



## Polysomnographic and pulmonary function changes in patients with sleep problems after septoplasty with turbinectomy<sup>☆</sup>

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### ABSTRACT

**Object:** To compare Polysomnography and Pulmonary function tests before and after Septoplasty with Turbinectomy in patients complaining of nasal obstruction and sleep problems due to deviated septum with hypertrophied inferior turbinate.

**Methods:** 90 patients underwent Septoplasty with Turbinectomy due to nasal obstruction and sleep problems involved in this study, their sleep quality evaluated by polysomnography before and after the surgery, their pulmonary functions assessed by spirometry before and after the operation.

**Results:** The postoperative pulmonary function values; FVC, FEV1, PEFr and postoperative polysomnographic values; AHI, Snoring index/hour, SpO2 were higher than the preoperative values, and the results were statistically significant ( $p$ -values < 0.001).

**Conclusion:** Septoplasty with partial inferior turbinectomy might be a useful operation in the management of nasal obstruction and sleep problems that caused by a deviated nasal septum and hypertrophied inferior turbinate.

### 1. Introduction

The nasal cavity is divided into two halves by the nasal septum; the nasal septum consisted of two parts (cartilaginous part and bony or osseous part) [1]. Trauma, Environmental factors, and Genetic factors are the most common cause that leads to a deviated nasal septum [2]. The deviated nasal septum with hypertrophied inferior turbinate may cause nasal handicap to the patients [3].

The nose had a vital role in the respiratory tract physiology. The study of the effect of nasal diseases on the pathogenesis of sleep-disordered breathing and the value of nasal problems management would be significant [4]. Some pathological disorders that cause nasal obstruction might make sleep-disorder breathing worse, the causes of nasal obstruction might be divided into irreversible reasons like septal deviation, hypertrophied inferior turbinate, nasal polyposis, and inverted papilloma and reversible reasons like allergic rhinitis and non-allergic rhinitis that respond to medical treatment [5].

The septoplasty operation would include removing the deviated

part of septal cartilage or bone and remodeling with replacing the cartilage in the midline; the turbinate reduction might be one by different techniques like laser, radiofrequency or electrocautery [6,7].

Polysomnography is an accurate investigation that detects the presence of obstructive sleep apnea and classifies its severity. Polysomnography is a night laboratory test, several physiologic parameters can be recorded continuously and simultaneously during the sleep, and the wake, these parameters include electromyography, electroencephalography, and electro-oculography [8,9].

The nasal breathing helps the respiratory system in warming and humidifies the inspired air, deviated nasal septum and its pathological sequelae as hypertrophied inferior turbinate may lead to alteration of the respiratory mechanics, and changes in the compositions of arterial blood, these changes in standard pulmonary functions may lead to malfunction of many body systems especially the respiratory system [10–12].

There were many old studies which concluded that the nasal obstruction could affect pulmonary functions [11], there might be a

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relationship between improvement of nasal obstruction after the success of correction of nasal pathology by nasal operation and improvement of postoperative pulmonary function after the surgery [12].

## 2. Patients and methods

The study included 90 patients aged from 17 years to 35 years, 39 males (43.3%) and 51 females (46.7%) underwent Septoplasty with Turbinectomy for the reason of nasal obstruction and sleep problems; the study carried out in Benha and Kafr Elsheikh University Hospitals, Faculty of Medicine, ENT department and Chest department at the period from April 2017 to August 2018. Ethical committee approval from Benha and Kafr-Elsheikh university Hospitals and informed written consent from the patients obtained before the onset of this study, The mean age was  $26.7 \pm 9.48$  years, 39(43.3%) of the patients were males, and 51(46.7%) were females, the investigations of this prospective study conducted in the Chest department of Benha University Hospital and Kafr Elsheikh University Hospital.

### 2.1. Inclusion criteria

Patients presented by severe nasal obstruction, shortness of breath, snoring and sleep problems caused by significant deviated nasal septum with hypertrophied inferior turbinates.

### 2.2. Exclusion criteria

Patients who had one or more condition of these criteria were excluded: nasal allergy, nasal polyps, smoking, any lung diseases, allergic, fungal sinusitis, previous nasal operations, pregnancy, any systemic diseases as (heart failure, hypertension, diabetes), any lung diseases, any other cause of sleep apnea like (large tonsil, long thick uvula, redundant palate, obese patients (BMI > 35), neurological disorders), patients who were lost during follow up period.

### 2.3. Methods

All patients were subjected to the following:

- 1- Nasal obstruction assessment; the presence of nasal congestion, blockage trouble breathing through nose, trouble sleeping, unable to get enough air through the nose, and presence of the significant deviated nasal septum with hypertrophied inferior turbinates.
- 2- Nasal endoscopy and computed tomography (CT) scan of nose and paranasal sinuses.
- 3- Polysomnography: Laboratory polysomnography (SOMNO screen™ plus PSG Tele, by SOMNO medics GmbH), done for all patients one week before the surgery and then 12 weeks after it.
- 4- Spirometry: All patients in this study underwent spirometry (MIR, spiro-doc, Italy); all patients guided to have a suitable sitting position without any restriction to the movements of the chest (like heavy or tight clothes). The same physician observed all patients, the best trial out of 3 successful trials taken as the best results or till 8 trials done by the patient, the forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), FEV1/FVC ratio, peak expiratory flow (PEF), forced inspiratory flow at 50% of FVC (FIF50%) forced expiratory flow at 50% of FVC (FEF50%), pre-operatively and post-operatively were recorded and compared.
- 5- Septoplasty and turbinectomy: The operation done under general anesthesia with use of endoscope to ensure adequate correction of the deviated nasal septum (removing the deviated part of septal cartilage or bone and remodeling with replacing the cartilage in the midline) and excision of only posterior portion of the inferior

turbinate (to prevent empty nose syndrome), nasal septal splint placed then merocel packs left in nose, patients kept 48 h after the surgery.

### 2.4. Follow up

Nasal packs removed 48 h after the surgery but nasal septal splint seven days after the surgery; Antibiotics prescribed with alkaline nasal douching for ten days after the surgery, there were no complications detected during the postoperative two months follow up.

### 2.5. Statistical analysis

The clinical data expressed as Mean and standard deviation ( $\pm$  SD) for quantitative data, frequency, and distribution of qualitative data. Quantitative data were compared using: - Paired *t*-test and Wilcoxon test (Z test). All data tabulated and analyzed using the computer program SPSS (Statistical package for social science) version 20. A *p* value < 0.05 was considered statistically significant (\*) while > 0.05 statistically insignificant. A *p* value < 0.01 was considered highly significant (\*\*) in all analyses.

## 3. Results

This study included 90 patients with age ranged from 17 to 35 years old with mean  $26.7 \pm 9.48$ , there were 39 males (43.3%), and 51 females (56.7%) and the mean of their body mass index (BMI) was  $26.17 \pm 6.69$ , Table 1.

Preoperative pulmonary function values compared to the post-operative values showed that; the preoperative FVC ( $3.1 \pm 0.79$  l) became ( $4.47 \pm 1.03$  l) after the surgery and showed highly statistically significant value (*p*-value < 0.001). The post-operative FEV1 ( $3.83 \pm 0.69$  l) significantly increased than the preoperative FEV1 ( $2.63 \pm 0.76$  l) (*p*-value < 0.001). The preoperative FEV1/FVC (84.6  $\pm$  9.54%) became (88.53  $\pm$  3.58%) after the surgery, this improvement was statistically significant value (*p*-value = 0.001). The pre-operative PEF (5.53  $\pm$  1.60 l) became (7.07  $\pm$  2.23 l) after the surgery with a highly statistically significant difference (*p*-value < 0.001). The pre-operative FEF25–75% ( $2.7 \pm 1.14$  l) became (3.7  $\pm$  1.35 l) after the surgery with highly statistically significant difference (*p*-value < 0.001), Table 2.

In this study, the pre-operative polysomnography data compared to the post-operative data and showed improvement of the pre-operative AHI from (11.6  $\pm$  5.76) to (6.5  $\pm$  2.88) post-operatively, with highly statistically significant difference (*p*-value < 0.001). The Snoring index/hour decreased from (127.8  $\pm$  84.92) before the surgery to (53.33  $\pm$  41.22) after the surgery with highly statistically significant difference (*p*-value < 0.001). The basal SpaO2 improved from (96.4  $\pm$  1.34 mmHg) before the surgery to (97.0  $\pm$  0.26 mm Hg) after the surgery with highly statistically significant difference (*p*-value < 0.001). The Minimal SpaO2 enhanced from (89.83  $\pm$  4.59 mm Hg) before the surgery to (92.57  $\pm$  2.67 mm Hg) after the surgery; these changes were highly statistically significant (*p*-value < 0.001), Table 3.

**Table 1**  
Age, sex and body mass index.

|                       |                  |
|-----------------------|------------------|
| Age (mean + SD) years | 26.7 $\pm$ 9.48  |
| Sex                   |                  |
| Males                 | 39 (43.3)        |
| Females               | 51 (56.7)        |
| BMI                   | 26.17 $\pm$ 6.61 |

**Table 2**  
Comparing pulmonary function pre and postoperative of the patient.

| Items         | Preoperative | Postoperative | Paired t-test | p-Value   |
|---------------|--------------|---------------|---------------|-----------|
| FVC L(L)      | 3.1 ± 0.79   | 4.47 ± 1.03   | 19.61         | < 0.001** |
| FEV1 (L/S)    | 2.63 ± 0.76  | 3.83 ± 0.69   | 28.3          | < 0.001** |
| FEV1/FVC      | 84.6 ± 9.54  | 88.53 ± 3.58  | 3.36          | 0.001**   |
| PEFR (L/S)    | 5.53 ± 1.60  | 7.07 ± 2.23   | 14.6          | < 0.001** |
| FEF 25–75 (L) | 2.7 ± 1.14   | 3.7 ± 1.35    | 18.27         | < 0.001** |

\*\* = highly statistically significant difference.

**Table 3**  
Comparing polysomnography data pre and postoperative of the patients.

| Items                  | Preoperative  | Postoperative | Paired t-test | p-Value   |
|------------------------|---------------|---------------|---------------|-----------|
| AHI                    | 11.6 ± 5.76   | 6.5 ± 2.88    | 14.07         | < 0.001** |
| Snoring index/<br>hour | 127.8 ± 84.92 | 53.33 ± 41.22 | Z = 8.25      | < 0.001** |
| Basal SpaO2            | 96.4 ± 1.34   | 97.0 ± 0.26   | 4.61          | < 0.001** |
| Minimal SpaO2          | 89.83 ± 4.59  | 92.57 ± 2.67  | 10.84         | < 0.001** |

\*\* = highly statistically significant difference.

#### 4. Discussion

The nasal cavity is the first entry for air that the lungs inhale it. Nasal obstruction is one of the most common problems in rhinologic practice, the deviated nasal septum with hypertrophic inferior turbinate represents the first cause of nasal obstruction [13], almost 60–90% of peoples who had nasal obstruction had deviated nasal septum with hypertrophic inferior turbinate [14,15].

The effect of nasal obstruction on sleep breathing disorders might be controversial. Lavie et al. and Mc Nicholas et al. found a healthy relationship between nasal obstructions and sleep breathing disorders. Miljeteig et al. and Atkins et al. recommended for more attention for the nose during the investigations for patients with sleep breathing disorders [16].

The nose should keep opened during sleep for patients who need continuous positive airway pressure (CPAP) mask [17]. The nasal surgery as (septoplasty, nasal valve surgery, and functional rhinoplasty) should be done if it will improve snoring, sleep problems and keep the patient compliance with CPAP [18], that I why nasal surgery should be an essential part of a multi-level plan that should be done for treatment of sleep breathing disorders [19].

Nasal surgery should be done to change structural abnormalities found in primary snores suffering from nasal obstruction with snoring; some patients come to the rhinologist trying to improve CPAP efficacy, or try to correct the causes [20]. There were many studies published about the effect of septoplasty on snoring, and these studies demonstrated improvement snoring as it reduced by 50–75% [21,22], surgical outcome of these studies measured subjectively by questionnaire or visual analog scales [23].

Panicker et al. reported in their study, that the majority of the their studied patients underwent septoplasty (88.57%) in comparison with septorhinoplasty (11.42%), patients with septoplasty showed significant improvement in the mean postoperative values of FVC%, FEV1% and PEFR ( $p < 0.05$ ), while patients with septorhinoplasty recorded postoperative values of FVC%, FEV1% and PEFR higher than the preoperative values ( $p > 0.05$ ), [24].

Elzayat et al reported in their study: effect of partial inferior turbinectomy operation on pulmonary function tests that; the post-operative FVC ( $4.551 \pm 0.253$  l), FEV1 ( $3.8807 \pm 0.2106$  l), FEV1/FVC ratio ( $85.29\% \pm 1.648$ ), PEF ( $8.186 \pm 0.562$  L/M) and FIF50% ( $4.686 \pm 0.1332$  L/S), significantly improved in comparison with the pre-operative FVC ( $4.348 \pm 0.270$  l), FEV1 ( $3.613 \pm 0.219$  l), FEV1/FVC ratio ( $83.10\% \pm 0.689$ ), PEF ( $6.724 \pm 0.3694$  L/Min) and FIF50% ( $3.240 \pm 0.1711$  L/s), ( $p < 0.001$ ). However, the post-

operative FEF50% ( $4.100 \pm 0.17811$  L/M) was not significantly improved from the pre-operative FEF50% ( $4.0233 \pm 0.165$  L/M), ( $p = 0.673$ ), [25].

In this study, Pulmonary functions tests done by spirometry in a comparative way: the pre-operative; FVC ( $3.1 \pm 0.79$  l), FEV1 ( $2.63 \pm 0.76$  l), FEV1/FVC ( $84.6 \pm 9.54\%$ ), PEFR ( $5.53 \pm 1.60$  l) and FEF25–75% ( $2.7 \pm 1.14$  l) much improved significantly post-operatively to become FVC ( $4.47 \pm 1.03$  l), FEV1 ( $3.83 \pm 0.69$  l), FEV1/FVC ( $88.53 \pm 3.58\%$ ), PEFR ( $7.07 \pm 2.23$  l) and FEF25–75% ( $3.7 \pm 1.35$  l), ( $p$ -value  $< 0.001$ ). This improvement suggests that following surgical correction of nasal breathing pattern and widening of the nasal cavity; the respiratory capacity and the deepness of the respiration increase when compared to the preoperative period.

In this study, polysomnography data before the operation would compare with polysomnography data after the procedure; The AHI changed from  $11.6 \pm 5.76$  before the surgery to  $6.5 \pm 2.88$  after the surgery, these changes were highly statistically significant ( $p < 0.001$ ). The Snoring index/h changed from  $127.8 \pm 84.92$  before the surgery to  $53.33 \pm 41.22$  after the surgery, these changes were highly statistically significant ( $p < 0.001$ ). The Basal SpaO2 changed from  $96.4 \pm 1.34$  before the surgery to  $97 \pm 0.26$  after the surgery; these changes were statistically significant ( $p < 0.001$ ). The Minimal SpaO2 changed from  $89.83 \pm 4.59$  before the surgery to  $92.57 \pm 2.67$  after the surgery; these changes were highly statistically significant ( $p < 0.001$ ).

It has been hypothesized that nasal obstruction causes an increase in negative pressure in the upper airway and induces an inspiratory collapse at the pharyngeal level which cause reduction or cessation of airflow. It may cause nighttime hypoxemia or vascular injury due to free oxygen radicals and even lead to cardiovascular, endocrinologic and neurocognitive diseases without proper diagnosis treatment [26].

Chong et al, in their study provides evidence that the surgical treatment of nasal pathology improves nasal airway patency and reduces OSA severity in 56% subjects. Furthermore, correction of nasal pathology appears to result in improved sleep quality in both responders and non-responders OSA subjects, [27]. Kim et al. concluded that Snoring and OSA might be corrected merely by septal surgery in some patients, and secondary surgery (uvulopalatoplasty) might consider after a thorough evaluation by utilizing of postoperative PSG, [19].

Lavie and coworkers, demonstrated in their study on 14 patients who were complaining of sleep breathing disorders; when these patients underwent the only septoplasty, the severity of sleep breathing disorders did not change after the operation, but the majority of the patients demonstrated with improvement in quality of sleep and reduced daytime fatigue [28].

Verse et al. studied 26 patients with sleep breathing disorders; 1 female and 25 males. The mean age was 52.5 years, and the mean body mass index was  $29.16 \text{ kg/m}^2$  that did not change when the patients re-examined ( $29.2 \text{ kg/m}^2$ ); 7 of them complained of simple snoring, their AHI was  $< 10$  but 19 of them complained of obstructive sleep apnea, their AHI was  $> 10$ , the postoperative follow-up polysomnography showed no significant improvement in AHI ( $31.6$  vs.  $28.9$ ) and the oxygen desaturation [29].

#### 5. Conclusion

In this study results suggest that Septoplasty with partial inferior turbinectomy is a useful operation in the management of nasal obstruction and sleep problems that caused by a deviated nasal septum and hypertrophied inferior turbinate as there is an improvement of polysomnography results and pulmonary function tests after the surgery.

## Conflict of interest

All authors declare that they have no conflict of interest.

## Funding

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Ethical committee approval from Benha and Kafr Elsheikh University Hospitals were taken and informed written consent from all patients was obtained before the onset of this study.

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