

Original Research Article

Pulmonary function improvement following septoplasty

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ABSTRACT

Background: Nasal septal deviation is a frequent cause of increased nasal airway resistance. A narrow nasal airway would result in a decreased airflow into the lungs. The aim of the present study was to evaluate the alterations of the pulmonary functions prior to and following septoplasty using spirometry.

Methods: Thirty patients with obvious nasal septal deviations were enrolled in the study. All patients had a detailed otorhinolaryngologic examination, and were performed spirometry, prior to and one month after septoplasty surgery, and the results were compared.

Results: Septoplasty improves the nasal breathing pattern. While reducing FEF_{50%} (maximum expiratory flow at 50% of FVC)/FIF_{50%}, it increases PEF and FIF_{50%} values. In addition, exercise capacity improves following surgery. Postoperative scores showed reduction markedly compared to preoperative values ($p < 0.001$).

Conclusions: Nasal septal surgery has a positive effect on pulmonary functions.

Keywords: Nasal septal deviation, Septoplasty, Spirometry

INTRODUCTION

Nasal obstruction is caused by various conditions including nasal polyposis, adenoid hypertrophy and turbinate hypertrophy. Nevertheless, nasal septal deviation (NSD) is deemed to be a very common etiological factor of nasal obstruction.¹ The prevalence is approximately 80% of the general population.² The surgical modality for correction of deviated septum is septoplasty and is the definitive treatment for the same. This is a surgical procedure aimed at straightening the partition between the two nasal cavities, the nasal septum. A judicious realignment or even excision of a portion of the bone or cartilage or both are involved in the nasal cavity. Structural support is ensured in this procedure by preserving sufficient cartilage. Initially alone, the septum is straightened, stabilized splints, gauze packs, small plastic tubes, splints and sutures.³

During controlled ventilatory maneuvers, air moves to the lungs and vice versa. Spirometry is non-invasive procedure used for measuring the movement pattern of air during this process. The debatable perceptions of patients and circumstances faced by the physicians pertaining to the status of airflow obstruction and/or severity of lung disease associated with nasal septal deviation shall be cleared owing to the objective evidence in identifying patterns of disease.

Spirometry interpretation

Obstructive disorders - FVC normal or ↓, FEV1 ↓, FEF_{25-75%} ↓, FEV1/FVC ↓, TLC normal or ↑.

Restrictive disorders - FVC ↓, FEV1 ↓, FEF_{25-75%} normal to ↓, FEV1/FVC N↑, TLC ↓.

Forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), FEV1/FVC ratio, peak expiratory flow (PEF) and forced expiratory flow at 25% to 75% of FVC (FEF 25-75%)

METHODS

The study was a comparative study conducted at the Department of ENT, Vinayaka Missions Medical College, Karaikal done between August 2017 to July 2018. Thirty patients were enrolled for the study. The study was submitted to the ethical committee of our college and obtained the ethical committee approval

Inclusion criteria

Patients with the complaint of chronic nasal obstruction and diagnosed with degree III nasal septal deviation, both male and female and age >18 years were included in the study.

Exclusion criteria

Patients with hypertension, coronary artery disease, diabetes mellitus, cerebrovascular accident and other nasal pathologies such as allergic rhinitis, excessive turbinate hypertrophy, concha bullosa, chronic rhino sinusitis or nasal polyposis and patients with other pulmonary diseases and patients below 18 years were excluded from the study.

Among patients who presented in the ENT out-patient department with recurrent nasal obstruction was subjected to proper history taking, physical examination and ENT examination followed by anterior rhinoscopy and diagnostic nasal endoscopy. Patients with marked nasal septal deviation, i.e. with degree III septal deviation (septum touching and compressing the inferior turbinate) and those who fulfilled the inclusion and exclusion criteria were included in the study. Details about the

study were explained to all the 30 patients in their vernacular language and written consent were obtained from them in their vernacular language. These patients were admitted and evaluated for septoplasty. After taking proper informed consent for surgery from the patients in their vernacular language, septoplasty was performed under general anesthesia in all patients. All surgeries were done by a single surgeon. Spirometry was performed 1 day prior to surgery, and 1 month after the surgery in all patients, with the patient is sitting in an upright position. Informed consent was obtained for spirometry from all the patients. Preoperative and postoperative forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), FEV1/FVC ratio, peak expiratory flow (PEF) and forced expiratory flow at 25% to 75% of FVC (FEF25%-75%) was compared. Unit in which spirometric indices are calculated: FVC (l), FEV1 (l), FEV1/ FVC, PEF (l/sec), FEF25–75% (l/sec) l-litre.

Statistical analysis

Statistical analysis was done by SPSS 16.0. The numerical variables were presented as mean±standard deviation and median (range), and the categorical variables were presented as the number and the percent. Student t test (paired and independent t test) was used for quantitative analysis. T-test was used for “before and after” measurements of numerical variables. Pearson’s or Spearman’s correlations were used for the analysis by correlation. P value less than 0.05 was considered to be significant.

RESULTS

A total of 30 patients who had degree III DNS included in this study were underwent septoplasty under general anaesthesia. Spirometry was done 1 day prior and 1 month after surgery. Pre and post-operative values of standard spirometric indices were compared.

Table 1: Comparison of post-operative and pre-operative values using paired t test.

Variables	Paired Differences				T	df	P value	
	Mean	Standard deviation	Standard error mean	95% confidence interval of the difference				
				Lower				Upper
Pre FEV1-post FEV1	-0.15423	0.06956	0.01270	-0.18021	-0.12826	-12.144	29	0.001
Pre FVC-post FVC	-0.10923	0.06444	0.01176	-0.13329	-0.08517	-9.285	29	0.001
Pre FEV1/FVC-post FEV1/FVC	-1.54133	1.25001	0.22822	-2.00809	-1.07457	-6.754	29	0.001
Pre PEF-post PEF	-0.43370	0.13191	0.02408	-0.48295	-0.38445	-18.009	29	0.001
Pre FEF 25-75%-post FEF 25-75%	-0.25063	0.09137	0.01668	-0.28475	-0.21652	-15.025	29	0.001

Table 1 shows comparison of post-operative and pre-operative values using paired t test. P value is 0.001 for

all comparisons which is <0.05 and hence is statistically significant.

All indices showed significant improvement post-operatively, and the standard error mean and standard deviation are depicted in Table 2.

Table 2: Pre-operative and post-operative spirometry statistical analysis.

Variables	Mean	Standard deviation	Standard error mean
Pre-FEV 1	3.1943	0.43106	0.07870
Post-FEV 1	3.3486	0.40034	0.07309
Pre-FVC	3.782	0.52177	0.09526
Post-FVC	3.8913	0.47386	0.08651
Pre-FEV1/FVC	84.512	1.25268	0.22871
Post-FEV1/FVC	86.0533	1.18307	0.21600
Pre-PEF	6.1107	0.55427	0.10120
Post-PEF	6.5444	0.56483	0.10312
Pre-FEF 25-75%	3.3941	0.23445	0.04280
Post-FEF 25-75%	3.6447	0.25943	0.04737

All 30 patients were subjected to spirometry 1 day prior to surgery and 1 month after surgery. The spirometry values were analyzed and the pre-operative and post-operative values were compared. Analysis of the spirometry values of this study revealed that all the parameters improved statistically post operatively. P value was <0.05 for all the parameters which was statistically significant. The parameters compared were, forced expiratory volume in one second (FEV1), forced vital capacity (FVC), FEV1/FVC, peak expiratory flow rate (PEF) and forced expiratory flow rate at 25-75% of FVC (FEF 25-75%).

TABLE 3: Pre-operative and post-operative range of spirometry parameters.

Variables	No. of cases	Minimum	Maximum
Pre-FEV1	30	1.79	3.61
Pre-FVC	30	2.08	4.28
Pre-FEV1/FVC	30	81.59	86.75
Pre-PEF	30	4.63	6.99
Pre-FEF 25-75%	30	2.74	3.76
Post-FEV1	30	2.04	3.76
Post-FVC	30	2.37	4.37
Post-FEV1/FVC	30	83.31	88.39
Post-PEF	30	4.98	7.39
Post-FEF	30	2.97	3.99
Valid N	30		

Pre-operative ranges of spirometry indices as shown in Table-8 are as follows. Pre-operative FEV1 ranges from 1.79 to 3.61. FVC ranges from 2.08 to 4.28, FEV1/FVC

from 81.59 to 86.75, PEF from 4.63 to 6.99 and FEF 25-75% from 2.74 to 3.76.

Post-operative ranges are the following. FEV1 ranges from 2.04 to 3.76, FVC from 2.37 to 4.37, FEV1/FVC from 83.31 to 88.39, PEF from 4.98 to 7.39 and FEF 25-75% from 2.97 to 3.99.

The individual tabulated data with their respective findings are outlines as follows:

Table 4: Forced expiratory volume at 1st second (FEV1).

Group	Pairs	Mean	SD	P value
FEV1	Pre	3.1943	0.43106	0.001
	Post	3.3486	0.40034	

Comparison of pre and post-operative value of FEV1 showed a p value of 0.001 which is statistically significant. There is significant improvement in post-operative value.

Table 5: Forced vital capacity (FVC).

Group	Pairs	Mean	SD	P value
FVC	Pre	3.7820	0.52177	0.001
	Post	3.8913	0.47386	

FVC showed significant improvement post-operatively (p=0.001).

Table 6: FEV1/FVC.

Group	Pairs	Mean	SD	P value
FEV1/FVC	Pre	84.5120	1.25268	0.008
	Post	86.0533	1.18307	

Post-operative FEV1/FVC value also improved significantly and the p value was 0.001.

Table 7: Peak expiratory flow rate (PEF).

Group	Pairs	Mean	SD	P value
PEF	Pre	6.1107	0.55427	0.001
	Post	6.5444	0.56483	

Post-operative PEF value also improved significantly. P value was 0.001.

Table 8: Forced expiratory flow (FEF) 25%-75%.

Group	Pairs	Mean	SD	P value
FEF 25-75%	Pre	3.3941	0.23445	0.001
	Post	3.6447	0.25943	

FEF 25-75% value also showed statistically significant improvement. P=0.001.

DISCUSSION

In a study done by Ragab et al, it was found that the 6 and 12 month post-operative FEV1 per cent (% of predicted) showed significant increase.¹ In our study, mean pre-operative FEV1 was 3.194 ± 0.431 and mean post-operative FEV1 was 3.348 ± 0.403 . On comparing, both p values were 0.001 which was statistically significant. Karaman et al performed septoplasty in 40 patients, and compared the spirometry parameters obtained before operation and three months after the surgery. They showed that FEV1/FVC, PEF (l/sec), FEF25–75% (l/sec), increased statistically significantly, following surgery, substantiated in our study as well.² Niedzielska et al studied PFT differences in children after adenoidectomy, and found significant differences for vital capacity, FEV1, FVC, PEF, FEV1/PEF, and FEV1/FVC. Similarly the mean pre-operative FVC, FEV1/FVC, PEF and FEF 25-75% were 3.78 ± 0.52 , 84.51 ± 1.25 , 6.11 ± 0.554 and 3.394 ± 0.234 respectively and mean post-operative values of the same were 3.891 ± 0.473 , 86.05 ± 1.18 , 6.544 ± 0.564 and 3.644 ± 0.239 respectively. On comparing these values also there was significant improvement. For these parameters except FEV1/FVC the p value was 0.001 which was significant, which is replicable in our findings, and nevertheless, the FEV1/FVC value also improved statistically with p value being 0.008.³ Tzuner et al studied PFT differences after septoplasty in 30 patients, PEF values changed statistically significantly 1 month after septoplasty ($p < 0.001$).⁴ In accordance to all above studies, in our study as well, the spirometry parameters showed improved significantly. P value was 0.001.

Rogha et al found improvement in FEF 25-75%, 40 days after surgery in children with enlarged tonsils as compared with baseline measures.⁵ This is confirmed by our study also. In another study by Ikeda et al which evaluated the clinical efficacy of endonasal ESS in patients with asthma associated with chronic sinusitis, the average peak expiratory flow 6 months following surgery improved in the ESS patients significantly ($p < 0.05$).⁶ Post-operative PEF value also improved significantly. P value was 0.001, showed similar responses in our study as well. Batra et al found significant improvement in post-operative FEV1 and a reduction in systemic steroid usage in a study conducted on asthmatic patients with nasal polyps.¹¹ Post-operative FEV1 was significantly improved in our study. In a similar study done by Karuthedath et al, it was noted that there was increase mean postoperative FEV1 percentage (3 months-92.8%) from the preoperative value (89.9%). The difference between the FEV1 values measured at 1 month and pre-surgical value, 3 and 1 month values, 3 month and pre-surgical value were all found to be significant by the 2 tailed t test (p value less than 0.05). There was also an increase in the FVC percentage from the mean preoperative value (92.06 %) to the 3 month (92.51 %). The difference in the measured FEV at different periods (preoperative, 1 and 3 months) were found to be non-

significant. The mean difference in FEV1/ FVC values at 1 month post-operative and preoperative was 0.024. The mean difference in FEV1/FVC values at 3 and 1 month post-operative was 0.008. The mean difference in FEV1/FVC values at 3 month post-operative and preoperative was 0.032. The difference in the FEV1/FVC ratio was found to be statistically significant only between 3 month post-operative and preoperative period using 2 tailed t test ($p < 0.05$). This improvement can be attributed mainly to the surgery with steroid sprays and antibiotics also playing a role. The absence of significant difference between the preoperative and 1 month values may be due to postoperative inflammation.¹² As appraised earlier, in our study all the parameters, i.e. FEV1, FVC, FEV1/FVC, PEF, and FEF25-75%, showed statistically significant ($p < 0.05$) improvement after septoplasty. Similar to our findings, Kavukcu et al reported an increase in FVC, PEF, FEV1, MEF25, FEF, and FEF75 after adenotonsillectomy.¹⁰ In their study Bulcun et al concluded that septoplasty can improve nasal symptoms, pulmonary function tests and bronchial hyper responsiveness after surgery and this is reflected in our study results.⁸ Yadav et al concluded that, spirometry proved as a useful diagnostic tool in adenotonsillar hypertrophy deciding early intervention to prevent cardio-pulmonary complications. The flow volume plot was abnormal in all patients along with hypoxia. As depicted by us, in their study there was statistically significant improvement in above parameters following surgery.¹³ Aykan et al in their study in 2016 observed significantly lower forced vital capacity values in children with prominent adenoid hypertrophy. The final forced mid-expiratory flow rate (FEF 25-75) values were statistically higher in patients who were using nasal steroids.⁹ In another study by Goldstein et al, few patients demonstrated statistically significant improvement after FESS in asthma symptom scores (1 patient), medication use scores (1 patient), or pulmonary function test results (2 patients), which is in clearly proven to be the case in accordance to our findings as well.⁷

CONCLUSION

There was 100% improvement IIIrd degree deviated nasal septal cases in all the patients even though the spirometry test was done only one month post-operatively, and this is the achievement of this study which could be also attributed to the surgical skill of the surgeon as a result of which there was less inflammation, crusting and other complications post-operatively and hence all these did not affect the final outcome. All the surgeries were done by a single surgeon. This improvement in pulmonary functions of patients following septoplasty suggests that following surgical correction of nasal breathing pattern, respiratory capacity and the deepness of the respiration increase when compared to the preoperative period. This also signifies decrease in bronchial hyper responsiveness as compared to the pre-operative condition. This study was done in patients with normal pulmonary functions attributing to the authenticity of the findings.

Nevertheless this study focuses on the improvement in values of the spirometry indices post-operatively alone. Thereby, further studies could be taken up for assessment of symptom analysis postoperatively as well.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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