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Radiological Evaluation of Inferior Turbinate in Patients with Deviated Nasal Septum using Computed Tomography

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ABSTRACT

Introduction: Compensatory hypertrophy of inferior turbinate in the contralateral side of the deviated nasal septum is a known phenomenon. The objective of this study was to establish the relationship between the nasal septum and inferior turbinate and to determine the dimension and composition of inferior turbinate hypertrophy.

Methods: This prospective, cross-sectional study was performed on 52 patients who were referred for Computed tomography of PNS with deviated nasal septum having compensatory hypertrophy of contralateral inferior turbinate. Non-hypertrophied inferior turbinate on the side of deviation was taken as a control group. Deviation angle, mucosal thickness including medial and lateral and bone thickness were evaluated using three-dimensional CT scan and compared to the control group.

Result: Dimensions of the bony and mucosal components of the inferior turbinate were significantly greater than those of the control group. This study included 52 patients (M- 30, F- 22) having a mean age of 37 years. Out of 52, the septum deviated to the left side in 56% and 44% to the right side. The average angle of deviation was 10.12°. There was a statistically significant correlation ($p<0.05$) between total turbinate thickness and angle of deviation. A statistically significant correlation ($p<0.05$) was also observed between medial mucosa and bone thickness.

Conclusion: Compensatory hypertrophy of inferior turbinate in patients with deviated nasal septum not only involves the mucosal component but also the bone itself. Pre-operative CT scan of PNS helps evaluate dimension and composition of inferior turbinate and assists to decide on surgical technique to fix turbinate.

Keywords: *Computed Tomography; Hypertrophy; Septal Deviation; Turbinate*

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INTRODUCTION

A significant proportion of the population has a nasal septal deviation of varying degrees.[1]

Nasal septal deviation (DNS) plays a critical role in nasal obstruction symptoms, the aesthetic look of the nose, increased nasal resistance and occasionally snoring.[2] In patients with nasal obstruction and anterior septal deviations to one side, a common finding is a varying degree of concomitant or compensatory inferior turbinate hypertrophy in the side of the nose opposite the major septal deviation.[3] This is a counterbalanced mechanism characterized by compensatory hypertrophy of the inferior turbinate (IT), which protects the more patent nasal side from the drying and crusting effects of excess airflow.[4] Of the three turbinates, the inferior turbinate is the most susceptible to enlargement. Enlargement of the erectile mucosa of the inferior turbinate significantly increases nasal airway resistance, contributing greatly to symptoms of nasal airway obstruction.[5] Septoplasty is often performed as the only procedure in patients with nasal obstruction and septum deviation however some authors suggest concomitant surgery of hypertrophied inferior turbinate during septoplasty as the failure rate of septoplasty operation in patients with nasal obstruction is 30%. However, the indications for turbinectomy are still not clear and can vary widely among different ENT surgeons. This is partly caused by the fact that the criteria in the definition of turbinate hypertrophy are based on anterior rhinoscopy, which is a subjective evaluation.[6] Failure to reduce the size of the turbinate at the time of septal reconstruction may result in persistent nasal obstruction.[7]

Thus, this study aims to evaluate the dimensions of compensatory inferior turbinate hypertrophy caused by septum deviation and septal deviation angle with the help of three-dimensional computed tomography (CT) and to aid otorhinolaryngologists to decide whether to add turbinectomy with conventional septoplasty.

METHODS

This prospective, cross-sectional study was performed in patients complaining of nasal obstruction having deviated nasal septum with compensatory hypertrophy. Patients complaining of nasal obstruction having deviated nasal septum with compensatory hypertrophy of inferior turbinate of the contralateral side who underwent CT PNS at our institution between July 2019 to June 2020 were analyzed. The study group consisted of 52 patients. Institutional review committee approval was obtained.

The aim was to identify a group of patients with a unilateral septal deviation and a contralateral hypertrophied inferior turbinate who were willing to be evaluated.

Inclusion criteria:

Age >16years, no previous Sinonasal pathology, not taking decongestant at the time or before CT scan.

Exclusion criteria:

Previous maxillofacial trauma, benign/ malignant PNS tumour, sinonasal polyps, congenital PNS abnormality, Acute/ Chronic sinusitis, S type deviation, previous surgery. All patients were evaluated by GE Revolution Evo 128 slice CT scan (120KV/ 200mA / 34.2x24.5cm FOV / collimation 0.6). 5mm slice thickness images were reformatted and reconstructed in the coronal section in the workstation and measurements were taken. Measurements include septal deviation angle, contralateral inferior turbinate hypertrophy with separate measurements of medial, lateral mucosa and conchal bone thickness. Also, the length of the hypertrophied turbinate was taken and divided into anterior, mid and posterior segments.

For septal deviation angle measurement

Deviation angle was the angle between 2 lines, the first line was drawn from the maxillary spine to crista galli and the second line from crista galli to the most prominent point of the nasal septum. (Figure 1)

For inferior turbinate hypertrophy

Total turbinate thickness was measured along

with widest lateral and medial diameter was measured. The maximum width of the inferior turbinate bone was also measured. (Figure 1)

For determining the thickest portion of the turbinate

The lengths of the anterior, middle and posterior portions of the turbinate were determined by dividing the total length by 3. The thickest site in each portion of the turbinate was selected for measurement. (Figure 2)

For accurate measurements, all the images were magnified. Non-hypertrophied inferior turbinate on the opposite side (deviated side) was taken as control.

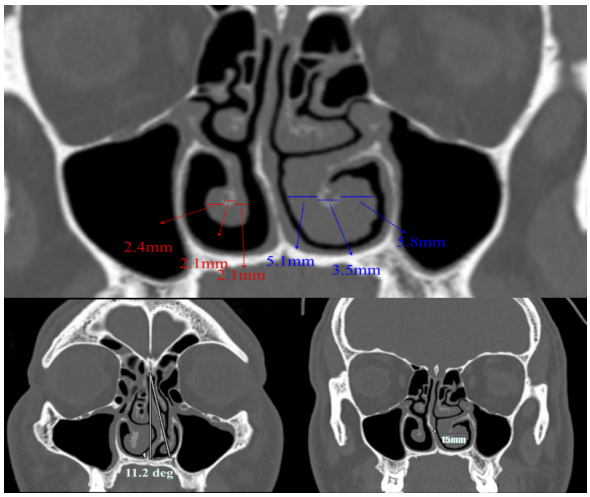

Figure 1: *Coronal computed tomography section through the anterior portion of inferior turbinate showing measurement of medial, lateral mucosal thickness and bone thickness (top), measurement of septal deviation angle (bottom right) and total turbinate hypertrophy (bottom left)*

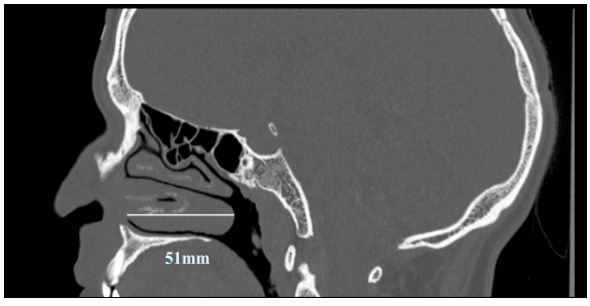

Figure 2: *Sagittal computed tomography section showing measurement of the length of hypertrophied left inferior turbinate*

Statistical analysis

The statistical analysis was done using a statistical package for the social sciences (SPSS). Mean, standard deviation, minimum and maximum were calculated and the values were compared by paired samples t-tests. A probability value (p-value) of less than 0.05 was considered significant.

RESULTS

The total number of patients included was 52 out of which 30 were male (57.7%) and 22 were female (42.3%). They were between 17 to 66years of age (mean age 37.01 ± 12.68years). The nasal septum was deviated to the right in 23 patients (44%) and to the left in 29 (56%). (Figure 3)

The average deviation angle (both right and left) was 10.12 ± 2.48° (4.9-19.6°). There was a positive statistically significant correlation ($p < 0.05$) between deviation angle and the total thickness of turbinate. (Figure 4)

The average length of the hypertrophied turbinate was 4.95 ± 0.36cm and in most cases, the posterior mucosal component was thicker than the anterior and mid segments. The posterior segment was prominent in 32 patients (62%), mid in 7(13%) and anterior in 13(25%) patients. (Figure 5)

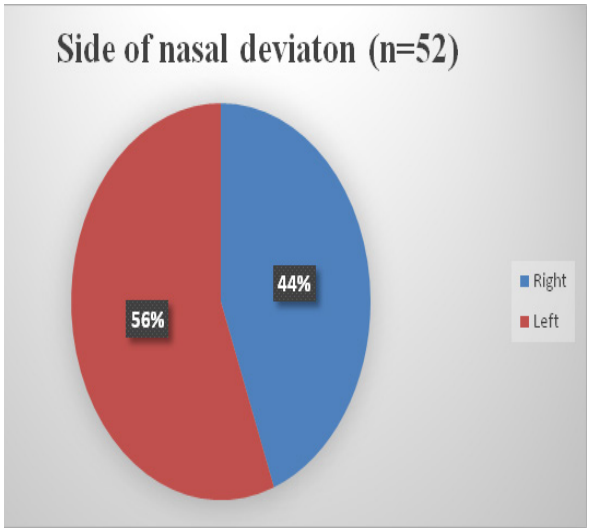

Figure 3: *Pie chart showing the side of nasal septum deviation*

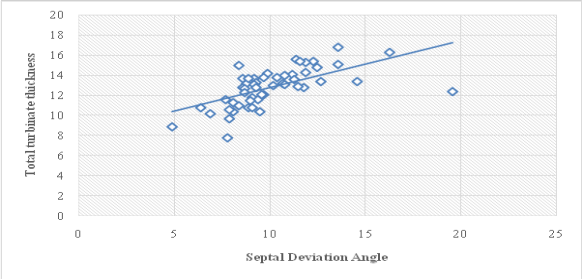

Figure 4: *Relationship between deviation angle and total turbinate thickness of the hypertrophic group*

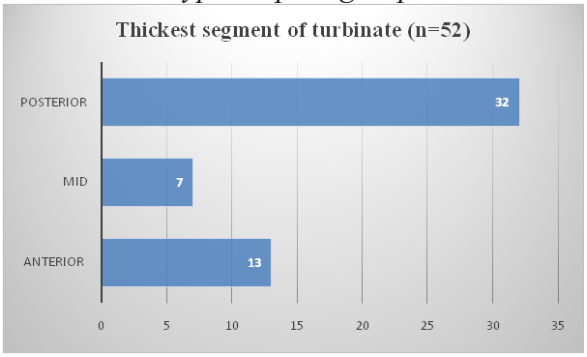

Figure 5: *Bar graph showing the number of patients with the most prominent anterior; mid; or posterior segment*

The inferior turbinate measurements taken were total mucosal thickening, bone thickness, medial mucosal thickness, and lateral mucosal thickness and were statistically analyzed. Significant differences between control and hypertrophic groups were noted. (Table. 1)

Table 1: Measurement of inferior turbinate medial mucosa, lateral mucosa and bone in control and hypertrophic group

	Hypertrophic Group Mean ± SD	Control group Mean ± SD	p-value	t
Medial mucosa	5.7±0.79	4.04±0.94	<0.05	14.93
Lateral mucosa	4.74±1.04	3.76±0.79	0.168	5.95
Bone	2.74±0.46	2.2±0.55	<0.05	7.49
Paired sample t-Test; p-value < 0.05				

Although there was a positive correlation between lateral mucosal thickening between the groups, this correlation was not statistically significant ($p > 0.05$). However, a positive correlation between medial mucosal thickening and bone thickness were found to be statistically significant in compensatory hypertrophic groups. ($p < 0.05$). These results imply there was an eminent increase in medial mucosal and bone thickness of the inferior turbinate contralateral to the side of septal deviation as compared with the other side. Bone thickness was most prominent in the middle segment whereas the mucosal thickness was prominent in the posterior.

DISCUSSION

The inferior turbinate is composed of highly vascularized erectile soft tissue surrounding a central bone. They are the largest of all turbinates and play an important role in breathing along with humidification and filtering inhaled air. When the nasal septum deviates, compensatory hypertrophy of inferior turbinate to fill the excess space in the contralateral nasal cavity is a known phenomenon.[8]

Inferior turbinate hypertrophy can be seen in several conditions that are influenced by inflammatory processes, environmental or physiological conditions. Although this swelling is mostly reversible, inferior turbinate enlargement may sometimes persist, e.g., as allergic rhinitis or compensatory hypertrophy in septal deviations.[9,10]

This study showed the dimensions of the compensatory hypertrophy of the IT including medial, lateral mucosa and bone width and its relative contribution to its overall size. Medial mucosa was thicker than bone and lateral mucosa in the majority of the cases.

Many authors have agreed that septal deviation along with IT hypertrophy contributes to nasal obstruction and intervention of inferior turbinate is suggested during septal surgery. In a study conducted by Hilberg et al., the success rate of septoplasty and turbinoplasty together was higher.[11]

Besides, Jun et al. in their study stated that surgical intervention should not be limited to the inferior turbinate mucosa during

septoplasty operations, because the inferior turbinate bone on the concave side of the nasal septum was significantly thicker than the bone on the convex side of the septum.[12]

In our study along with hypertrophy of inferior turbinate mucosa, the bone thickness was also thicker as compared to the control group. (hypertrophied group mean: 2.75 ± 0.47, control mean: 2.2 ± 0.55)

Berger et al. studied 19 patients who underwent surgery for deviated nasal septum with contralateral inferior turbinate hypertrophy.[4] Specimen from these patients were compared to the control group of 10 inferior turbinates which were removed during autopsy. He reported that bone hypertrophy was mainly responsible for inferior turbinate hypertrophy and medial and lateral mucosa thickness were not significant. Our study however showed both bone and mucosal thickness hypertrophy contributed to the total turbinate thickness and were not consistent with the findings of Berger et al.[4]

Egeli et al., Uzun et al. and Orhan et al. in their study measured the IT dimensions using CT and reported that the enlargement of the mucosa and bone is significant in the compensatory hypertrophy group, in line with our findings.[5,13,14]

Many studies have been published showing the use of acoustic rhinometry to evaluate the relative participation of the skeletal and mucosal components in IT hypertrophy.[4,11,15,16] Although this minimal cross-sectional area examination before and after nasal decongestion reveals the dimensions of the mucosal and bony components, it was unclear as to the relative contribution of each layer to the growth of the IT. Computed tomography shows the mean thickness of each layer contributing to overall turbinate hypertrophy.

There are a few limitations in our study, the first is the limited number of cases. The second was related to the bone structure of the concha, which varies from patient to patient. To determine possible effects of the septal deviation on the conchal bone thickness, we comprised the control group in the same patient sample.

CONCLUSION

Septal deviation is associated with compensatory hypertrophy of inferior turbinate in the contralateral side. This hypertrophy is not only caused by mucosal hypertrophy but also bone hypertrophy. Our Study shows different dimensions and composition of inferior turbinate hypertrophy. The findings support the decision to fix inferior turbinate at the time of septoplasty, because of the significant bony and mucosa expansion.

Therefore, a pre-operative CT scan before septoplasty can be useful for deciding about the type of surgery and the mucosal and bony dimensions measured on CT scans should be considered.

CONFLICT OF INTEREST

None

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None

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