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ORIGINAL ARTICLE

Laryngeal Changes After Septoplasty and Turbinectomy

Yasser Mohammed Hassan Mandour[1] · Ashraf El Hamshary[1] · Salwa A. Abdel-Elhay[1] · Mostafa S. Abdel-Hamid[1] · Mostafa Gomaa[1]

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Abstract
Studies found only a little amount of evidence about the impact of septoplasty on the mechanism of voice production, as well as vocal cord and laryngeal mucosal changes. Nasal obstruction is a common medical issue that is linked to changes in the quality of resonance of voice. To assess patients with deviated nasal septum and inferior turbinate hypertrophy's voice alterations using laryngeal stroboscope before and after septoplasty and turbinectomy. In this prospective case–control study, patients in group A had inferior turbinate hypertrophy and a nasal septal deviation, while participants in group B were healthy controls who were matched for age and gender. All of the included patients had their laryngeal stroboscope and acoustic voice characteristics evaluated both preoperatively and three months after surgery. Only the baseline evaluation of healthy controls was done. We included 30 patients with mean age 24.43 ± 7.81 years, and males accounted for two thirds of the included cases, speech testing showed that Amplitude perturbation significantly improved post septoplasty with p values < 0.05, while Fundamental frequency and NHR parameters didn't show statistically significant improvement compared to preoperative measurements and control groups. Paired comparison of laryngeal erythema, mucosal edema and mucosal waves showed significant improvement compared to preoperative laryngeal stroboscopic findings with p values < 0.001 each. Significant improvements were made to septal deviation following surgery nasal obstruction caused by nasal septal deviation and inferior turbinate hypertrophy is associated with amplitude perturbation, laryngeal erythema, mucosal edema, and mucosal waves in the patients.

Keywords Laryngeal changes · Septoplasty · Voice · Turbinectomy

Introduction

The most frequent complaint of patients visiting otorhinolaryngology outpatient clinics is nasal blockage [1]. Sound quality is influenced by voice resonance, which is influenced by the nasal cavity and paranasal sinuses [2]. Coordination between the vocal cords and the respiratory system, in particular the nasal cavity, is necessary for voice production.Voice quality is significantly influenced by nasal airflow resistance [3]. About two-thirds of nasal resistance is caused by the anterior nasal valve, which is made up of the nasal septum, the anterior end of the inferior turbinate, and the upper lateral nasal cartilage [4]. Effective voice hygiene has become more important as a result of recent otorhinolaryngological research advancements since chronic nasal obstruction can affect voice quality [5]. Nasal polyposis and deviated nasal septum with hypertrophic inferior turbinate are two of the most common disorders that result in chronic nasal blockage [6]. The glottis region, laryngeal mucosa, and other laryngeal structures can all be examined using video-stroboscopic technology to identify changes [7]. Little information is available in the literature about the relationship between laryngeal changes brought on by persistent nasal obstruction and changes in the acoustic voice after septoplasty [8].

✉ Yasser Mohammed Hassan Mandour
ghader_massoud@yahoo.com

Ashraf El Hamshary
ash_ham@yahoo.com

Salwa A. Abdel-Elhay
sal_raz@yahoo.com

Mostafa S. Abdel-Hamid
mos_rah@yahoo.com

Mostafa Gomaa
mos_goma@yahoo.com

[1] Faculty of Medicine, Benha University, Benha, Egypt

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Patients and Methods

This prospective case–control study was conducted in the outpatient clinic at Benha University Hospitals. We included adults, regardless of gender, between the ages of 18 and 40 who had nasal obstruction caused by inferior turbinate hypertrophy and a deviation of the nasal septum, alongside a control group of thirty healthy individuals. The current investigation excluded patients with uncontrolled systemic disorders, coagulopathy, significant laryngeal pathology, smoking, hormone imbalance, or autoimmune diseases. Each patient underwent a thorough medical history review, an anterior rhinoscopy and nasal endoscopy clinical assessment, and video-stroboscopic recording before surgery and three months after surgery by the same phonetician and using the same video-stroboscopic system. All of the cases that were included underwent computed tomography for the nose, paranasal sinuses, coronal and axial cuts, and bone window. Voice recordings were made in a space with very little background noise. All of the patients recordings were made in mono using a 16-bit sampling format at a sampling rate of 44,100 Hz. Voice analyses were performed using the Praat V2.5 software (Praat software, version 2.5).

In each case's speech analysis, the fundamental frequency (F0), frequency perturbation (jitter), amplitude perturbation (shimmer), and NHR characteristics were evaluated. After undergoing septoplasty with turbinectomy, patients with a deviated nasal septum and an enlarged inferior turbinate had their pre- and postoperative condition evaluated. The speech analysis characteristics were evaluated before surgery and three months thereafter. Patients who had a deviated nasal septum and an enlarged inferior turbinate received a septoplasty and turbinectomy. The same doctor used the same technique to conduct a septoplasty while under general anaesthesia. Each patient spent a day in the hospital and was then followed up on.

A day later, the nasal pack was taken out. The patient was given oral antibiotics to take for 7 days after surgery, as well as instructions to use an alkaline nasal wash for at least a month. The patients' two nasal cavities were fitted with nasal splints, which were taken out seven days after the surgery. Following surgery, for one week, every week for one month, and then every month for three months, all patients underwent nasal endoscopy evaluations.

Ethical Considerations

Study protocol was approved by the local ethical committee of Benha University. all participants singed a written informed consent prior participation and all study procedures followed GCP-ICH guidelines.

Statistical Analysis

The IBM SPSS software programme version 20.0 was used to examine the data that were fed into the computer (IBM Corp.) Armonk, New York. Quantitative data were described in terms of percentage and number. To confirm the distribution's normality, the Kolmogorov–Smirnov test was utilised. Utilizing the range (minimum and maximum), mean, standard deviation, median, and interquartile range, quantitative data were reported (IQR).The 5% level was used to determine the results' significance. The tests used were: Chi-square analysis was used to compare two groups. Correction for Monte Carlo: When more than 20% of the cells have an expected count lower than 5, chi-square must be corrected. The Student t-test was used to compare two examined groups when the quantitative data were regularly distributed, while the Mann–Whitney U test was employed when the quantitative variables had an aberrant distribution. For quantitative variables with anomalous distributions, the Wilcoxon signed ranks test was applied. The McNemar Test was then used to compare two paired groups and determine the significance of the various stages. A p value of 0.05 or lower was deemed significant.

Results

Thirty cases diagnosed with nasal obstruction with underlying cause of deviated nasal septum and inferior turbinate hypertrophy with mean age 24.43 ± 7.81 years and males accounted for 66.7% of the included patients, thirty age and gender matched healthy control individuals. Comparison of demographic characteristics showed that there was no statistically significant difference in occupation, marital status or residence (Table 1).

Acoustic voice parameters showed significant improvement of shimmer with p value < 0.001 (Fig. 1), however other parameters as F0, jitter and NHR showed no statistically significant between pre and postoperative measurements. Comparison of pre, postoperative and control group acoustic voice parameters showed that jitter, shimmer and NHR were significantly higher among cases in the pre and postoperative measurements compared to control group with p values < 0.005. (Table 2).

Laryngeal stroboscope showed that there was a statistically significant improvement of laryngeal erythema, mucosal edema, and mucosal waves compared to preoperative findings with p values < 0.001 as shown in Table 3, Figs. 2 and 3.

Table 1 Comparison between the two studied groups according to demographic data

	Cases		Control		*P* value
	(n = 30)		(n = 30)		
	Count	%	Count	%	
Sex					
Male	20	66.7	17	56.7	0.426
Female	10	33.3	13	43.3	
Age (years)					
Mean ± SD	24.43 ± 7.81		26.97 ± 5.69		0.157
Occupation					
Worker	7	23.3	5	16.7	0.040*
Teacher	4	13.3	6	20	
Student	16	53.3	6	20	
Officer	0	0	2	6.7	
Nurse	0	0	2	6.7	
Housewife	2	6.7	6	20	
Electrician	1	3.3	1	3.3	
Doctor	0	0	2	6.7	
Marital status					
Single	17	56.7	11	36.7	0.121
Married	13	43.3	19	63.3	
Residence					
Banha	16	53.3	16	53.3	1.000
Menofia	14	46.7	14	46.7	

p: *p* value for comparing between Cases and Control

*Statistically significant at $p \leq 0.05$

Discussion

The most common reason for nasal obstruction is nasal septal deviation. Patients who visit clinics for otorhinolaryngology frequently report with nasal blockage [9]. Voice quality could be greatly impacted by nasal blockage [10]. The normalcy of the vocal, the degree and origin of voice disorders, and the effectiveness of therapies can all be assessed using voice analysis methods, especially in clinical trials [11]. Nasal septal deviation is a common surgical condition that can be treated by septoplasty [12].This straightforward surgical procedure is carried out to lengthen the nasal tube, which alters the resonance characteristics of the vocal tract [13]. There aren't many articles about the voice's acoustic properties following a septoplasty [14]. For patients with a deviated nasal septum and inferior turbinate hypertrophy, we conducted a prospective case–control study to assess voice alterations and laryngeal stroboscope results before and after septoplasty and turbinectomy. While other acoustic voice characteristics did not exhibit the same improvement, the current investigation found that septoplasty considerably improved shimmer. Similar results were reported by Apaydin et al., who highlighted that the shimmer value was statistically significantly lower at 1 month (*P* 0.05) and 3 months postoperatively (*P* 0.05) compared to preoperative analysis for the acoustic voice analysis parameters of F0, jitter, and Harmonics-to-Noise Ratio values after septoplasty [15]. The results of a case–control research by Gulec et al. with the exception of shimmer analysis, were consistent with those of the current investigation for vowel's voice analysis, which did not reveal any statistically significant differences between pre- and postoperative measures [16]. Atan et al., also found that severe obstruction groups significantly

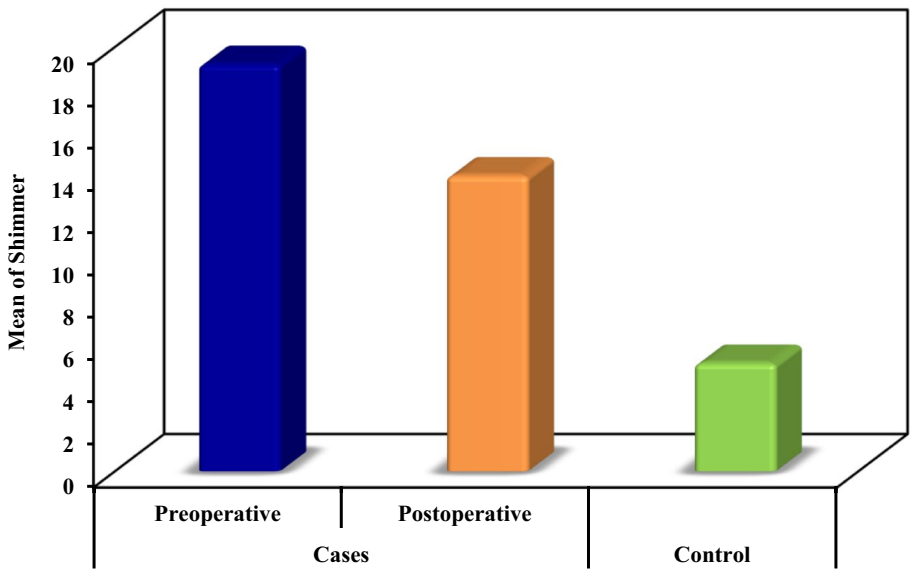

Fig. 1 Comparison between the two studied groups according to Shimmer

Table 2 Comparison between the two studied groups according to Acoustic voice parameters

Acoustic voice parameters	Cases (n = 30)		*P* value	Control (n = 30)	P1 (control vs preop)	P2 (control vs postop)
	Preoperative	Postoperative				
F0 (HZ)						
Median (IQR)	136.23 (121–229.3)	149.32 (116.12–230)	0.572	167.09 (148–216.0)	0.690	0.451
Jitter						
Median (IQR)	1.23 (0.57–2.50)	0.96 (0.34–6.31)	0.877	0.34 (0.29–0.58)	< 0.001	0.002
Shimmer						
Median (IQR)	19.41 (18.42–20.73)	11.54 (8.45–20.5)	< 0.001	4.79 (2.24–5.72)	< 0.001	< 0.001
NHR						
Median (IQR)	0.18 (0.13–0.28)	0.16 (0.04–0.42)	0.600	0.02 (0.02–0.03)	< 0.001	< 0.001

Table 3 Comparison between the two studied groups according to Acoustic voice parameters

Laryngeal stroboscope	Cases (n = 30)				*P* value
	Preoperative		Postoperative		
	Count	%	Count	%	
True vocal cord borders					
Smooth	22	73.3	26	86.7	0.125
Swollen	8	26.7	4	13.3	
True vocal cord mobility					
Normal	30	100	30	100	–
Abnormal	0	0	0	0	
False vocal cord compression					
No	27	90	27	90	0.317
Mild	2	6.7	2	6.7	
Mild to moderate	0	0	0	0	
Moderate	0	0	0	0	
Moderate to severe	1	3.3	1	3.3	
Vocal cord closure					
Complete	30	100	30	100	–
Laryngeal erythema					
No	0	0	22	73.3	< 0.001*
Mild	15	50	5	16.7	
Mild to moderate	1	3.3	0	0	
Moderate	0	0	0	0	
Moderate to severe	14	46.7	3	10	
Mucosal edema					
No	0	0	24	80	< 0.001*
Mild	0	0	2	6.7	
Mild to moderate	22	73.3	1	3.3	
Moderate	0	0	0	0	
Moderate to severe	8	26.7	3	10	
Mucosal waves					
Normal	6	20	23	76.7	< 0.001*
Decreased	24	80	7	23.3	

*Statistically significant at $p \leq 0.05$

improved in all acoustic voice parameters, with the exception of F0 measurement, which they found to be the only significant difference between patients with severe obstruction and those with non-severe symptoms of deviated nasal septum [17].Similar findings were reported by Hernandez et al., who found that there were no variations between preoperative and postoperative assessments for the majority of acoustic voice characteristics (F0, Jitter, Shimmer, HNR, NHR) [18]. They believed it to just be an indication of improved voice acoustics and less nasalized speech, which would ultimately signal a successful outcome, since a pilot study revealed that post-septoplasty changes in the voice parameters are small and lack statistically significant variations from baseline [19]. In the current study we assessed the laryngeal changes as well, laryngeal stroboscope showed that there was a statistically significant improvement of laryngeal erythema, mucosal edema, and mucosal waves compared to preoperative findings with *p* values < 0.001. These results were in line with those of a prospective randomized case–control study conducted by Mandour et al. on patients with deviated nasal septum and inferior turbinate hypertrophy. Their findings revealed that laryngeal erythema and laryngeal edema were significantly reduced after the nasal surgery, and they came to the conclusion that nasal surgery would have a significant impact on these conditions [8]. Additionally, Karimi et al. stated in their study that laryngeal erythema and laryngeal mucosal edema were the most frequent changes related to nasal polyposis, and they highlighted that laryngeal erythema was alleviated in the majority of the patients included after FESS [20]. The exact mechanism by which chronic nasal obstruction affects the true vocal cords and laryngeal mucosa is still unknown. However, a theory has been put forth that suggests that changes in the true vocal cords' harmonic movement as a result of a change in airflow resistance brought on by chronic nasal obstruction may affect the laryngeal mucosa [21]. However, more research is needed to determine the short and long-term effects of chronic nasal obstruction on laryngeal mucosa.

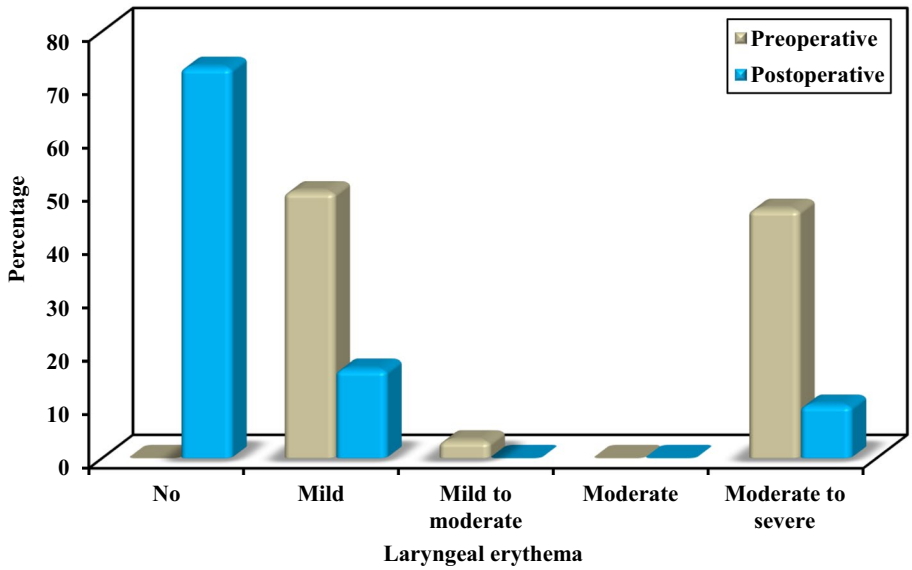

Fig. 2 Comparison between pre and postoperative according to Laryngeal erythema

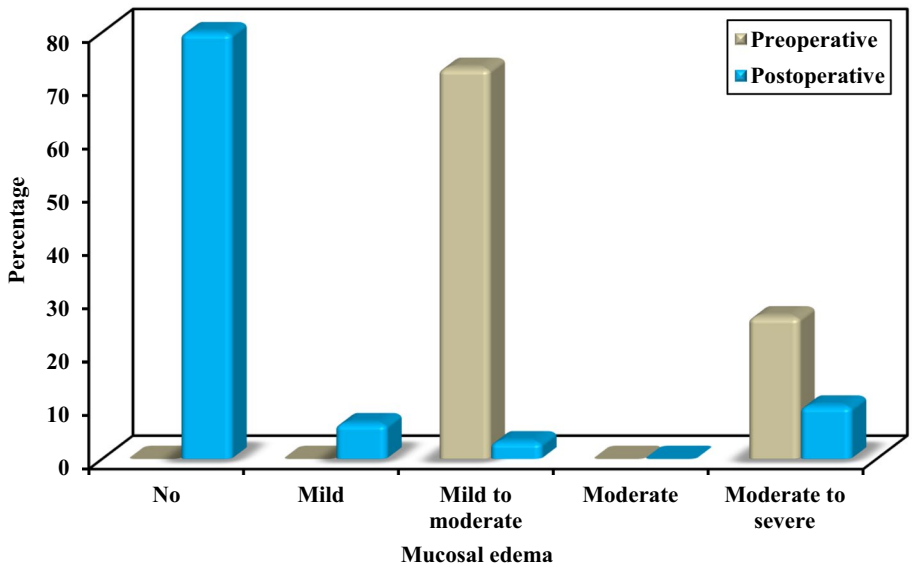

Fig. 3 Comparison between pre and postoperative according to Mucosal edema

Conclusion

Significant improvements were made after surgery to address septal deviation. Patients with nasal obstruction brought on by nasal septal deviation and inferior turbinate hypertrophy exhibit amplitude perturbation, laryngeal erythema, mucosal edoema, and mucosal waves.

Declarations

Conflict of Interest All the authors declare that they have not any conflict of interest.

Ethical Approval Taken from institutional ethical committee of Benha Faculty of Medicine, Benha University Hosipital.

Human or Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration.

Informed Consent Informed consent was obtained from all individual participants involved in the study.

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