Evaluation of Septal surgery effects on pulmonary function tests

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Background: Nasal obstruction due to deviated nasal septum is a common condition, affecting respiration and daily activity. Septal surgeries, including septoplasty and submucosal resection (SMR), are safe and effective operations treating the nasal obstruction and nasal resistance induced by significant nasal septal deviation.

Patients and Methods: Sixty patients were included in this study to determine the effect of the septal surgeries on pulmonary functions and daily activity, objectively by using spirometry and 6-minutes walking test before and after the operation.

Results: FVC, FEV1, and FEV1/FVC significantly improved after the operation. VAS score, fatigue Score, and dyspnea score much improved post-operatively.

Conclusions: Septal surgeries are profitable operations in the management of nasal obstruction caused by severe symptomatic septal deviation, resulting in improvement of the pulmonary function tests and daily activity after the operation without marked complications.

Keywords: Septoplasty, SMR, Pulmonary functions, Nasal obstruction, 6 Minutes walk test.

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Introduction

The nasal septum, which separates the nasal space into two halves, consists of cartilaginous and osseous parts. [1] The deviated nasal septum, involving dislocation of the nasal septum, is mostly limited to the septal bone, septal cartilage and sometimes both. [2] It is approximated that up to 90% of individuals have nasal septal deformities without any symptoms.1 Trauma, along with genetic and environmental factors, are the foremost usual etiologic factors for nasal septal deviation. [2]

The nose is the most physiologic way of respiration, performing essential functions such as filtration, heat exchange, humidification, and olfaction. [3] Nasal septum deviations and the subsequent pathological alteration of the nasal turbinates are commonly identified to cause nasal handicap to the patients. [4] These alterations may lead to one-sided obstruction and can with respiratory and aesthetic problems. [5]

Deviation of the nasal septum and subsequent pathological alterations are usually identified to cause changes in respiratory mechanics and arterial blood compositions. Deviation of normal pulmonary functions leads to dysfunction of the respiratory system, and this affects the functions and vitality of other related systems. [6]

Pulmonary function tests provide useful information on the state of the airways, lung volumes, and lung function. A clinically significant deviated septum is defined as one with sufficient deviation that would make the patient a candidate for septoplasty if the obstructive nasal symptoms do not respond to medical therapy. [7] Surgical correction of the deviated septum theoretically by septoplasty or submucous resection (SMR) should improve nasal breathing as well as pulmonary mechanics.

In this study, we attempted to correlate between septal surgeries and their impact on the pulmonary functions and daily activity.

Methods

This prospective study was conducted in the Otorhinolaryngology Department in collaboration with the Chest Department in Kaferelsheikh University Hospitals, Egypt, in the period between October 2017 July 2019. Sixty consecutive cases planned for septal surgery were included in the study. Patients were included in this study by signing an informed consent. The local ethical committee approved the study. All patients complained of severe nasal obstruction and shorting of breath due to severe septal deviation (after exclusion of other causes of nasal obstruction), and after failure of medical management (local and systemic corticosteroids). All cases with smoking, previous nasal operations, any medical problems (as heart failure, hypertension, diabetes, lung diseases, neurological disorders), obese patients (BMI >30), physical disability preventing 6-minutes walking test performance, and improper follow-up patients were excluded from the study. Clinical examination of the patients was done in the form of anterior rhinoscopy and endoscopic examination with a computerized tomography (CT) scan of the nose to confirm the diagnosis and exclude other causes of nasal obstructions.

All operations were done under general anesthesia by the same surgeon; 45 septoplasties and 15 SMR. Endoscopic dissection of the septum was done to ensure maximal correction of septal deformities with flaps preservation. Hemostasis during and after the surgery was done using nasal packs without any cauterization modalities.

Every patient underwent a 6-minutes walking test 1 week before operation and two months after the operation. The test was done indoor on a flat 15-meter walking area (a straight line with two cones) in the room temperature, where the patient was informed to walk with his best usual

speed. Patients were observed by the same physician using a stopwatch. The usual physiological parameters of the test were measured one minute before starting the test, and one minute after the end, these parameters include; heart rate, blood pressure, and peripheral oxygen saturation by using an oximeter. We also used the modified Borg dyspnea scale and fatigue scale. Pulmonary functions were evaluated by the same physician one week before the operation and two months following the operation by using (P. K. Morgan Ltd.) Spirometry. The patient was asked to set in a comfortable position without any restriction to chest movements (as tight clothes) with a complete explanation of the test and adequate training with a 2- minute rest interval between tests. The patient was asked to do three successful trials of each test, and the maximal result was recorded to ensure accurate results. We focused on forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), FEV1/FVC ratio, peak expiratory flow (PEF). The pre-operative and post-operative results were recorded and compared. We also used the VAS score, which is ranged from 1 (no improvement) to 10 (complete improvement), to evaluate the effect of the surgery on nasal obstruction subjectively. Lund and Kennedy's score was used to assess the extent of intra-nasal crustations after surgery, the score ranges from 1 (no crustations) to 3 (severe crustations filling the nasal cavity). 8 All data were collected, recorded, and statistically analyzed by IBM SPSS 22 software package.

Results

The study included 60 patients, their age ranged between 19 and 35 years old with a mean of 23.89±5.856. They were 36 males (60%) and 24 females (40%), **(Table 1)**.

Table 1: Age, sex and septal demographics

Age: (Mean±SD) years		19-35 (25.89±5.816)
Sex: number (%)	Male	36 (60%)
	Female	24 (40%).
Laterality of deviated septum	Right	20
	Left	25
Bony and cartilaginous deviation	S-shaped	15
	Cartilage	35
	Bony	20
	Both	5
Type of septal surgery	septoplasty	45
	SMR	15

Pulmonary function tests were measured by spirometry in a comparative pattern, and the pre-operative FVC was 4.126±0.05 liters, while the post-operative FVC was 4.662±0.475 liters, the improvement in FVC was statistically significant (p<0.001). The pre-operative FEV1 was 3.401±0.207 liters, while the post-operative FEV1 was 3.8605±0.211 liters, the difference was statistically significant (p<0.001). The pre-operative FEV1/FVC ratio was 81.10%±0.467, while the post-operative FEV1/FVC ratio was 84.07%±1.426 which had increased significantly after the operation (p<0.001) **(Table 2)**.

Table 2: pulmonary function tests results

Parameter	Pre-operative (Mean±SD)	Post-operative (Mean±SD)	P value
FVC (L)	4.126±0.05	4.662±0.475	<0.001
FEV1 (L)	3.401±0.207	3.8605±0.2114	<0.001
FEV1/FVC (%)	81.10±0.467	84.07±1.426	<0.001

The 6-minutes walking test, the total distance pre-operative increased from 676.30±3.215 meters to 717.144±6,317 meters post-operatively; this improvement was statistically significant (p<0.001). The mean systolic blood pressure after the test, before the operation was 114.65±4.064, and after the operation it was 114.333±5.512 with no significant difference (p=0.375). The mean post-operative diastolic blood pressure after the test was 79.333±4.096, when compared to the pre-operative diastolic blood pressure after the test which was 75.333±3.924, the difference was statistically significant (p<0.001) **(Table 3)**.

Table 3: 6-minutes' walk test results

Parameter	Before operation	After operation	P value
Walked distance (meters)	676.30±3.215	717.144±6.317	<0.001
Systolic blood pressure	114.65±4.064	114.333±5.512	0.375
Diastolic blood pressure	75.333±3.924	79.333±4.096	<0.001
Heart rate (before test) (beats per minute)	72.30±7.206	75.322±5.101	0.018
Heart rate (after test) (beats per minute)	93.088±5.278	85.30±5.113	<0.001
Dyspnea score	2.357±0.6404	0.45±0.210	<0.001
Fatigue score	3.311±0.554	0.44±0.58	<0.001

The mean pre-operative heart rate before the test was 72.30±7.206 beats per minute, while the post-operative heart rate was 75.322±5.101 beats per minute, the difference was statistically insignificant (p=0.018). Modified Borg dyspnea scale was 2.357±0.6404 pre-operatively and became 0.45±0.21 post-operatively, the change was statistically significant (p<0.001). Fatigue scale changed significantly from 3.311±0.554 preoperatively to 0.44±0.58 postoperatively. Visual Analogue Score (VAS) was 8.66±0.875 after the operation, and Lund and Kennedy score regarding intranasal crustations after the operation was 0.25±0.230 **(Table 4)**.

Table 4: Subjective studies

Visual analog score (Mean±SD)	8.66±0.875
Lund and Kennedy score (Mean±SD)	0.25±0.23

Discussion

Difficulty in nasal breathing is perhaps the most common grievance in rhinology practice. Among the leading causes, nasal septum deviation accounts first.9 Studies have quoted that 60–90% of the population have a deviated septum. [10]

Chronic nasal obstruction cause mouth breathing which affects the cranial shape, obstructive sleep apnea. [11] Loss of nasal warming and humidification due to mouth breathing cause changes in the diffusion and viscosity of the surfactant which may be stimulating bronchiolar obstruction, consequently affecting the daily activity and causes psychological disturbances. [12]

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 causes 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. [13]

Loehr et al, studied 85 patients with chronic sinusitis and recorded an improvement in subjective and objective symptoms of asthma, and decreased use of bronchodilators following FESS operation. [14] Chien et al, reported that chronic obstructive pulmonary disease was associated with an increased risk of chronic rhinosinusitis without nasal polyps, independent of a number of potential confounding factors. [15]

Many studies have been done to prove the relation between nasal obstruction and pulmonary functions. However, Mandour et al, evaluated the effect of septoplasty with turbinectomy on polysomnographic and pulmonary function changes in patients with sleep problems in a comparative way where the pre-operative; FVC, FEV1, and FEV1/FVC have significantly improved postoperatively. This improvement, following the surgical correction of nasal breathing pattern, suggested being due to widening of the nasal cavity; the respiratory capacity, and the deepness of the respiration when compared to the preoperative period. [16]

Elzayat et al, studied the effect of partial inferior turbinectomy on pulmonary function tests and reported that the post-operative FVC (4.551 ± 0.253 l), FEV1 (3.8807 ± 0.2106 l), FEV1/FVC ratio (85.29% ± 1.648), significantly improved in comparison with the pre-operative FVC (4.348 ± 0.270 l), FEV1 (3.613 ± 0.219 l), FEV1/ FVC ratio (83.10% ± 0.689). [11]

In this study, we tried to declare the relationship between

nasal obstruction and pulmonary functions by evaluating the pulmonary functions before and after septal correction surgery, subjectively, and objectively. We included 60 patients in this study, their age ranged between 19 and 35 years old with a mean of 25.89±5.816. They were 36 males (60%) and 24 females (40%). We excluded any factor affecting results as smoking, obesity, and any other diseases aiming at getting reliable, accurate results. Spirometry objectively used to measure the pulmonary function tests one week before and two months after the operation by the same physician. It reported significant improvement of pulmonary functions tests, especially FVC, FEV1, and FEV1/FVC ratio after the operation. The 6-minutes walking test, another objective test easy to administer, was used to assess activity improvement. There was a significant improvement in the walked distance without dyspnea or fatigue. The VAS scale, applied to achieve more accurate confirmed results, reported a significant improvement of nasal obstruction after the operation with minimal complications, especially crustations according to Lund and Kenedy score.8 The study results confirmed the significant improvement of nasal obstruction, pulmonary function tests, 6-minutes walk test and daily activity following corrective septal surgery.

Conclusion

Septal corrective surgery is a profitable surgery in the management of nasal obstruction due to severe septal deviation resulting in improvement of the pulmonary function tests and daily activity after the operation without marked complications.

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Conflict of interests

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