaka ile fovea etmoidalis arasındaki lateral lamel boyunca koronal düzlemde ölçülmüş ve bu ölçümler Keros sınıflandırması kullanılarak sınıflandırılmıştır. (Keros tip 1: 1-3 mm, Keros tip 2: 4-7 mm, Keros tip 3: 8-16 mm).

Bulgular: Bilateral KB grubunda kadın ve erkek hastaların sağ ve sol kafatası tabanı yükseklikleri arasında istatistiksel olarak anlamlı bir fark saptanmadı. Ayrıca, kadın ve erkeklerin kendi içlerinde yapılan karşılaştırmalarında da istatistiksel anlamlı bir fark saptanmadı. Unilateral KB grubunda kadın ve erkek hastaların KB'si olan ve KB'si olmayan taraf kafatası tabanı yükseklikleri arasında istatistiksel olarak anlamlı bir fark saptanmasına rağmen, kadın ve erkeklerin kendi içlerinde yapılan karşılaştırmalarında istatistiksel anlamlı bir fark saptanmadı.

Sonuç: Unilateral KB'li hastalarda, KB olan ve olmayan taraflar arasında kafatası tabanı asimetrisi vardır ve komplikasyonları önlemek için bu dikkate alınmalıdır.

Anahtar Kelimeler: Konka bülloza, kafatası tabanı, paranazal sinüs tomografisi

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Introduction

The roof of the ethmoidal labyrinth is formed by the fovea ethmoidalis, which is an extension of the frontal bone, primarily separating the ethmoidal cells from the anterior cranial fossa. Fovea ethmoidalis is part of the ethmoid bone that attaches to the lateral lamella of the cribriform plate medially. The depth of the olfactory fossa is determined by the height of the lateral lamella of the cribriform plate (1,2). According to the literature, in the skull base, iatrogenic lesions occur predominantly in the lateral lamella of the cribriform plate. The site where the anterior ethmoidal artery penetrates the cranial fossa is particularly interesting, considering that this is the thinnest and less resistant region of the whole skull base (1,2).

Depending on the Keros type, a variable segment of the lateral wall of the olfactory fossa will be exposed during the dissection of the frontoethmoidal region. Keros divided the roof of the ethmoid into three categories according to the depth of the cribriform plate (Keros type 1: 1-3 mm, Keros type 2: 4-7 mm, Keros type 3: 8-16 mm) (3). The Keros type 3 is the most vulnerable one, considering the major risk for an iatrogenic lesion of the lateral lamella of the cribriform plate (2,4).

The knowledge about the complex skull base anatomy and anatomical relations, including the fovea ethmoidalis and lateral lamella of the cribriform plate, is essential in the prevention of complications in endoscopic nasal surgeries (5,6). Computed tomography (CT) is considered to be a radiological method that can evaluate the anatomy and anatomical variants of the paranasal sinuses in the right way and is extremely useful in the planning of the preoperative endonasal surgery (7).

Concha bullosa (CB) represent the entity of an air cell in the turbinates. Middle turbinate (MT) pneumatization results from changes in the development of the ethmoid air cell system. The incidence of pneumatization of the MT is between 13 and 53.6% (8). CB is usually asymptomatic and diagnosed incidentally by CT. From time to time, an over-pneumatized MT can lead to deviated nasal septum, contact headache, nasal obstruction, and sinusitis (9).

Evaluation of anatomical findings may determine a higher intraoperative safety during endonasal surgeries in the frontoethmoidal region, giving the surgeon previous knowledge about the configuration of the ethmoidal roof and depth of olfactory fossae, consequently reducing the patient exposure to potential complications. There are no studies investigating the relationship between different CB types and skull base configurations in the literature. This study aimed to determine the effect of CB on the skull base.

Methods

We retrospectively scanned the files of 1022 patients who had undergone paranasal sinus CT for sinusitis in our hospital between 2014 and 2018. Patients were divided into three groups as unilateral CB, bilateral CB, and non-CB. In our study, the sample size was accepted as 330 for each group. When 330 patients were selected for each group, the retrospective scan was completed. Patients with inappropriate sections and positions were excluded from the study. Each group of patients was divided into two groups as men and women. The right and left heights of the skull base of the groups were compared between male and female patients as well as within itself, both male and female patients.

Examinations were performed using CT equipment (GE Optima CT660, General Electric, Waukesha, Wisconsin, USA) with 64 detectors-128 Slices. For the scanning parameters, 120 kVp; 120-150 mA; a spacing of 200 mm field of view and 1.75 was used. The scans were performed in a coronal plane with a cross-section thickness of 2.5 mm and a cross-section of 3 mm. CT images were analyzed using GE Volume Viewer SW. The images were examined in the bone window on a digital screen. The same otolaryngologist evaluated all of the cases included in the study. The ethmoid roof measurements were performed manually using a digital screen-standard anatomic points (Figure 1).

The study was approved by University of Health Sciences, Ümraniye Training and Research Hospital Ethics Committee (B.10.1.TKH.4.34.H.GP.0.01/132, date: 21.12.2017).

Statistical Analysis

IBM SPSS Statistics Version 22 (IBM Turkish limited company, İstanbul, Turkey) program was used for statistical analysis. The normality of the parameters was evaluated by the Shapiro-Wilks test. Descriptive statistical methods (mean, standard deviation, and median) were calculated. When the groups were evaluated together, nonparametric data were assessed by Kruskal-Wallis test. P values were confirmed by the Bonferroni test. Mann-Whitney U test was used in the comparison of nonparametric data between groups. Significance was assessed at $p<0.05$ level.

Results

Three hundred thirty patients were included in each group. Of the patients included in the study, 567 were female, and 423 were male. Of the patients in the bilateral CB group, 231 were female, and 99 were male. The ages of the women ranged from 20 to 68 years, and the mean age was 35.27±13.9 years, while the ages of the males ranged from 18 to 72 years, and the mean age was 36.67±14.21 years. In the unilateral CB group, 193 patients were female, and 137 were male. The ages of the women ranged from 21 to 61 years, and the mean age was 38.86±14.21

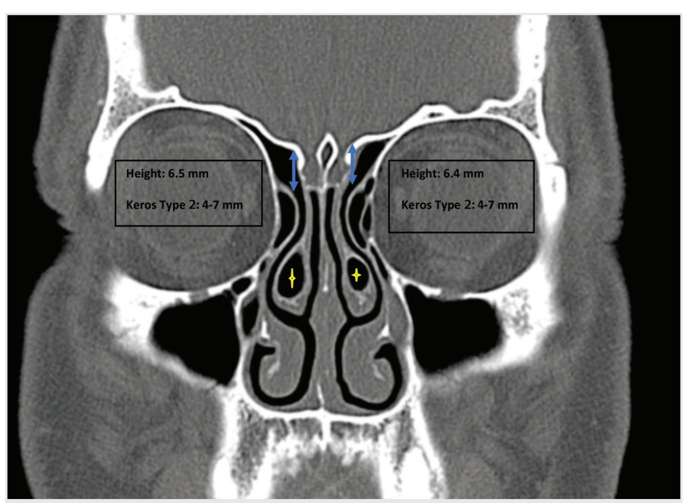

Figure 1. Skull base measurement in a patient with bilateral concha bullosa

years, while the ages of the males ranged from 25 to 57 years, and the mean age was 34.39±10.16 years. In the non CB group, 142 patients were female, and 188 were male. The ages of the women ranged from 19 to 65 years, and the mean age was 35.19±13.07 years, while the ages of the men ranged from 23 to 70 years, and the mean age was 35.28±11.86 years.

The right and left skull base heights of females and males in bilateral CB group, there were 3.9% Keros type 1, 69.7% Keros type 2, 26.4% Keros type 3; 3.03% Keros type 1, 79.8% Keros type 2, 17.17% Keros type 3; 6.06% Keros type 1, 76.19% Keros type 2, 17.75% Keros type 3; and 6% Keros type 1, 81% Keros type 2 and 13% Keros type 3, respectively (Table 1).

The right and left skull base heights of females and males without CB, there were 1.41% Keros type 1, 84.51% Keros type 2, 14.08% Keros type 3; 1.06% Keros type 1, 73.4% Keros type 2, 25.54% Keros type 3; 3.52% Keros type 1, 85.21% Keros type 2, 11.27% Keros type 3; and 0.53% Keros type 1, 76.07% Keros type 2 and 23.4% Keros type 3, respectively (Table 2).

Skull base values of females and males in the sides with and without CB in the group with unilateral CB, there were 3.11% Keros type 1, 70.98% Keros type 2, 25.91% Keros type 3; 0.73% Keros type 1, 70.8% Keros type 2, 28.47% Keros type 3; 8.29% Keros type 1, 80.31% Keros type 2, 11.4% Keros type 3; and 7.3% Keros type 1, 83.21% Keros type 2 and 9.49% Keros type 3, respectively (Table 3).

In the evaluation of the bilateral CB group, the right and left skull base heights of females and males were 5.91±1.71 mm, 5.74±1.68 mm, 5.66±1.67 mm, and 5.47±1.64 mm, respectively. There was no statistically significant difference between women and men both in their own and in comparison with each other ($p<0.144$, $p=0.323$, $p=0.25$, $p=0.27$) (Table 4).

In the group without CB, the right and left skull base values of females and males were 5.61±1.39 mm, 6.03±1.57 mm, 5.46±1.52 mm and 5.82±1.51 mm, respectively. There was no statistically significant difference between women and men both in their own and in comparison with each other (except female-male left comparison) ($p=0.318$, $p=0.949$, $p=0.06$, $p<0.001$) (Table 5).

Skull base values of females and males in the group with unilateral CB in the sides with and without the CB were 5.95±1.64 mm, 6.13±1.55 mm,

Table 1. Bilateral concha bullosa group (female right/left keros, male, right/left keros)

Right female	n	%	Mean ± SD
Keros 1	9	3.9	2.67±0.23
Keros 2	160	69.7	5.26±0.98
Keros 3	61	26.4	8.11±1.02
Left female	**n**	**%**	**Mean ± SD**
Keros 1	14	6.06	2.65±0.39
Keros 2	176	76.19	5.3±1.04
Keros 3	40	17.25	8.23±0.89
Right male	**n**	**%**	**Mean ± SD**
Keros 1	3	3.03	2.73±0.3
Keros 2	79	79.8	5.25±0.96
Keros 3	18	17.17	8.57±1.21
Left male	**n**	**%**	**Mean ± SD**
Keros 1	6	6	2.58±0.37
Keros 2	81	81	5.21±1.02
Keros 3	13	13	8.37±1.15

n: number of patients, %: patient percentage, SD: standard deviation, Keros 1: 1-3 mm, Keros 2: 4-7 mm, Keros 3: 8-16 mm

Table 2. Group without concha bullosa (female right/left keros, male, right/left keros)

Right female	n	%	Mean ± SD
Keros 1	2	1.41	2.65±0.07
Keros 2	120	84.51	5.24±0.85
Keros 3	20	14.08	8.15±1.1
Left female	**n**	**%**	**Mean ± SD**
Keros 1	5	3.52	2.66±0.28
Keros 2	121	85.21	5.18±0.94
Keros 3	16	11.27	8.49±1.34
Right male	**n**	**%**	**Mean ± SD**
Keros 1	2	1.06	2.6±0.28
Keros 2	138	73.4	5.37±0.99
Keros 3	48	25.54	8.07±0.98
Left male	**n**	**%**	**Mean ± SD**
Keros 1	1	0.53	2.3
Keros 2	143	76.07	5.43±1.03
Keros 3	44	23.4	8.03±0.92

n: number of patients, %: patient percentage, SD: standard deviation, Keros 1: 1-3 mm, Keros 2: 4-7 mm, Keros 3: 8-16 mm

Table 3. Unilateral concha bullosa group (female concha bullosa side/non-concha bullosa side, male concha bullosa side/non-concha bullosa side)

The CB side			
Female	**n**	**%**	**Mean ± SD**
Keros 1	6	3.11	2.38±0.22
Keros 2	137	70.98	5.34±0.97
Keros 3	50	25.91	8.05±0.92
The non-CB side			
Female	**n**	**%**	**Mean ± SD**
Keros 1	16	8.29	2.47±0.48
Keros 2	155	80.31	4.86±0.97
Keros 3	22	11.4	7.92±0.94
The CB side			
Male	**n**	**%**	**Mean ± SD**
Keros 1	1	0.73	2.3
Keros 2	97	70.8	5.38±0.94
Keros 3	39	28.47	8.10±0.75
The non-CB side			
Male	**n**	**%**	**Mean ± SD**
Keros 1	10	7.3	2.73±0.23
Keros 2	114	83.21	5.18±0.94
Keros 3	13	9.49	7.86±1.02

CB: concha bullosa, n: number of patients, %: patient percentage, SD: standard deviation, Keros 1: 1-3 mm, Keros 2: 4-7 mm, Keros 3: 8-16 mm

5.01±1.55 mm and 5.26±1.4 mm, respectively. There was a statistically significant difference between right and left skull base heights in male and female patients, but there was no statistically significant difference between them (p<0.001, p<0.001, p=0.348, p=0.74) (Tables 6,7).

In the comparison of the right and left levels of the groups, a statistically significant difference was not found between the bilateral CB group and the non-CB group (p=0.998, p=0.171) (Table 8).

In the comparison of the right and left levels of the groups, a statistically significant difference was found between the bilateral CB group right and the unilateral CB group non-CB side (p<0.001) (Table 9).

Table 4. Bilateral concha bullosa group (female right/left, male right/left comparison) and (female-male right/left comparison)

Female	**n**	**Mean ± SD**	**p**
Right	231	5.91±1.71	0.144
Left	231	5.66±1.67	
Male	**n**	**Mean ± SD**	**p**
Right	99	5.74±1.68	0.323
Left	99	5.47±1.64	
Female-male	**n**	**Mean ± SD**	**p**
Female right	231	5.91±1.71	0.25
Male right	99	5.74±1.68	
Female-male	**n**	**Mean ± SD**	**p**
Female left	231	5.66±1.67	0.27
Male left	99	5.47±1.64	

Mann-Whitney U test p<0.05, n: number of patients, SD: standart deviation

Table 5. Group without concha bullosa (female right/left, male right/left and female-male right/left comparison

Female	**n**	**Mean ± SD**	**p**
Right	142	5.61±1.39	0.318
Left	142	5.46±1.52	
Male	**n**	**Mean ± SD**	**p**
Right	188	6.03±1.57	0.949
Left	188	5.82±1.51	
Female-male right	**n**	**Mean ± SD**	**p**
Female right	142	5.61±1.39	0,06
Male right	188	6.03±1.57	
Female-male left	**n**	**Mean ± SD**	**p**
Female left	142	5.46±1.52	0,001
Male left	188	5.82±1.51	

Mann-Whitney U test, p<0.05, n: number of patients, SD: standart deviation

Table 6. Unilateral concha bullosa group female (+)/(-) and male (+)/(-) comparison

Female	**n**	**Mean ± SD**	**p**
CB side	193	5.95±1.64	0.001
Non-CB side	193	5.01±1.55	
Male	**n**	**Mean ± SD**	**p**
CB side	137	6.13±1.55	0.001
Non-CB side	137	5.26±1.4	

Mann-Whitney U test, p<0.05, (+): CB side, (-): Non-CB side, n: number of patients, SD: standart deviation, CB: concha bullosa

A statistically significant difference was found between the left side of the bilateral CB group and the CB side of the unilateral CB group as well as the non-CB side of the unilateral CB group (p<0.001) (Table 10).

A statistically significant difference was found between the right side of the non-CB group and the non-CB side of the unilateral CB group (p<0.001) (Table 11).

A statistically significant difference was found between the left side of the non-CB group and the non-CB side of the unilateral CB group (p<0.001) (Table 12).

There was no statistically significant difference in the other comparisons of the groups.

Table 7. Unilateral concha bullosa group (female-male concha bullosa/non-concha bullosa side comparison)

Female-male	**n**	**Mean ± SD**	**p**
Female CB side	193	5.95±1.64	0.348
Male CB side	137	6.13±1.55	
Female-male	**n**	**Mean ± SD**	**p**
Female non-CB side	193	5.01±1.55	0.74
Male non-CB side	137	5.26±1.4	

Mann-Whitney U test p<0.05, n: number of patients, SD: standart deviation, CB: concha bullosa

Table 8. Comparison of bilateral concha bullosa and non-concha bullosa group

	n	**Min-max**	**Mean ± SD**	**p**
BCB group right	330	2.4-11.8	5.86±1.705	0.998
Non-CB group right	330	2.4-11.4	5.85±1.51	
BCB group left	330	1.7-10.2	5.6±1.66	0.171
Non-CB left	330	2.3-11.5	5.78±1.54	

Mann-Whitney U test, p<0.05, BCB: bilateral concha bullosa, CB: concha bullosa, SD: standard deviation, min: minimum, max: maximum

Table 9. Comparison of bilateral concha bullosa and unilateral concha bullosa group

	n	**Min-max**	**Mean ± SD**	**p**
BCB group right	330	2.4-11.8	5.86±1.705	0.115
UCB group CB side	330	2.2-11.4	6.03±1.607	
BCB group right	330	2.4-11.8	5.86±1.705	0.001
UCB group non-CB side	330	1.1-11	5.11±1.49	

Mann-Whitney U test, p<0.05, BCB: bilateral concha bullosa, CB: concha bullosa, min: minimum, max: maximum, SD: standard deviation, UCB: unilateral concha bullosa

Table 10. Comparison of bilateral concha bullosa and unilateral concha bullosa group

	n	**Min-max**	**Mean ± SD**	**p**
BCB group left	330	1.7-10.20	5.60±1.66	0.001
UCB group CB side	330	2.2-11.4	6.03±1.607	
BCB group left	330	1.7-10.20	5.60±1.66	0.001
UCB group non-CB side	330	1.1-11	5.11±1.49	

Mann-Whitney U test, p<0.05, BCB: bilateral concha bullosa, CB: concha bullosa, min: minimum, max: maximum, SD: standard deviation, UCB: unilateral concha bullosa

Also, no statistically significant difference was found in the comparison of all groups (p=0.22) (Table 13).

Discussion

The anatomy of the paranasal sinuses and skull base are highly complex, with many anatomic variations. Detailed knowledge of anatomic variations in the paranasal sinus and skull base are essential to understand sinonasal pathology and avoid complications if surgery is indicated. Variations of the paranasal anatomic structures can be detected easily with paranasal CT (10). CB is the pneumatization of the concha and is a frequent variation of the sinonasal anatomy. CB is most commonly seen in MTs (11). It is rarely found in upper and lower turbinates (12,13). Because we performed only MT analysis in our study, anatomical variations other than the MT were excluded from the study.

The frontal bone of the ethmoid roof area is dense and thick. The thicker frontal bone is medially located near the thin lateral lamellae of the ethmoid bone (14). It is already well established that the area at risk is not in the highest point of the ethmoid sinus formed by the fovea ethmoidalis, but in the lateral lamella of the cribriform plate in the region of the ethmoidal sulcus. This is the most vulnerable site in the whole skull base where the anterior ethmoidal artery leaves the ethmoid sinus and courses anteriorly in the ethmoidal sulcus of the olfactory fossa (1,2).

The lateral lamella, a thin bone component of the lamina cribrosa, forms the medial wall of the ethmoid roof. Determining the length and width of the olfactory fossa and the depth of the ethmoid roof by radiological methods is significant for determining the upper limit of the dissection. Radiologic examinations can help us to prevent complications such as anterior cranial fossa penetration, cerebral damage, bleeding, and cerebrospinal fluid fistulae (15).

Table 11. Comparison of non-concha bullosa group and unilateral concha bullosa group

	n	Min-max	Mean ± SD	p
Non-CB group right	330	2.4-11.4	5.85±1.51	0.09
UCB group CB side	330	2.2-11.4	6.03±1.60	
Non-CB group right	330	2.4-11.4	5.85±1.51	0.001
UCB group non-CB side	330	1.1-11	5.11±1.49	

Mann-Whitney U test, p<0.05, BCB: bilateral concha bullosa, CB: concha bullosa, min: minimum, max: maximum, SD: standard deviation, UCB: unilateral concha bullosa

Table 12. Comparison of non-concha bullosa and unilateral concha bullosa group

	n	Min-max	Mean ± SD	p
Non-CB group left	330	2.3-11.5	5.78±1.54	0.3
UCB group CB side	330	2.2-11.4	6.03±1.60	
Non-CB group left	330	2.3-11.5	5.78±1.54	0.001
UCB group non-CB side	330	1.1-11	5.11±1.49	

Mann-Whitney U test, p<0.05, BCB: bilateral concha bullosa, CB: concha bullosa, min: minimum, max: maximum, SD: standard deviation, UCB: unilateral concha bullosa

Table 13. Comparison of all groups

	n	Min-max	Mean ± SD	p
BCB group	330	1.7-11.8	5.73±1.69	0.22
UCB group	330	1.1-11.4	5.57±1.61	
Non-CB group	330	2.3-11.5	5.82±1.52	

Kruskall-Wallis test p<0.05, BCB: bilateral concha bullosa, CB: concha bullosa, min: minimum, max: maximum, SD: standard deviation UCB: unilateral concha bullosa

CT has contributed not only to the evaluation of sinonasal diseases but also to the characterization of the paranasal sinuses anatomy. Paranasal sinus CT studies on the coronal plane may provide sufficient information about individual variations of patients and ethmoid roof depths (14). Coronal images can particularly be considered as maps in the evaluation of the anatomy that is highly variable even between the two sides of the same individual, demonstrating areas potentially at risk for complications in the planning of endoscopic nasal surgeries (16-18). The ethmoid roof height difference was shown to be a risk factor regarding complications, and therefore continuous analysis of the ethmoid roof by CT during the intraoperative period was fundamental regarding surgical safety (19). Disregard to consider asymmetry in the skull base during the intraoperatively or preoperative period may result in significant complications (20).

Ethmoid roof configuration may vary in different societies (21,22). In their ethmoid roof analysis of 136 cases, Erdem et al. (23) found that 8.1% of the cases were Keros type 1, 59.6% were Keros type 2, and 32.3% were Keros type 3. Şahin et al. (24) examined 100 paranasal sinus CT scans in their study and reported that 10% of the cases were Keros type 1, 61% were Keros type 2, and 29% were Keros type 3. Kaplanoglu et al. (25) stated that, of the 1.000 total examinations (two sides in each patient), 13.4% were Keros type 1, 76.1% were Keros type 2, and 10.5% were Keros type 3. Type 1 was more prevalent in women than men (31.6% vs 21.4%), and type 3 was more prevalent in men than women (24.4% vs 17.9%). These studies support and make strong the hypothesis that the ethmoid roof configuration varies in the Turkish population. In our study, it was found that Keros type 2 in both men and women was seen more frequently than Keros type 1 and 3. In some of the other studies, although gender difference was found to affect the height of the skull base, no such condition was found in our study.

The MT is one of the essential marking places in endoscopic sinus surgery. In a study comparing the height of the MT to the depth of the cribriform plate, it was determined that the olfactory fossa was less deep and that the MT was longer in Keros type 1 cases, whereas in the Keros type 3 cases, where the olfactory fossa was deeper, and the MT length was detected shorter (26). During endoscopic sinus surgery, it is advisable that it should not move beyond the MT attachment site to prevent trauma to the skull base (26).

Determining the relation of the middle concha to the surrounding anatomic formations can provide important benefits in endoscopic sinus surgery. In a study comparing the total height of the nasal cavity with the depth of the olfactory fossa, it was determined that the depth of the olfactory fossa was parallel to the depth of the nasal cavity. In the same study, the height of the orbit was compared with the depth of the olfactory fossa, and it was determined that this height of the most stable formation (23). Knowing the average lengths of the skull base composition and surrounding anatomical structures in patients during endoscopic sinus surgery may prevent serious complications that may occur during the operation. Therefore, careful evaluation of preoperative CT for safer surgery is one of the most critical steps.

The MT is formed by the medial part of the ethmoid bone. As it elongates in the nasal cavity, anterosuperior stabilization is achieved by the cribriform plate, and posterolateral stabilization is achieved by the lamina papyricea. CB is the pneumatization of the MT and is one of the most common variations of the sinonasal anatomy. Pneumatization of the MT happens due to variation in the ethmoidal air cell system development (27-29). The CB turns into apparent after 7-8 years of age and continues its development even after the period of adolescence. The mean age (30.3 years) of CB was consistent with other studies on the same topic (30). CB can be unilateral or bilateral and can be classified into three types according to the site of pneumatization. They are lamellar-type (vertical lamella of MT pneumatization), bulbous-type (the inferior portion of MT pneumatization), and extensive/large type (vertical lamella and inferior portion of the MT pneumatization) (13). The rate of pneumatization and the inflammatory changes that take place within the CB may correlate with the presentation, and the severity of symptoms (31).

In a study conducted by Bolger et al. (13), Paranasal sinus CT of 207 patients was investigated, and lamellar type CB was found in 46.2%, bullous type CB in 31.2% and extant type CB in 15.7%. Similar to this study, we found 43.1% lamellar type CB, 33.5% bullous type CB and 23.4% extensive type CB. In our study, we evaluated all types of CB, and we did not distinguish between the types of CB in the evaluation of the skull base. In 85.3% of the patients from mild to advanced nasal septal deviation, 14% were nasal polyps, and 56% had sinusitis. CB may cause nasal septal deviation and sinusitis findings in these patients, but may also be effective on skull base height. In this study, we evaluated the effect of CB on the skull base height. We found that unilateral CB effects the height of the skull base.

The fact that it is different only in the unilateral CB group in the evaluation of skull base height may be caused by embryological development. There may be a need for more studies to make this clear.

Conclusion

Because unilateral CB causes changes in the skull base height, it may be useful to carefully the side of the unilateral CB during endoscopic sinus surgery to avoid possible complications.

Ethics Committee Approval: The study was approved by University of Health Sciences, Ümraniye Training and Research Hospital Ethics Committee (B.10.1.TKH.4.34.H.GP.0.01/132, date: 21.12.2017).

Informed Consent: Since it was a retrospective study, consent was not obtained from the patients.

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