International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)

Journal Home page: www.iscientific.org/Journal.html

Evaluation of Nasal Septum Morphology in CBCT Images of Patients Referred to Ahvaz Dentistry School in 2019

Mahshid Razavi[1], Nasim Shams[2], Behnaz Baratvand[3]*, Alireza Bazdar[4]

[1] *Assistant professor, Department of Oral and Maxillofacial Radiology, School of Dentistry, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran mahshid.razavi@gmail.com*

[2] *Assistant professor, Department of Oral and Maxillofacial Radiology, School of Dentistry, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran nassham61@gmail.com*

[3] *Postgraduate Student, Department of Oral and Maxillofacial Radiology, School of Dentistry, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran behnaz.baratvand@gmail.com*

[4] *Dentist, Department of Oral and Maxillofacial Radiology, School of Dentistry, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran alireza.bazdar1401@gmail.com*

Abstract

Nasal septum deviation can be considered as a risk factor for sinus diseases. Division of nasal septal deviation can be helpful in investigating the relationship between sinusitis and nasal septum deviation. A total of 118 patients who underwent maxillary and nasal radiography for various reasons were divided into seven groups in terms of nasal septum deviation and the relationship between septum deviation in each group was examined with sinusitis, concha bullosa, age and gender. According to the results, seven types of septum deviation were the most common (21.2%); 76 patients (64.4%) were female and 42 patients (35.6%) were male. The mean age of patients was 30.14 years; type III had the lowest (27.53 years) and type IV had the highest (36.30 years) mean age. A total of 21 patients (17.8%) had concha bullosa. The highest prevalence of concha bullosa was in type IV (38.1%) and 5 (23.8%) nasal septum deviation, respectively. A total of 20 patients (16.9%) had osteoma obstruction. Among these, the highest osteoma occlusion was observed in type VII (30%) and the lowest in type II (5%). Out of 118 patients, 59 (50%) had radiographic sinusitis. According to the results, most patients had type VII nasal septum deviation and no significant difference was observed between different genders in terms of nasal septum deviation. Considering the mean age of people in different types of septum deviation, the difference between age and septum deviation was not significant. According to the studies on concha bullosa, the results showed that there is no significant relationship between the prevalence of septum deviation variations based on the presence of concha bullosa. There was also no significant relationship between the prevalence of septum deviation and osteoma occlusion. There was no significant relationship between the prevalence of septum deviations based on sinusitis. There was no significant relationship between the side involved in sinusitis and the side of septum deviation. Finally, there was no significant relationship between the presence of concha bullosa and sinusitis.

Keywords: Nasal septum, concha bullosa, sinusitis.

Full length article*Corresponding Author*, e-mail: behnaz.baratvand@gmail.com

1. Introduction

Ostomyatal complex or ostomyatal unit is not a separate anatomical structure, but is a functional unit of structures including the middle meatus, the uncinate process, the infundibulum, the maxillary sinus foramen, the ethmoid bulla, and the anterior ethmoid sinus foramen and frontal recess [1]. The nasal septum is a bony-cartilaginous wall that divides the nasal cavity into two parts. This septum consists of bony parts: perpendicular plate of ethmoid bone from above, vomer bone from below and posterior, nasal process of maxilla from below, nasal process of palatine bone from below and posterior, anterior nasal spine of maxilla from anterior and below, and nasal process of frontal bone from anterior and above. The cartilaginous parts include septal cartilage and vomeronasal cartilage. In terms of septum function and orientation, they play a vital role in the nasal entrance pathway. Therefore, anatomical or acquired deformity can affect the nasal function [2]. Nasal septum deformities can be in the form of: 1] Septal processes or spurs: acute angles that are caused by connection of ethmoid septal cartilage from above and vomer bone from below and can occur with septum deviation or alone. 2] Deviations: deviation of the septum

from the midline, which can be local or related to the entire septum. These deviations can be c- or s-shaped, either vertically or horizontally, and can also involve bony or cartilaginous sections. Posterior deviations are usually associated with hypertrophy of the opposite turbinate and ethmoid bulla, but anterior deviations are usually associated with deviations of tip of the nose. 3] Relocation of the cartilage-vomer junction: the upper anterior edge of the vomer is in the form of a groove where the edge of the septal cartilage is jointed, and when this connection is severed, the lower edge of the septal cartilage deviates from the midline and grows towards one of the cavities. Relocation of the junction can be due to spurs [3].

Mladina classified septum deviations into 7 types: Type I] Mild anterior deviation in the vertical plane, which does not affect nasal function. It acts like an anterior ridge at the nose entrance and does not touch any of the walls [Figure 1]. Type II] Moderate anterior vertical deviation in relation to one of the lateral walls of the nose that affects the airway [Figure 2]. Type III] Posterior vertical deviation: a unilateral deviation near the tip of the middle concha that may be associated with the concha bullosa on the non-involved side [Figure 3]. Type IV] S-shaped septum deviation, which is one ridge near the middle concha and the other on the opposite side, affects the nasal function [Figure 4]. Type V] A ridge at the septum base that connects to the lateral nasal wall and is directly opposite [Figure 5]. Type VI] Similar to type 5 deviation, while on the opposite side, there is a groove in the septum [Figure 6]. Type VII] A combination of previous types [3]. Large nasal concha and concha bullosa may cause nasal congestion and prevent proper sinus drainage. The sinuses can lead to recurrent sinus infections if they are not drained in time. People with concha bullosa are more prone to nasal deviation. Symptoms of concha bullosa are associated with the amount of air in the middle tentacle. The larger the air volume, the more likely it is to have signs and symptoms, and the symptoms will be more severe [4].

Concha bullosa, which is one of the most common anatomical variations, often manifests itself as pneumatization within the bone of one of the turbinates [Concha], often the middle turbinate. This anatomical condition can be unilateral or bilateral [5]. View of concha bullosa types in CBCT axial views is shown in Figures 7, 8 and 9. Sinusitis is one of the most common diseases that affects 16% of the adult population annually. Sinusitis is an inflammation of one or more paranasal sinuses; there are three types: acute [less than four weeks], subacute [from 4 to 8 weeks], chronic [more than 8 weeks]. Imaging features of sinusitis include sinus mucosa thickening and sinus airway reduction due to accumulation of secretions and increased radiopacity. Evaluation of the areas around the osteoma shows thickening of the mucous tissues, which may cause the osteoma obstruction. It is also possible to observe the presence of an air-fluid surface due to the accumulation of secretions in the sinuses. Chronic sinusitis may lead to permanent radiopacity of sinuses and sclerosis, and thickening of the sinus bony walls due to periosteal stimulation [6]. Based on previous studies, some scientists have suggested a relationship between sinus diseases and nasal septum deviation [7].

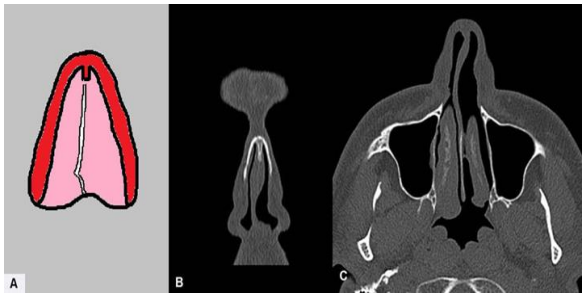

Figure 1: Type I septum deviation

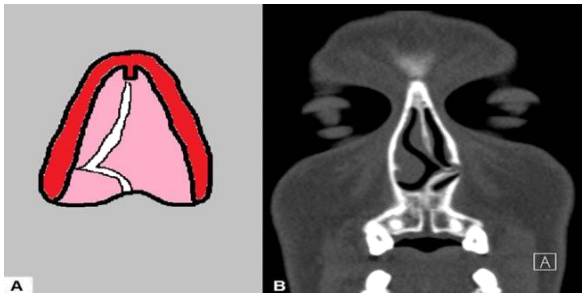

Figure 2: Type II septum deviation

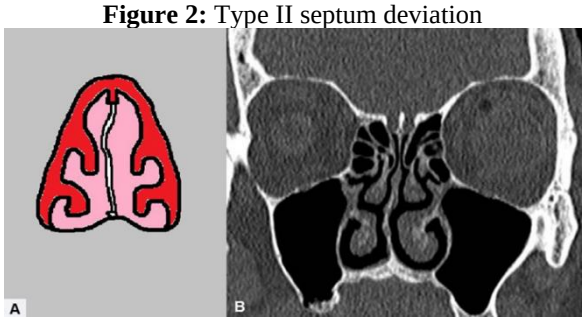

Figure 3: Type III septum deviation

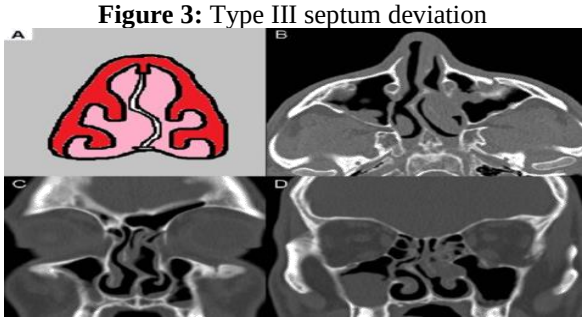

Figure 4: Type IV septum deviation

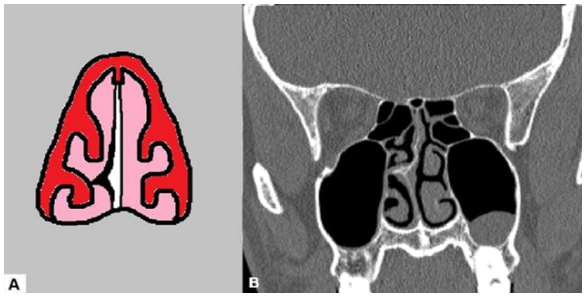

Figure 5: Type V septum deviation

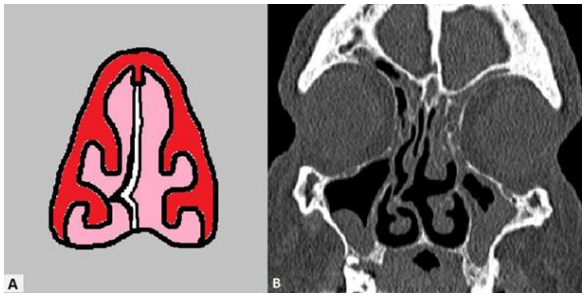

Figure 6: Type VI septum deviation

Figure 7: Bullous concha bullosa in CBCT coronal section

Figure 8: Lamellar concha bullosa in CBCT coronal section

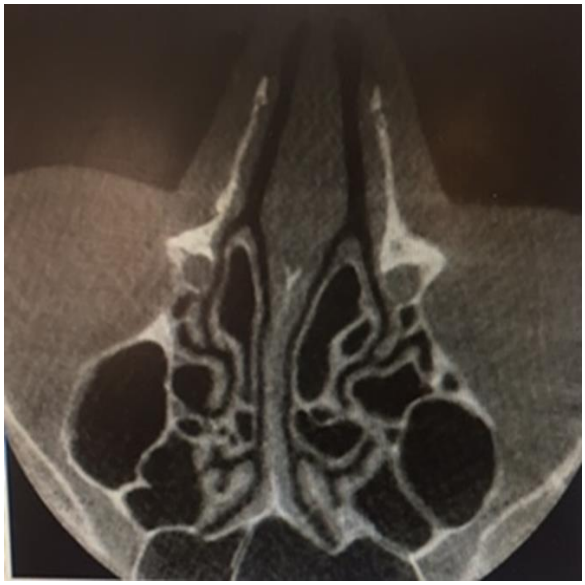

Figure 9: extensive concha bullosa in CBCT coronal section

Cone-beam computed tomography is a new technology that was first used in 1982 for angiography and later for maxillofacial imaging. This method uses an ionizing X-ray source in a divergent or cone shape and a fixed 2D detector on a rotating gantry to obtain multiple consecutive images in a complete scan around the desired area. During the rotation of the gantry, the image receiver records the X-ray attenuated by the patient. This recorded information consists of a series of raw images that are reconstructed by a computer algorithm to generate cross-sectional images whose pixel values correspond to a linear attenuation coefficient. Therefore, this study tends to investigate the prevalence of sinusitis in relation to various septum deviations in patients referred to Ahvaz Dentistry School.

2. Materials and methods

2.1. Procedure

This descriptive-analytical study was performed on 118 patients referred to the Department of Oral and Maxillofacial Radiology of Ahvaz Jundishapur Dentistry School in 2019 for cone-beam computed tomography for various reasons. All images were taken and stored by the device (New Tom VGI, QR, Verona Italy) with FOV = 11×8 and HIGH RESOLUTION and exposure conditions KVP = 90 with a time of 9 seconds.

Inclusion criteria included optimal image quality, available information of age and gender of patients, coverage of the anterior maxillary nasal cavity.

Patients with a history of midfacial surgery, pathology and trauma were excluded from the study. All images were evaluated by NNT viewer software (New Tom VGI, QR, Verona Italy) version 3.00 and by two maxillofacial radiologists on LENOVO, CHINA, 15 INCH monitors. To evaluate the morphology of the nasal septum and to evaluate the radiographic signs of sinusitis (sinus mucosa thickening, sinus airway reduction, increased radiopacity, visible presence of an air-fluid surface and thickening of the sinus bony walls), reconstructed coronal

and axial and quasi-panoramic images were obtained from volumetric information. Morphologically, nasal septum deviation was divided into the following seven types:

Type I: Mild deviation in the vertical plane without touching the nasal wall and without interfering with nasal function.

Type II: Moderate anterior deviation with a unilateral vertical ridge which affects the airway.

Type III: Posterior vertical deviation which can be related to concha bullosa and includes a unilateral deviation near the middle concha.

Type IV: S-shaped middle ridge which restricts the nasal function.

Type V: Unilateral septum deviation which touches one of the walls, while the other side is direct wall.

Type VI: Similar to type V, while there is a horizontal groove on the opposite side.

Type VII: A combination of previous types.

The patient information form was completed to evaluate clinical signs of sinusitis (nasal congestion, runny nose, face-toothache, posterior nasal discharge, headache and cough) under the supervision of an ENT specialist. All patient information including age, gender, type of septum deviation, clinical and radiographic signs of sinusitis were collected in an information form. Finally, it was referred to a statistical consultant for analysis and the data was analyzed using SPSS software version 22.

2.2. Sample Size

$$N = \frac{Z_1^2 - \alpha cc P(1-p)}{d^2}$$

$$Z_1 - \alpha cc = 1.96$$

where, P = 0.5 and D = 0.09.

$$N = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.09)^2} = 118$$

N = 118.

2.3. Statistical Analysis of Results

While using descriptive statistics such as mean and standard deviation and percentage and frequency distribution tables, Chi-square test was also used, which was all done by SPSS software version 22 [7].

3. Results and discussions

The present study tended to investigate the nasal septum morphology in cone-beam computed tomography images of patients referred to Ahvaz Dentistry School in 2019. For this purpose, a sample of 118 patients referred to the Department of Oral and Maxillofacial Radiology of the School of Dentistry was selected and the collected data was analyzed statistically, which will be discussed below.

3.1. Prevalence of Morphological Variations of Nasal Septum in CBCT Images

Table 1 reports the frequency distribution of morphological variations of nasal septum in CBCT images.

Table 1: Frequency distribution of morphological variations of nasal septum in CBCT images

variable	type	n	%
morphological variations of nasal septum	I	21	17.8
	II	4	3.4
	III	15	12.7
	IV	22	18.6
	V	21	17.8
	VI	10	8.5
	VII	25	21.2
	sum	118	100

As shown in Table 1, a total of 118 patients referred to the Department of Oral and Maxillofacial Radiology of the School of Dentistry were examined. Prevalence of morphological variations of nasal septum was 17.8% type I, 3.4% type II, 12.7% type III, 18.6% type IV, 17.8% type V, 8.5% type VI and 21.2% type VII. As shown in Diagram 1, the highest frequency was related to type VII and the lowest frequency was related to type II.

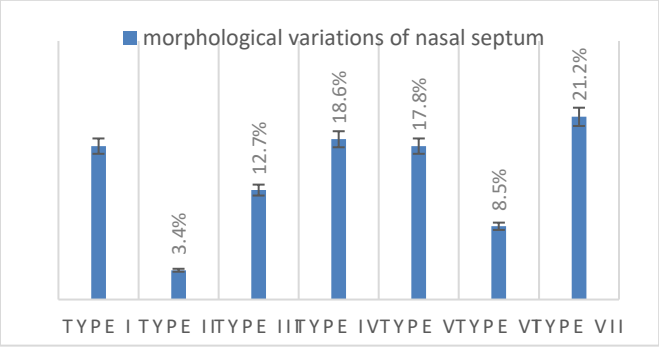

Diagram 1: Frequency of morphological variations of nasal septum in CBCT images

3.2. Prevalence of Morphological Variations of Nasal Septum in CBCT Images by Gender

Table 2 reports the frequency distribution of morphological variations of nasal septum in CBCT images by gender.

Table 2: Frequency distribution of morphological variations of nasal septum in CBCT images by gender

variable	type	female		male		sum		p-value
		n	%	n	%	n	%	
morphological variations of nasal septum	I	15	19.7	6	14.3	21	17.8	0.769
	II	3	3.9	1	2.4	4	3.4	
	III	9	11.8	6	14.3	15	12.7	
	IV	16	21.1	6	14.3	22	18.6	
	V	13	17.1	8	19.0	21	17.8	
	VI	7	9.2	3	7.1	10	8.5	
	VII	13	17.1	12	28.6	25	21.2	
	sum	76	100	42	100	118	100	

As shown in Table 2, out of 118 patients referred to the Department of Oral and Maxillofacial Radiology, 76 (64.4%) were female and 42 (35.6%) were male. In female patients, the prevalence of morphological variations of nasal septum was 19.87% type I, 3.9% type II, 11.8% type III, 21.1% type IV, 17.1% type V, 9.2% type VI and 17.1% type VII. Therefore, type IV had the highest prevalence and type II had the lowest prevalence in women. In male patients, the prevalence of morphological variations of nasal septum was 14.3% type I, 4.2% type II, 14.3% type III, 14.3% type IV, 19% type V, 7.1% type VI and 28.6% type VII. The results of Chi-square (Ch^2) test showed that there was no significant difference in prevalence of morphological variations of nasal septum in CBCT images between different genders (p = 0.769).

3.3. Prevalence of Morphological Variations of Nasal Septum in CBCT Images by Age

Table 3 reports the mean and standard deviation of age of patients in morphological variations of nasal septum. The mean and standard deviation of the whole sample was 30.14 (±9.35) years. As shown in Table 3, the mean age of patients in morphological variations of the nasal septum of type I was 28 years, type II was 30.50 years, type III was 27.53 years, type IV was 30.86 years, type V was 30.86 years, type VI was 36.30 years and type VII was 29.76 years. Because of normal distribution of patient age in different morphological variations of nasal septum based on Kolmogorov-Smirnov test (P<0.05) as well as equal variances of the variable age in different morphological variations of nasal septum based on Leven's test (P=0.131), one-way analysis of variance (ANOVA) was used to compare the age of patients in different morphological types of nasal septum. ANOVA results showed that there is no significant difference in morphological variations of nasal septum between means of patient age (P=0.333).

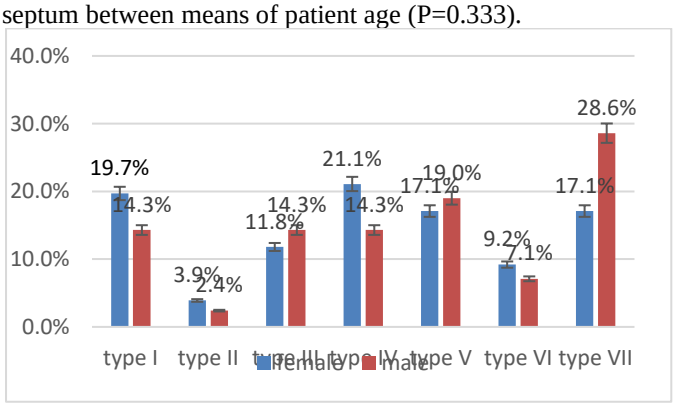

Diagram 2: Frequency of morphological variations of nasal septum in CBCT images by gender

Table 3: Mean and standard deviation of age of patients in morphological variations of nasal septum

variable	type I	type II	type III	type IV	type V	type VI	type VII	p-value
	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	
age (year)	28.00 ±8.97	30.50 ±0.87	27.53 ±7.37	30.86 ±6.19	30.86 ±9.88	36.30 ±13.46	29.76 ±10.49	0.333

note. M=Mean, SD=Std. Deviation

3.4. Prevalence of Sinusitis in People with Septum Deviation and Relationship with Septum Deviation Types

Table 4 reports the frequency distribution of morphological variations of nasal septum by prevalence of radiographic sinusitis.

Table 4: Frequency distribution of morphological variations of nasal septum by prevalence of radiographic sinusitis

variable	type	Radiographic sinusitis no		Radiographic sinusitis yes		sum		p-value
		n	%	n	%	n	%	
morphological variations of nasal septum	I	12	20.3	9	1.53	21	17.8	0.755
	II	1	1.7	3	5.1	4	3.4	
	III	7	11.9	8	13.6	15	12.7	
	IV	11	18.6	11	18.6	22	18.6	
	V	10	16.9	11	18.6	21	17.8	
	VI	7	11.9	3	5.1	10	8.5	
	VII	11	18.6	14	23.7	25	21.2	
	sum	59	100	59	100	118	100	

Out of 118 patients referred, 59 (50%) had radiographic sinusitis. As shown in Table 4, out of 59 patients who had positive radiographic sinusitis, 15.3% had morphological variations of type I nasal septum, 5.1% had type II, 13.6% had type III, 18.6% had type IV, 18.6% had type V, 5.1% had type VI and 23.7% had type VII. In other words, the highest prevalence was related to type VII and the lowest prevalence was related to types II and VI. Of 59 patients who did not have radiographic sinusitis, 20.3% had morphological variations of type I nasal septum, 1.7% had type II, 11.9% had type III, 18.6% had type IV, 16.9% had type V, 9 11.6% had type VI and 18.6% had type VII. The results of exact, Pearson, Chi-square (Ch^2) test showed that there was no significant difference in prevalence of morphological variations of nasal septum in CBCT images based on radiographic sinusitis (p = 0.755).

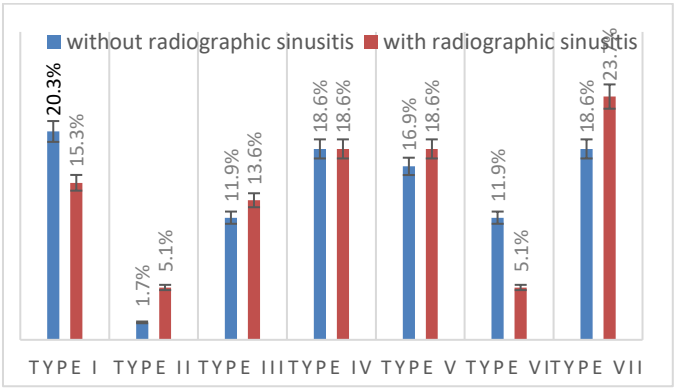

Diagram 3: Frequency of morphological variations of nasal septum by radiographic sinusitis

Table 5 reports frequency distribution of nasal septum deviation and the involved side of radiographic sinusitis.

Table 5: Frequency distribution of septum deviation side and the involved side of radiographic sinusitis

variable		radiographic sinusitis side						sum		p-value
		opposite side		same side		both sides				
		n	%	n	%	n	%	n	%	
septum deviation side	left	8	47.1	7	50	8	28.6	23	39	0.537
	right	8	47.1	5	35.7	15	53.6	28	47.5	
	both	1	5.9	2	14.3	5	17.9	8	13.5	
	sum	17	100	14	100	28	100	59	100	

A total of 59 patients had radiographic sinusitis, of which 17 (28.8%) had it on the opposite side of the involved area, 14 (23.7%) had it on the same side of the involved area, and 28 (47.5%) had it on both sides. Of these 59 patients with radiographic sinusitis, 6 (10.2%) did not have a deviated septum and the sinusitis did not result from septal deviation. Septum deviation was on the left in 23 people (39%), on the right in 28 people (47.5%) and on both sides in 8 people (13.5%). As shown in Table 5, out of 17 cases of radiographic sinusitis on the opposite side of the involved area, septum deviation was on the left side in 8 cases (47.1%), on the right side in 8 cases (47.1%) and on both sides in 1 case (5.9%). Out of 14 cases of radiographic sinusitis on the same side of the involved area, septum deviation was on the left side in 7 cases (50%), on the right side in 5 cases (35.7%) and on both sides in 2 case (14.2%). Out of 28 cases of radiographic sinusitis on both sides, septum deviation was on the left side in 8 cases (28.6%), on the right side in 15 cases (53.6%) and on both sides in 5 cases (17.9%). The results of exact, Pearson, Chi-square (Ch^2) test showed that there was no significant difference between septum deviation side and the involved side of radiographic sinusitis (p = 0.537).

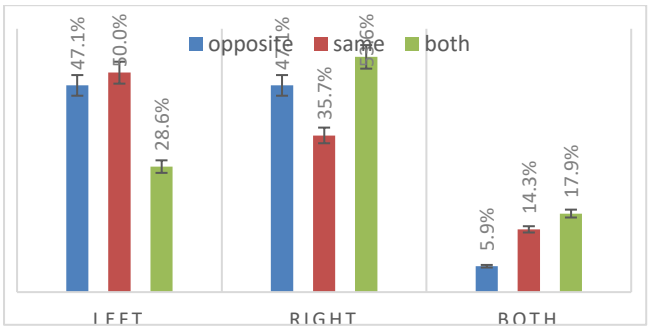

Diagram 4: Frequency of septum deviation side and the involved side of radiographic sinusitis

3.5. Relationship between Presence of Concha Bullosa and Sinusitis

Table 6 reports the frequency distribution of concha bullosa based on sinusitis.

Table 6: Frequency distribution of concha bullosa based on sinusitis

variable		concha bullosa				sum		p-value
		no		yes				
		n	%	n	%	n	%	
Clinical sinusitis	no	76	78.4	19	90.5	95	80.5	0.244
	yes	21	21.6	2	9.5	23	19.5	
Radiographic sinusitis	no	48	52.4	11	52.4	59	50	0.810
	yes	49	47.6	10	47.6	59	50	
	sum	97	100	21	100	118	100	

As shown in Table 6, 23 (19.5%) out of 118 patients who referred had clinical sinusitis and 59 (50%) out of these 118 had radiographic sinusitis. Out of 97 patients who did not have concha bullosa, 21.6% had clinical sinusitis and 9.5% out of 21 patients who had concha bullosa had clinical sinusitis. The results of Pearson, exact, Chi-square (Ch2) test showed that there was no significant difference between the presence of concha bullosa and clinical sinusitis (p = 0.244). Out of 97 patients who did not have concha bullosa, 47.6% had radiographic sinusitis and 47.6% out of 21 patients who had concha bullosa had radiographic sinusitis. The results of Chi-square (Ch^2) test showed that there was no significant difference between the presence of concha bullosa and radiographic sinusitis (p = 0.810).

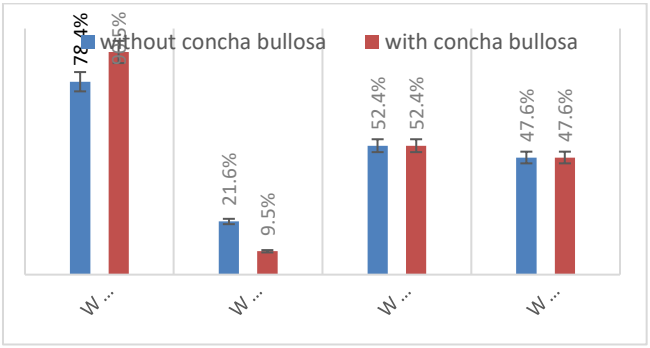

Diagram 5: Frequency of the presence of concha bullosa based on sinusitis

This study tended to examine different types of nasal septum deviation and its relationship with sinusitis. Based on the results obtained in this study, it was found that there is no significant relationship between the presence of sinusitis and different types of nasal septum deviation. Since many sub-objectives were examined in this study, we will discuss each of them in detail below. In our study, unlike similar studies that examined the presence of chronic sinusitis and its association with septum deviation, the presence of radiographic sinusitis and clinical sinusitis were examined separately with septum deviation.

Aktas et al. examined 54 patients with concha bullosa and concluded that there was a significant relationship between unilateral concha bullosa and nasal septum deviation, while the same study found that the relationship between unilateral and bilateral concha bullosa and sinusitis as well as the relationship between bilateral concha bullosa and nasal septum deviation was not significant. The results of this study were consistent with our study in terms of the relationship between concha bullosa and sinusitis, but not in terms of the relationship between concha bullosa and septum deviation. The reason for this inconsistency can be attributed to multifactorial nature of sinusitis or to the choice of statistical population that Aktas selected all patients from those with concha bullosa [8]. In a study conducted by Shoib, 200 patients were examined, all of whom had nasal septum deviation as well as chronic sinusitis; this study tended to investigate the relationship between symptomatic nasal septum deviation and sinusitis. Finally, they concluded that the prevalence of nasal septum deviation was higher in men than in women (2:1). They also concluded that C-shaped nasal septum deviation was the most common type of deviation, which was associated with unilateral maxillary sinusitis in 40% of cases and bilateral sinusitis in 27.5% of cases. In S-shaped septum deviation, 25% of patients were associated with bilateral sinusitis. The final result was that there was a significant relationship between nasal septum deviation and the presence of chronic sinusitis. The results of this study were not consistent with our study, because the statistical population of our study was randomly selected, but Shoib studied the patients with sinusitis and septum deviation, and this could explain the difference between the prevalence of sinusitis in men and women. Shoib also classified septum deviation into two general forms, S and C, while in our study, septum deviation was classified into 7 groups; thus, the results were not consistent [9,10]. In the most similar study to ours, Rao studied 100 patients who were recommended septum surgery and compared them to 100 controls. As in our study, this study used the MLADINA classification; but because most people were in group VII of this classification, changes were made to the classification, in which case they considered the dominant deviation. Rao concluded that the highest rate of horizontal deviation was in types V and VI (63%) in people recommended for surgery and the lowest in people with type I (2%), while, in the control group, the highest septum deviations were in types I, II and III, respectively, and only 17% of the control group had types V and VI and 59% were type I. As Rao reported, 16 out of 20 people with concha bullosa had horizontal septum deviation, while in our study, types V, VI and VII were seen in 10 out of 21 people. Rao concluded that types III to VII, which are deviations in the posterior septum, play a greater role in sinus diseased than types I and II, which are anterior segment problems. In our study, 18 out of 23 people who had clinical sinusitis and 47 out of 59 people who had radiographic sinusitis were people with deviation problems in the posterior septum, and therefore the results of our study and Rao were consistent [10, 11]. In his study, Smith did not find any definite relationship between nasal septum deviation and increased maxillary sinusitis, which was consistent with our results [12, 13]. Sumaily examined the relationship between nasal septum deviation and pathology of paranasal sinuses. He examined 238 patients, 104 of whom had sinus problems. There was no difference between different genders, which was consistent with our study, and finally he concluded that there is no significant relationship between nasal septum deviation and sinusitis, which was also consistent with our study [14,15].

4. Conclusions

Our analyses showed that most of the patients had type VII nasal septum deviation (a combination of different types) and no significant difference was observed between different genders in terms of nasal septum deviation. Considering the mean age of people in different types of septum deviation, the difference between age and septum deviation was not significant. According to the studies on concha bullosa, the results showed that there is no significant relationship in prevalence of septum deviations based on the presence of concha bullosa. There was also no significant relationship between the prevalence of septum deviation and osteoma obstruction. In the study of the prevalence of mucosal thickening and age in different types of septum deviation, the amount of mucosal thickening increased with age only in type VII septum deviation. There was no significant relationship between the prevalence of septum deviations based on clinical sinusitis. No significant relationship was also found regarding radiographic sinusitis. There was no significant relationship between the side involved in clinical sinusitis and the septum deviation side. This result was also not significant in radiographic sinusitis. Finally, there was no significant relationship between the presence of concha bullosa and clinical and radiographic sinusitis.

References

[1] P.M. Som, H.D. Curtin. (2011). Head and Neck Imaging, St. Louis, ELSEVIER. Fifth edition.

[2] L.P. Gray. (1978). Deviated nasal septum incidence and etiology. Annals of Otology, Rhinology & Laryngology. May; 87(3_suppl2):3-20.

[3] V.F. Carrasco. (2015). Nasal septum anatomy and deviations: beyond straight and flat. European Congress of Radiology.

[4] Y. Toplu, T. Bayindir, E. Karatas, M. Akarcay. (2013). All concha bullosa: an undefined abnormality of the lateral nasal wall. Indian J Otolaryngol Head Neck Surg;65(1):86–88. doi:10.1007/s12070-012-0592-8

[5] V. Budu, A. Schnider, M.S. Tache, I. Bulescu. (2015). Evaluation of ostiomeatal complex pathology related to endoscopic sinus surgery–a retrospective analysis. Romanian J Rhinol;5(18):2393-3356.

[6] S.C. Whites, M.J. Pharoah. (2000). Oral radiology principle and interpretation. 4th Ed. St Louis: 521-521.

[7] L.F. Grymer, O.F. Pedersen, O.Hilberg, O.E lbrønd. (1989). Acoustic rhinometry: evaluation of the nasal cavity with septal deviations, before and after septoplasty. The Laryngoscope. Nov; 99(11):1180-7.

[8] D. Aktas, M.T. Kalcioglu, R. Kutlu, O. Ozturan, S. Oncel. (2003). the relationship between the concha bullosa, nasal septal deviation and sinusitis. Rhinology. Jun;41(2):103-6.

[9] S.M. Shoib, B. Viswanatha. (2016). Association between symptomatic deviated nasal septum and sinusitis: a prospective study. Res Otolaryngol;5(1):1-8.

[10] J.J. Rao, E.V. Kumar, K.R. Babu, V.S. Chowdary, J. Singh, S.V. Rangamani. (2005). Classification of nasal septal deviations—relation to sinonasal pathology. Indian journal of otolaryngology and head and neck surgery. Jul 1;57(3):199-201.

[11] K. Smith, P. Edwards, T. Saini, N. Norton. (2010). The Prevalence of Concha Bullosa and Nasal Septal Deviation and Their Relationship to Maxillary Sinusitis by Volumetric Tomography. International Journal of Dentistry. 2010: 404982.

[12] I. Sumaily, J. Hudise, S. Aldhabaan. (2017). Relation between deviated nasal septum and paranasal sinus pathology. International Journal of Otorhinolaryngology and Head and Neck Surgery. Oct;3(4):786.

[13] I. Dhiman, A. Singla, V. Mahajan, H. Singh Jaj, V. Seth, P. Negi. (2015). Reliability of frontal sinus with that of maxillary sinus in assessment of different types of skeletal malocclusions. Journal of Indian Orthodontic Society; 49 (2): 96-103.

[14] S. Yassaei, A. Emami, S. Mirbeigi. (2018). Cephalometric association of mandibular size/length to the surface area and dimensions of the frontal and maxillary sinuses;12 (2): 253-261.

[15] I. Dhiman, A. Singla, V. Mahajan, H. Singh Jaj, V. Seth, P. Negi. (2015). Reliability of frontal sinus with that of maxillary sinus in assessment of different types of skeletal malocclusions. Journal of Indian Orthodontic Society; 49 (2): 96-103.