

# CT of Anatomic Variants of Sinonasal region and its correlation with symptoms of Rhinosinusitis

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## ABSTRACT

**Background:** Sinonasal region is subjected to wide anatomical variation. The paranasal sinuses (PNS) create a connection with nasal cavity. They are placed in close proximity to nose. The four paranasalsinuses ;maxillary, ethmoid, sphenoid, and frontal, are named after their coinciding bone. Computed Tomography (CT Scan )is important modality to describe the location of these paranasal sinuses.

**Aim:** To ascertain the frequency of various anatomic variants of sinonasal region in population of Sahiwaland itsassociation with symptoms of rhinosinusitis.

**Methods:** This descriptive cross sectional study was conducted in Sahiwal Teaching Hospital from 10th June 2022 – 10th December 2022, with collaboration of Radiology and otorhinolaryngeology Departments. 60 symptomatic subjects between 18-60 years of age, irrespective of gender with rhinosinusitiswere taken.They underwent CT Scan of paranasal sinuses. The findings of CT Scan related to nasal-septum, turbinates, uncinat process, ethmoid air-cells and other anatomical variants corresponded with symptoms of rhinosinusitis. The data was analyzed using SPSS version 23.0. Frequency, percentages and p-value of different variants were calculated. The p-value of  $\leq 0.05$  was considered as significant.

**Results:** Our study showed 63.3% males and 36.7% females. The mean age of our subjects was  $30.65 + 12.7$  years. The most frequently seen anatomical variants in our population were nasal septum deviation (86.7%) followed by aggnasi cells (68.3%) and asymmetry of both sides of sphenoid sinuses (68.3%). The statically significant association was noted between concha bullosa of middle turbinate and nasal obstruction ( p-value 0.001) and between rhinorrhea and asymmetry of both sides of sphenoid sinus ( p-value 0.035)

**Practical Implications & Conclusion:** We concluded from our study that that however there is no significant association between rhinosinusitis and most of the anatomic variants of sinonasal region except concha bullosa of middle turbinate and asymmetry of both sides of sphenoid sinus. But to avoid operative complexities, a surgeon must be well aware of these diverse variants.

**Keywords:** Anatomical variations, CT-scan, Rhinosinusitis

## INTRODUCTION

The paranasal sinuses(PNS) form a connection with nasal cavity. They are placed close to the nose. The four paranasal sinuses; maxillary, ethmoid, sphenoid, and frontal, are named after their coinciding bones<sup>1</sup>. They are thought to perform various functions like lessen the weight of the head, act as cushion against facial contusion, enhance vocal resonance and modify the inhaled air<sup>2</sup>.

Some usually seen variants of PNS are deviation of nasal septum (DNS), aggnasi cells, variants of uncinat process, paradoxical middle turbinate and ethmoidal air sinuses ( hallar and onodi cells). Some other variants include hypoplastic frontal sinus, maxillary septa and asymmetry of sphenoid sinus<sup>3</sup>.

These anatomical variants are associated with restrictedflow of sinuses as they create a hindrance in routine drainage. These variants also impair the ability of sinuses to airify properly which is essential for preservation of well-being of nasal mucosa, resulting in collection of fluid in the paranasal sinuses and mucosal thickening<sup>4</sup>. As a consequence, patients experience frequent rhinosinusitis.

To describe the location of these paranasal sinuses and extent of their involvement in rhinosinusitis, radiological assessment plays a pivotal role. Computed Tomography (CT Scan) is thought to be the imaging modality of choice in this regard<sup>5</sup>. As these variants are found to be associated with varying degree ofrhinosinusitis, their detailed description on CT Scan is beneficial for the clinician to make accurate diagnosis<sup>6</sup>.

We planned this study to ascertain the extent and association of various anatomic variants of sinonasal region with symptoms of rhinosinusitis in patients presenting to Sahiwal Teaching Hospital, Sahiwal.

## MATERIALS AND METHODS

After taking approval from Institutional review board of the institute, this descriptive cross sectional study was carried out from 10th June 2022 to 10th December 2022, in collaboration with Radiology and otorhinolaryngeology Departments of Sahiwal Teaching Hospital. Sixty symptomatic subjects of rhinosinusitis, irrespective of their gender, having complaints of nasal obstruction, facial pain and rhinorrhea, referred from otorhinolayngeology Department to Radiology Department of Sahiwal Teaching Hospital were included in the study. After taking history and informed consent, their CT Scan of paranasal sinuses was done and evaluated for anatomical variants of paranasal sinuses. Subjects between 18-60 years of age, suffering from nasal obstruction, facial pain and rhinorrhea, having mucosal thickening of greater than 1 mm on CT scan were included in the study. Subjects younger than 18 years or older than 60 years, mucosal thickening of less than 1 mm on CT scan, pregnant females, those with history of facial trauma, fungal sinusitis, sinonasal polyps or malignancy were excluded from the study. Data was analyzed using SPSS version 23.0. Mean and standard deviations were calculated for quantitative variables like age. Frequency and percentages were calculated for thequalitative variables (gender, symptoms and anatomical variants of paranasal sinuses). Association of anatomical variants of paranasal sinuses with symptoms of rhinosinusitis was studied by analyzing p-value calculated by fisher exact test and chi-square Test. The p-value of  $\leq 0.05$ was taken as significant.

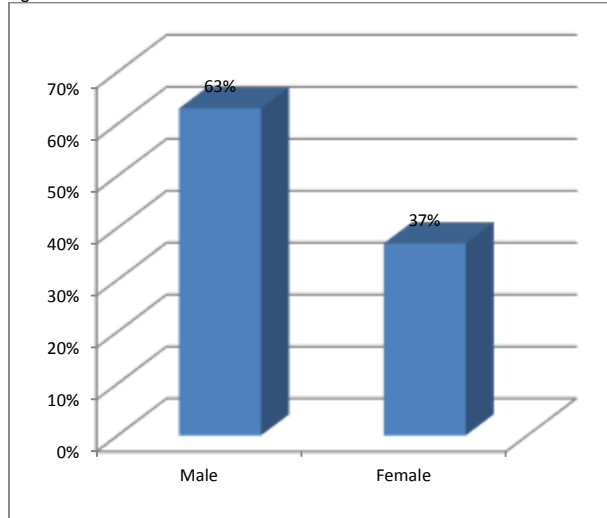
## RESULTS

The results of our study showed 63.3 % males and 36.7% females (Fig.1). The mean age of our subjects was  $30.65 + 12.7$  years.

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Fig. 1. Gender Distribution



The most frequently seen anatomical variants in our population was nasal septum deviation (86.7%) followed by agger nasi cells (68.3%) and asymmetry of both sides of sphenoid sinus (68.3%). The most frequent sinusitis seen in our population was maxillary sinusitis (81.7%) followed by ethmoid (71.7%) and frontal (30.0%) (Table 1).

The statically significant association was noted between concha bullosa of middle turbinate and nasal obstruction (p-value 0.001) and between rhinorrhea and asymmetry of both sides of sphenoid sinus ( p-value 0.035) (Table 2).

Table 1: Frequency of Anatomic Variants of Sinonasal Region

Variables	Groups	Frequency	%age
Nasal Obstruction	No	17	28.3
	Yes	43	71.7
Facial Pain	No	59	98.3
	Yes	1	1.7
Rhinorrhea	No	34	56.7
	Yes	26	43.3
Septal Deviation	No	8	13.3
	Yes	52	86.7
Septal Bony Spur	No	24	40
	Yes	36	60
Superior Concha Bullosa	No	58	96.7
	Yes	2	3.3
Middle Concha Bullosa	No	43	71.7
	Yes	17	28.3
Paradoxical Middle Concha	No	48	80.0
	Yes	12	20.0
AggerNasi cells	No	19	31.7
	Yes	41	68.3
Haller cells	No	47	78.3
	Yes	13	21.7
Onodi cells	No	53	88.3
	Yes	7	11.7
Maxillary Septa	No	50	83.3
	Yes	10	16.7
Hypoplastic Frontal Sinus	No	51	85.0
	Yes	9	15.0
Asymmetry of Both Sides of Sphenoid Sinus	No	19	31.7
	Yes	41	68.3
Maxillary Sinusitis	No	11	18.3
	Yes	49	81.7
Ethmoid Sinusitis	No	17	28.3
	Yes	43	71.7
Frontal Sinusitis	No	42	70.0
	Yes	18	30.0

Table 2: Association between anatomic variants of sinonasal region and symptoms of rhinosinusitis

Variables	Groups	Nasal obstruction		Facial Pain		Rhinorrhea	
		Percentage	P- value	Percentage	P- value	Percentage	P- value
Gender	Female	68.2%	0.649	0.0%	0.633*	36.4%	0.407
	Male	73.7%		2.6%		47.4%	
Septal Deviation	No	62.5%	0.405*	0.0%	0.867*	37.5%	0.515*
	Yes	73.1%		1.9%		44.2%	
Septal Bony Spur	No	58.3%	0.061	4.2%	0.400*	50.0%	0.395
	Yes	80.6%		0.0%		38.9%	
Superior CB	No	74.1%	0.077*	1.7%	0.967*	44.8%	0.317*
	Yes	0.0%		0.0%		0.0%	
Middle CB	No	83.7%	0.001	2.3%	0.717*	44.2%	0.832
	Yes	41.2%		0.0%		41.2%	
Pradoximal Middle Concha	No	72.9%	0.459*	2.1%	0.800*	43.8%	0.896
	Yes	66.7%		0.0%		41.7%	
AggerNasi cells	No	73.7%	0.813	5.3%	0.317*	42.1%	0.896
	Yes	70.7%		0.0%		43.9	
Haller cells	No	74.5%	0.360	2.1%	0.783*	44.7%	0.689
	Yes	61.5%		0.0%		38.5%	
Onodi cells	No	67.9%	0.083*	1.9%	0.883*	43.4%	0.651*
	Yes	100.0%		0.0%		42.9%	
Maxillary Septa	No	70.0%	0.414*	2.0%	0.833*	48.0%	0.098*
	Yes	80.0%		0.0%		20.0%	
HypoPlastic Frontal Sinus	No	76.5%	0.063*	0.0%	0.150*	43.1%	0.610*
	Yes	44.4%		11.1%		44.4%	
Assymetry of Both Sides of Sphenoid Sinus	No	84.2%	0.122*	0.0%	0.683*	63.2%	0.035
	Yes	65.9%		2.4%		34.1%	

\*p-value calculated by Fisher Exact test

Rest of the p-values are calculated by Chi-Square Test

## DISCUSSION

Existence of variants of sinonasal region and adjacent vital structures emphasize the importance of detailed knowledge of these variants for a surgeon. Our study demonstrated nasal septum deviation as the most commonly seen variant in our population (86.7%) followed by agger nasi cells (68.3%) and asymmetry of both sides of sphenoid sinus (68.3%). A Pakistani study conducted in Karachi showed some variation in frequency of these variants, most frequent anatomic variant to be agger nasi cells (64%) followed by deviated nasal septum (56%), and concha bullosa (46%)<sup>7</sup>.

A study conducted by Bora, A. et al also showed septal deviation to be most frequently seen variant (79.7%)<sup>8</sup>. According to a study by Gruszka, K et al, anatomic variants of sinonasal region are subjected to genetic and environmental influences. The most frequent variant seen in Polish population was septal deviation while in Turkish population, it was agger nasi cells<sup>9</sup>.

Our study found that maxillary sinusitis is most prevalent in our population followed by ethmoidal and frontal. These findings are also supported in a study by Alsaggaf ZH et al<sup>10</sup>.

As far as the association of sinonasal variants with symptoms of rhinosinusitis is concerned, in our study, only the statically significant association was noted between concha bullosa of middle turbinate and nasal obstruction (p-value 0.001) and between rhinorrhea and asymmetry of both sides of sphenoid sinus (p-value 0.035). A study by Gruszka, K. et al. showed only statically significant association between symptoms of sinusitis with closed osteomeatal complex and concha bullosa (P=0.001 and 0.01 respectively), while the association between other variants and rhinosinusitis remained statistically non-significant<sup>11</sup>.

While no association between sinonasal variants with symptoms of rhinosinusitis was found in a study conducted by Pereira DA et al<sup>12</sup>

Small sample size is one of the limitations of our study. Moreover, we could not address genetic and environmental factors of our patients which is also important factor in relation to these variants. So, more studies covering these aspects and inculcating large sample size are required for more detailed analysis.

## CONCLUSION

Our study concluded that there is no significant association between symptoms of rhinosinusitis and most of the anatomic variants of sinonasal region except concha bullosa of middle turbinate and asymmetry of both sides of sphenoid sinus. However detailed knowledge of these variants is vital for a surgeon to avoid per-operative and post-operative complexities.

**Conflict of Interest:** Nil

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