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RESEARCH ARTICLE

EVALUATION OF NASAL OBSTRUCTION BY MEASURING THE THICKNESS OF THE INFERIOR TURBINATE AND NASAL OBSTRUCTION QUESTIONNAIRE

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ABSTRACT

Back ground: Nasal obstruction is one of the commonest annoying symptoms of Sepal deviation, this deviation is usually accompanied by compensatory hypertrophy of the inferior turbinate on the concave side which increase nasal obstruction.
Objectives: To evaluate nasal obstruction after septoplasty by measure size of the inferior turbinate and Nasal Surgical Questionnaire (NSQ) score in patients with nasal septum deviation with compensatory turbinate hypertrophy.
Patients & Methods: This is study of 50 patients, complaining mainly of nasal obstruction. Otolaryngological examination had shown nasal septum deviation with compensatory hypertrophy of the inferior turbinate. The cross sectional areas of inferior turbinates were measured with computed tomography preoperatively & 6 months postoperatively. All patient answerd NSQ preoperatively & 6 months postoperatively. All the patients underwent only septoplasty without inferior turbinate surgery.
Results: The thickness of inferior turbinates on the concave side were significantly decreased after 6 months of septoplasty, while that of convex sides significantly increased. NSQ score show significant post operative improvement.
Conclusion: only without turbinate surgery is effective in improving the nasal obstruction in patients with nasal septum deviation & compensatory inferior turbinate hypertrophy. Septoplasty alone can reverse the size of inferior turbinate. Pre and postoperative NSQ score after Septoplasty resulted in a statistically significant improvement in nasal obstruction.

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INTRODUCTION

Deviation of the nasal septum is one of the most common causes of chronic nasal obstruction. Sepal deviation usually associated with varying degree of compensatory hypertrophy of the contra lateral inferior nasal turbinate (Berger *et al*., 2015), this compensatory hypertrophy is considered to protect the airways from the excess of air that could enter through the nostril and its potential negative effects such as dryness, alteration of air filtration, mucociliary flow, or lung involvement (Chiesa *et al*., 2015). The nasal valve is formed medially by the septum and laterally by the caudal edge of the upper lateral cartilage and it accounts for approximately 50% of total upper airway resistance. The anterior tip of the inferior turbinate is found in the nasal valve region, and hypertrophy cause increase in airway resistance (Ahmed *et al*., 2014). Turbinate surgery is commonly performed in association with Septoplasty but the indication for turbinate surgery is not clear because of evidence that degree of satisfaction of patients who undergo septoplasty alone is similar to those who undergo septoplasty and turbinectomy (Grymer *et al*., 1993). In compensatory Inferior turbinate hypertrophy, the osseous part of the inferior turbinate may have enlarged, as a developmental process on the wider side of the nose, contra lateral to marked septal deviations. This enlargement may be involving the mucosa (Grymer, 2008). He reported that the anterior part of the inferior turbinate influences the nasal valve. Also the nasal defense systems, including mucociliary transport, cellular and humoral defense are mainly carried out by the mucosa of the turbinates. When performed as an adjunct to septoplasty, inferior turbinate surgery is associated with an increased risk of morbidity, primarily hemorrhage, intranasal adhesions, and atrophic rhinitis (Kim *et al*., 2008). Computed Tomography (CT) scan is well suited to the investigation of the sinonasal cavities. Because CT scanning is as sensitive to soft tissue disease as to bony changes, each scan can be photographed at an appropriate window width and level to optimally see soft tissue differences in attenuation and fine bony detail. To study soft tissue, the window widths range from 150 to 400

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Hounsfield units. Conversely, the bony detail is best observed at wide window settings from 2000 to 4000 Hounsfield units (Carter and Runge, 1988). The bone and/or the mucosa of the turbinates in compensatory hypertrophy may be enlarged, but this not well defined therefore there is a controversy over the management of the turbinate's in symptomatic patients (Eccles, 2000). Monitoring the results of surgery is important. Preoperative and postoperative Nasal Surgical Questionnaire (NSQ) for continuous evaluation of nasal septoplasty (Haye *et al*., 2015). There are many questionnaires available, some of them only contain items related to nasal symptoms as "Nasal Obstruction Symptom Evaluation Scale" published by (Stewart *et al*., 2004), whereas others also include general quality of life items as Quality of Life (QOL questionnaire) published by (Thiago *et al*., 2012), We want to focus on the pre and post surgical results and would therefore prefer a questionnaire that specifically assesses nasal symptoms. The Nasal Obstruction Symptom Evaluation (NOSE) questionnaire has been validated and used in many countries (Haye *et al*., 2015).

Aim of work

To evaluate nasal obstruction after septoplasty by measure size of the inferior turbinate and NSQ score in patients with nasal septum deviation with compensatory turbinate hypertrophy.

PATIENTS AND METHODS

This study was done on 50 patients complaining of nasal obstruction. They were 42(84%) of male and 8(16%) of female. Their age ranges from 18 to 38 years (mean 24.5years). They attended ENT department outpatient clinics at Alazher University Hospitals; Egypt. The study was conducted from April 2014 to March 2016. Patients with symptoms of allergic rhinitis and those with history of previous septoplasty/turbinate surgery were excluded. Nasal obstruction was the main complaint in these study. Other nasal symptoms as history of hyposmia, nasal discharge, epitaxis, headache and previous trauma to the nose were included in this study. On examination they had septal deviation with contra lateral inferior turbinate hypertrophy which was confermed by preoperative computed tomography (CT) scan of the nose and para nasal sinuses. The computed tomography scans of the par nasal sinuses were performed with 3mm slice thickness in coronal plane. The measurements were made by electronic caliber at the anterior, middle, and posterior thirds of the inferior turbinate in coronal sections. For standardization, anterior measurement was performed on the first image in which the entire inferior turbinate bone could be identified.

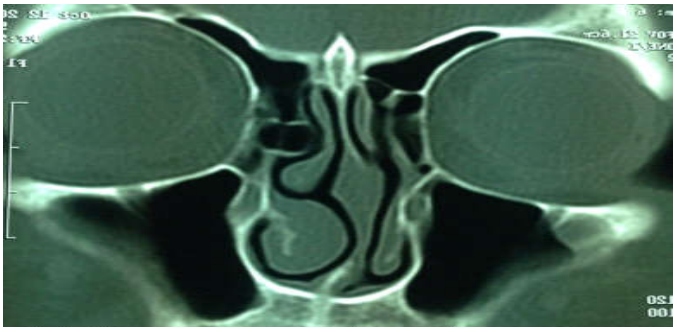

Figure (A): CT scan of paranasal sinuses (coronal section) showing anterior measurements which are taken on the first image where the inferior turbinate bone can be identified

Figure 1 (B): CT scan of paranasal sinuses (coronal section) showing middle measurements which are taken where the uncinate process and maxillary sinus ostium can be identified

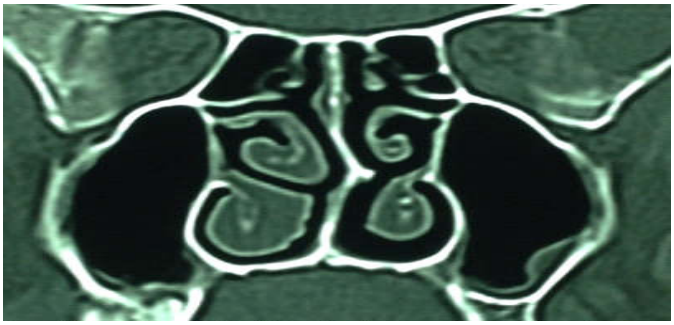

Figure (C): CT scan of paranasal sinuses (coronal section) showing posterior measurements which are taken in the last image where the inferior turbinate bone can be identified

The middle measurement was performed on the section in which the uncinate process and maxillary sinus ostium were visualized (Figure 1). Measurement of the thickness of the medial mucosa, conchal bones and lateral mucosa were taken separately on the anterior, middle and posterior portions of inferior nasal conchae at a place perpendicular to the mucosal surface with the aid of a cursor on the screen using computed tomography.

Functional septoplasty was done for all the patients without turbinate surgery. Follow up time ranged from 3 to 6 months, during follow up the patients were reviewed regarding symptoms of nasal obstruction and they were examined for septum and inferior turbinate. Postoperative CT scan was done 6 months after surgery and the same measurement were taken. All these documented on a data sheet (Ahmed *et al*., 2015). The mean thicknesses of the medial mucosa, conchal bone, and lateral mucosa of inferior turbinates before and after septoplasty were compared using T test. The pre- and postoperative (after 6 months) NSQ for 50 patients. The patients are asked to mark their sense of obstruction on this scale. There are 4-point (1 = no, 2 = mild, 3 = moderate, and 4 = severe). The postoperative NSQ is supplemented with the following 5-point nasal: Nasal congestion or stuffiness, Nasal blockage or obstruction, Trouble breathing through the nose, Trouble sleeping, Unable to get enough air through my nose during exercise or exertion .Patients are asked to answer the questionnaire based on a normal day without nasal infection. The total score was then multiplied by 5 for a maximum score of 100, with 0 being asymptomatic and 100 being the worst-case (Thiago *et al*., 2012). Dividing the group into 4 classes of severity and integrating the threshold resulted in the following classes and ranges: 0 mild (range, 5-25), moderate (range, 30-50), severe (range, 55-75), and extreme (range, 80-100) nasal obstruction (Rolf *et al*., 2015). All patients were guided during completing the questionnaire to help in translation and

explanation using the same verbal Arabic expressions as possible. Data were presented as mean and standard deviation (SD).Paired t test was used to compare mean values of before and after septoplasty values. This values before and after septoplasty were compared using the statistical analysis by SPSS 16.0 (statistics Package for the Social Sciences). P value < 0.05 is considered statistically significant

RESULTS

From our 50 patients with nasal deviation 22 were deviated to the left (20 male and 2 female) and 28 were deviated to the right (22 male and 6 female) with contra lateral inferior turbinate hypertrophy (Table 1) and (Table 2).

Regarding the inferior turbinates, in the concave side of the septum (Table 3), and (Figure 3, 6 and 8) septoplasty significantly decreased the mean thickness of the anterior part of medial mucosa by 1.05 mm (p value was 0.038), middle part of medial mucosa by 0.83 mm (p value was 0.031) and posterior part of medial mucosa by 0.65mm (p value was 0.02) Septoplasty also decreased the mean thickness of the anterior part of lateral mucosa by 0.03mm (p value was 0.02), middle part of lateral mucosa by 0.33 mm (p value was 0.04) and posterior part of lateral mucosa by 0.33 mm (p value <0.03) (figure 2). While the changes in conchal bone were decrease in mean thickness of anterior part by 0.06 mm (p value 0.51), increase in the middle part 0.08 mm (p value 0.43), decrease in the posterior part by 0.1mm (p value 0.32).

Table 1. Age and sex distribution

Sex		Age	
Male	Female	Mean+SD	Age range
42(84%)	8(16%)	24.5+ 5.01	18 - 38

Table 2. Side of the nasal septal deviation & Side of HIT

Side of the nasal septal deviation		Side of HIT	
RT	LT	RT	LT
22(44%)	28(56%)	28(56%)	22(44%)

Table 3. Mean thickness of medial mucosa, conchal bone and lateral mucosa on the concave side before and after surgery

Thickness in mm	Area	Mean preoperative dimenssion	Mean post operative dimension	Mean difference	P value
Medial mucosa	Anterior third	5.61	4.56	1.05	0.038*
	Middle third	5.27	4.44	0.83	0.031
	Posterior third	5.2	4.55	0.65	0.02*
Conchal bone	Anterior third	1.97	1.91	0.06	0.51
	Middle third	2.32	2.42	0.01	0.43*
	Posterior third	2.28	2.19	0.09	0.32*
Lateral mucosa	Anterior third	2.46	2.16	0.3	0.02*
	Middle third	3.66	3.33	0.33	0.04
	Posterior third	3.99	3.66	0.33	0.03*

Table 4. Mean thickness of medial mucosa, conchal bone, and lateral mucosa on the convex side before and after surgery

Thickness in mm	Area	Mean preoperative dimenssion	Mean post operative dimension	Mean difference	P value
Medial mucosa	Anterior third	3.04	3.41	0.7	0.05*
	Middle third	3.44	3.68	0.24	0.14*
	Posterior third	4.3	4.55	0.52	0.53
Conchal bone	Anterior third	1.22	1.53	0.31	0.45*
	Middle third	2.06	2.09	0.03	0.36
	Posterior third	2.1	2.22	21	0.23*
Lateral mucosa	Anterior third	2.06	2.55	0.49	0.023*
	Middle third	2.78	2.88	0.1	0.03*
	Posterior third	3.1	3.44	0.33	0.03*

Table 5. Pre and postoperative values of NSQ and of the difference using paired t test

	Preoperative	Postoperative	Difference	t value	P value
Mean	89.29	42.86	52.17	9.1317	<0.0001*
SD	6.07	14.68	15.26		

Table 6. Preoperative and postoperative other nasal Symptomatology

symptoms	Pre-operative		Post-operative	
	No.	%	No.	%
Nasal discharge	22	44	8	16
Epistaxis	0	0	0	0
Headache	11	22	4	8
Snoring	8	16	2	4
Hyposmia	6	12	4	8

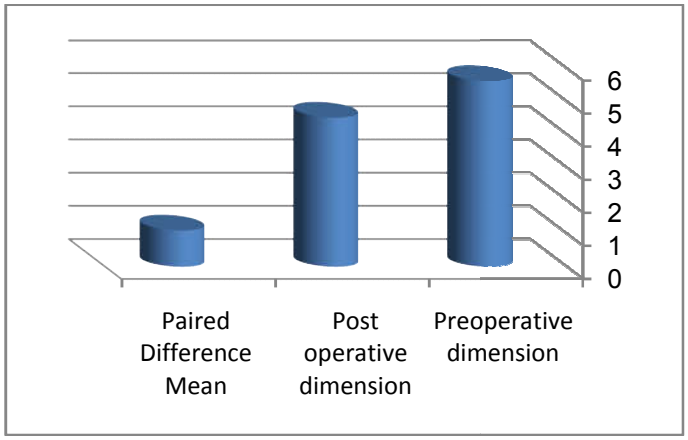

Figure 3. Mean dimensions of the inferior turbinates before & after septoplasty on the concave side

While on the convex side septoplasty (Table 4)(Figure 4,7,8 & 9) increased the mean thickness of anterior part of medial mucosa by 0.7mm (p value 0.05), middle part of medial mucosa by 0.24 mm (p value 0.14) and posterior part of medial mucosa by 0.52mm(p value 0.53). While it decreased the mean thickness of lateral mucosa at anterior part by 0.14mm (p value 0.26), increased at middle part by 0.01mm (p value 0.8) and increased at posterior part by 0.26mm (p value 0.08). The conchal bone thickness increased by 0.31mm (p value 0.45) in anterior part, decreased in middle part by 0.03mm(p value 0.36) and increased in posterior part by 0.21 mm (p value 0.23).

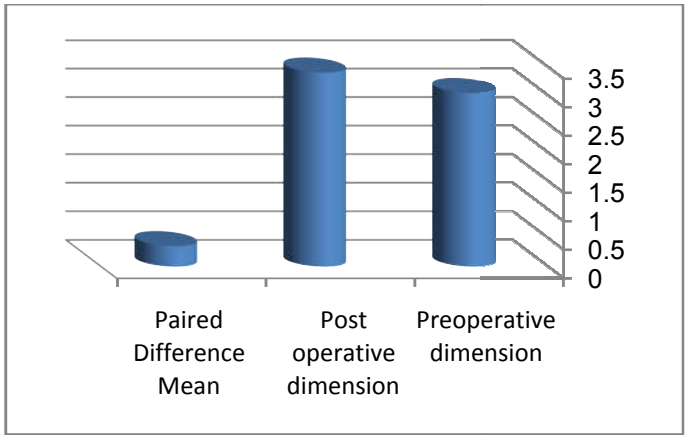

Figure 4. Mean dimensions of the inferior turbinates before & after septoplasty on the concvex side

Regarding the turbinate thickness, Among the patients complaining of nasal obstruction before the surgery 47 patients (94%) improved while 3patients (6%) are not satisfied. Paired t test NSQ score significantly decreased post operative the difference was 52.17 ($p<0.0001$) (Table 3). Regarding the NSQ score, among the patients complaining of nasal obstruction before the surgery 46 patients (92%) improved while 4 patients (8%) are not satisfied. Regarding the other nasal symptoms. Nasal discharge found in 22 patients. Hyposmia was present in 6 patients, and no history of epistaxis was present. Headache was found in 11 patients. History of nasal trauma was found in 6 patients. Postoperative assessment of the patients regarding as the other nasal symptoms showed the following results (table 6, Fig.6), in 6 patients who had hyposmia before septoplasty 2 patients (66.6%) improved while 4 patients (33.3%) did not improved after surgery.

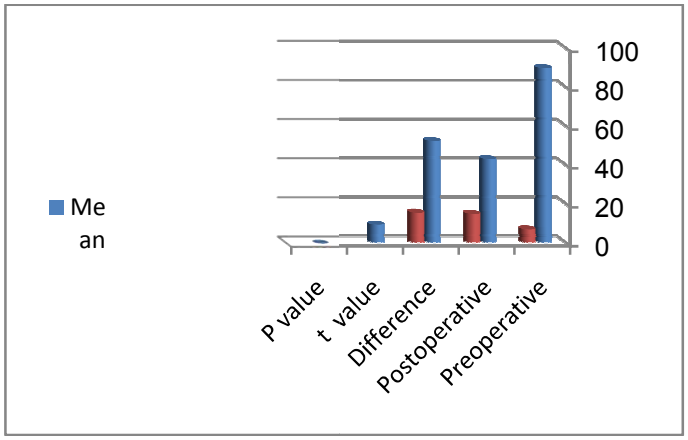

Figure 5. Pre and postoperative values of NSQ and of the difference using paired t test

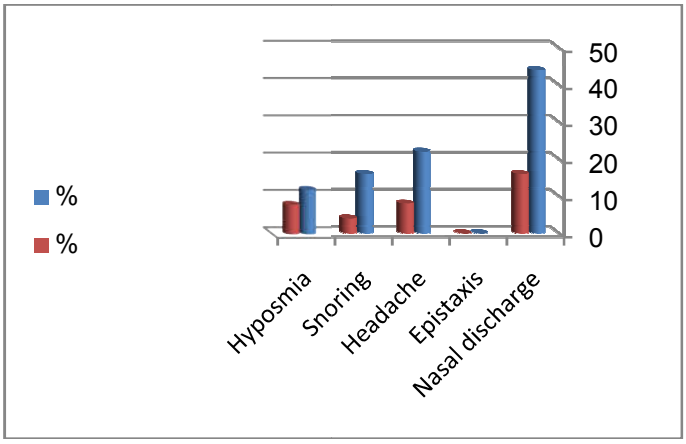

Figure 6. Preoperative and postoperative other nasal Symptomatology

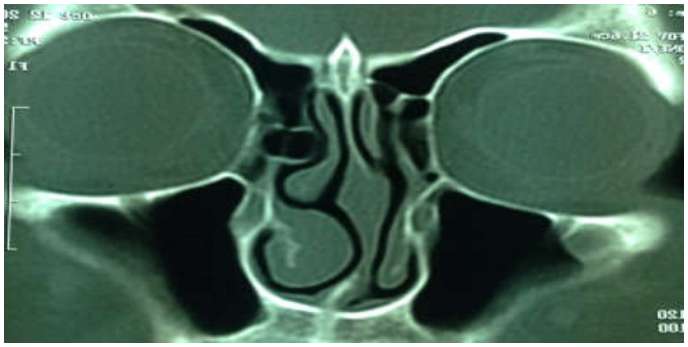

Figure 7 (A) preoperative MSCT nose & paranasal sinuses, Coronal cuts showing right sided compensatory hypertrophy of inferior turbinate at the anterior part

Figure 7(B) postoperative MSCT nose & nasal sinuses, coronal cuts, of the same patient showing reduction of the inferior turbinate on the right side and increase of the inferior turbinate on left side at the anterior part

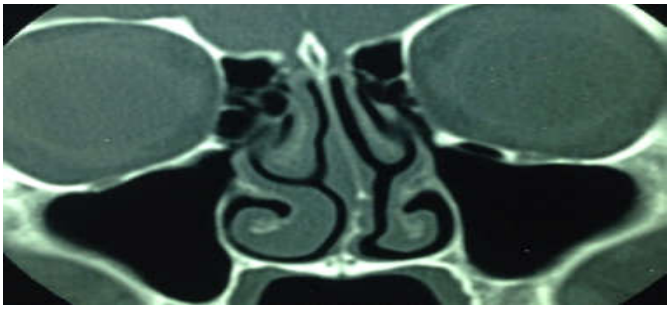

Figure 8 (A) preoperative MSCT nose & paranasal sinuses, Coronal cuts showing right sided compensatory hypertrophy of inferior turbinate at the middle part

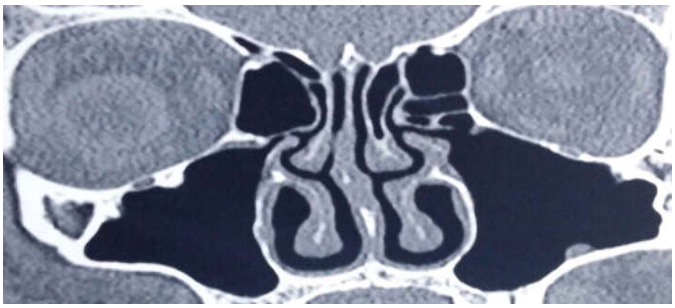

Figure 8(B) postoperative MSCT nose & nasal sinuses, coronal cuts, of the same patient showing reduction of the inferior turbinate on the right side and increase of the inferior turbinate on left side at the middle part

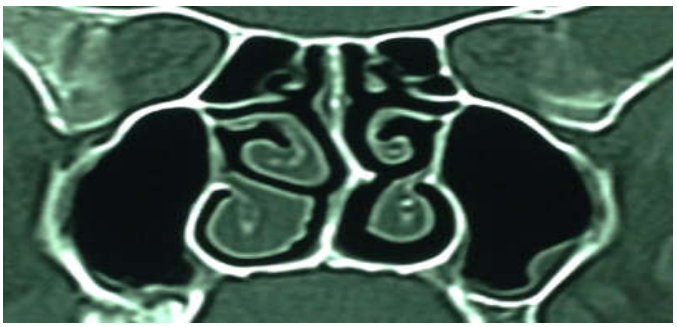

Figure 9 (A) preoperative MSCT nose & paranasal sinuses, Coronal cuts showing right sided compensatory hypertrophy of inferior turbinate at the posterior part

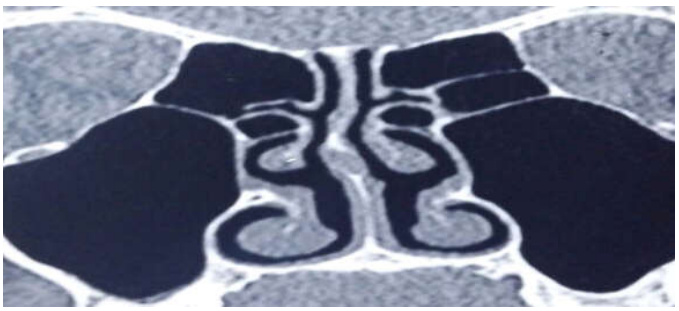

Figure 9(B) postoperative MSCT nose & nasal sinuses, coronal cuts, of the same patient showing reduction of the inferior turbinate on the right side and increase of the inferior turbinate on left side at the posterior part

DISCUSSION

This prospective study included 50 patients, their age ranged between 18 - 38 years (mean 24.5 years) This was close to the mean age of patients in the study of (Gandomi *et al*., 2010) which was 22.4 years, but it was different from the study of (Stewart *et al*., 2004), who reported that the mean age was 40 years. (Gandomi *et al*., 2010) study, showed that younger patients who have nasal obstruction with septal deviation get benefit more from septoplasty because their nasal obstruction may be more anatomicaly dependent, while in older patients dynamic causes are more important as it was reported by (Stewart *et al*., 2004), their study was on 62 patients with mean age of 44.7 years. Those patients had complained of allergic rhinitis in association to septal deviation and their success rates were 63% only. Out of these 42(84%) were male and 4 female (16%), this result was close to the result of a study done by (Behnoud *et al*., 2010) which showed 70% male, this higher incidence in male patients is attributed to the higher incidence of nasal trauma of male patients. In this study deviated nasal septum to the left side was found in 28 patients (56%) and to the right side in 22 patients (44%), this result was close to the result of a study that had done by (Jalil and Mazhar, 2012) in which t 61% of the patients had left side septal deviation and 39% of the patients had right side. .History of trauma in this study was present in 12% of the patients and this is close to the result of (Daghistani, 2002), who reported 19.3% nasal trauma but was less than the result of a study done by (Foda, 2005), who reported nasal trauma in 54 % of his patients. Also our result was less than the result of (Seung *et al*., 2004) which was 69.2%. This may be due to unnoticed minor nasal trauma during childhood. In our study the mean thickness of the entire dimension of the inferior turbinnates, in the concave side after the septotoplasty are significantly decreased by1.1mm. This reduction of size can be explained by the study of (Graamans, 1983), who postulated that the reduction of mucosal edema after septal surgery was probably the result of diminished submucosal blood circulation. While the mean thickness of the convex side after the septoplasty are significantly increased by 0.36 mm side after the septoplasty. This in agreement with (Ahmed *et al*., 2015) who show an significant decrease in the mean entire dimension on the concave part by about 0.825mm while significant increase in the mean entire dimension on the convex part by 0.31mm.This also consistence with (Ahmed *et al*., 2014) study which reported significantly decreased on the mean dimension of the entire inferior turbinates on the concave side by 18.87mm2 & significantly increased on the mean dimension of the entire inferior turbinate on the convex side by 14.37mm2 after 1 year post operative. Also our results were in consistence with (Illum, 1997) and (Gandomi *et al*., 2010) studied the effect of septoplasty on inferior turbinate hypertrophy, and concluded that in the group of patients who had turbinate manipulation with septoplasty, and those patients who had septoplasty alone no significant difference in patient satisfaction was observed but (Beom *et al*., 2009) found that both turbinate surgery and septoplasty are necessary for treatment of patient of septal deviation with compensatory turbinate hypertrophy.

In our study NSQ score was significantly decreased post operative, the difference was 52.17 ($p<0.0001$). (Haye *et al*., 2015) found significant differences between preoperative and postoperative score when studied, 55 patients pre and 6 months post septoplasty (NSQ) and the improvement was 87% which in agree with us. Also (Thiago *et al*., 2012) studied Fourty-six patients and show that Septoplasty resulted in a statistically significant improvement in the preoperative NOSE score (md = 75, IQR = 26) and after three months (md = 10, IQR = 20) ($p < 0.001$. T-Wilcoxon). The standardized response mean was 3.07. He also found a strong correlation between the

preoperative score in the NOSE questionnaire and improvements in the postoperative period (r = -0.789, $p < 0.001$, Spearman). Also, we agree (Ahmed *et al*., 2015) who reported twenty eight patients (70%) who underwent septoplasty were satisfied regarding improvement of their nasal obstruction. (Illum, 1997) and (Gandomi *et al*., 2010) also agree with us in the fact that nasal obstruction improved with septoplasty alone without turbinate surgery. The results of septoplasty are reported in many different studies, with improvement in obstruction varying from 47% to 98% (Sundh and Sunnergren, 2015). In our study 6 patients had hyposmia preoperatively 4out of them improved (66.6%) that were close to (Ahmed *et al*., 2015) which was 75% and the result reported by Smith *et al* (Smith *et al*., 2004) which was71%. The other nasal symptoms as Nasal discharge improved in 72.7% of patients, Headache in 36.36%., snoring in 25% .that were close to (Ahmed *et al*., 2015) who show nasal discharge improvement in 45% of patients, Headache in 40%., snoring in 20%.

Conclusion

Septoplasty without turbinate surgery significantly reduced the size of the inferior turbinate hypertrophy and improve the nasal obstruction as confirmed by results of Nasal Surgical Questionnaire (NSQ) which is significantly reduced after surgery.

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