The Egyptian Journal of Hospital Medicine (April 2024) Vol. 95, Page 1982- 1986

Effect of Septoplasty on Middle Ear Pressure in Patients with Nasal Septal Deviation

Medhat Mohammed Heshmet Mansour, Ahmed Samy Elguindy,
Maha Abo-Elela Ahmed*, Ahmed Ali El Naggar
Otolaryngology Department, Faculty of Medicine, Tanta University, Tanta, Egypt
*** Corresponding author:** Maha Abo-Elela Ahmed, Email: **docmaha18@gmail.com**, Phone: +2 01143107109

ABSTRACT

Background: Nasal septum deviation (NSD) is a widespread issue that may influence the Eustachian tube (ET), affecting middle ear pressure. While septoplasty is commonly performed to correct NSD and potentially alleviate related symptoms, its effect on ET function and middle ear pressure has been variably reported.

Objective: To examine the outcomes of septoplasty on the functionality of the Eustachian tube and the pressure levels in the middle ear among patients suffering from nasal blockage attributed to NSD.

Patients and Methods: This consecutive case series study was conducted on 50 patients over 18 years with symptomatic NSD and intact tympanic membranes. Assessments included tympanometry and nose score questionnaires preoperatively and eight weeks postoperatively.

Results: The study population had a mean age of 32.64 ± 8.93 years, with a slight male predominance (56%). Postoperative assessments showed significant improvement in nose scores (from 17.34 ± 8.05 pre-surgery to 9.6 ± 5.22 post-surgery, $P < 0.001$) and tympanometric measurements in both ears ($P = 0.023$ for the right ear, $P = 0.011$ for the left ear), indicating enhanced ET function and middle ear pressure regulation.

Conclusions: Nose score can be used as subjective tool for assessment of pre and postoperative nasal symptoms in addition to existing methods. Septoplasty in patients with septal deviation with concomitant middle ear dysfunction, might omit the need for Eustachian tube or middle ear surgery.

Keywords: Septoplasty, Middle Ear Pressure, Nasal Septal Deviation.

INTRODUCTION

Although the nose and ear may seem like distinct organs, they are interconnected via the Eustachian tube (ET) [1]. The ET, a structure made of bone and fibrocartilage, stretches from the middle ear cleft to the nasopharynx on the lateral wall. Its primary role is to balance the pressure in the middle ear with the external atmospheric pressure, crucial for the proper functioning of the middle ear. Various techniques are employed to evaluate the functionality of the ET [2]. One such method is sonotubometry, which relies on measuring the transmission of sound waves through the ET, though its execution presents challenges. Another approach is the manometric test through tympanometry, which faces limitations, especially in accurately assessing ET function when the tympanic membrane remains intact [3].

Nasal obstructions stemming from conditions such as allergies, deviated nasal septum, enlarged inferior turbinate, or nasopharyngeal masses, along with ET dysfunction, can adversely affect middle ear pressure. These issues often result in effusion, infection, and chronic inflammation within the middle ear [4].

The causes of nasal obstruction can be categorized into mucosal and anatomical origins. Septal deviation stands out as the primary anatomical reason, while the enlargement of the inferior turbinate is a frequent mucosal cause [5]. Septal deviation is the misalignment of the nasal septum inside the nose and is classified into several types: Type I involves minor deviations without extending through the septum's vertical dimension, either vertically or horizontally. Type II is characterized by a vertical deviation towards the front, and Type III involves a vertical deviation towards the back. Type IV is an S-shaped septum, whereas Type V displays horizontal spurs on one side, potentially accompanied by significant distortion on the opposite side. Type VI is similar to Type V but includes a deep groove on the concave side. Type VII represents any combination of Types II to VI [6]. Patients often report symptoms of Eustachian tube dysfunction on the same side as their nasal septal deviation [7].

This study aimed to investigate the impact of septoplasty on the function of the Eustachian tube in patients with nasal obstructions due to septal deviation, employing tympanometry and the nasal scale before and after surgery.

PATIENTS AND METHODS

Study Design and patients:

This consecutive case series study was conducted at the Otolaryngology, Head and Neck Surgery Hospital, Tanta University Hospitals. Fifty cases were recruited from August 2021 to August 2022.

Inclusion criteria were patients > 18 years, with symptomatic NSD and intact tympanic membrane.

Exclusion criteria were patient with other causes of nasal obstruction (Adenoid, nasopharyngeal masses, nasal polyposis), cleft palate, active upper respiratory tract infection and previously undergone septoplasty, functional endoscopic sinus surgery, or previous insertion of ventilation tube at the tympanic membrane.

All patients were subjected to:

History taking including the personal history, risk factors as hypertension, drug intake, diabetes mellitus, obesity, smoking, and renal, hepatic diseases, or collagen disorder etc.

Received: 07/12/2023
Accepted: 07/02/2024

Ear history including tinnitus, sense of air fullness, hearing loss. etc.

ENT examination: Before the operation and eight weeks post-surgery, patients underwent ENT examinations, which included completing nose score questionnaires. Those experiencing a sensation of fullness in the ear were also assessed through questionnaires both before the surgery and eight weeks afterward. To ensure ease and comfort in completion, the questionnaires were translated into Arabic, enabling patients to fill them out without any stress or challenges **(Figure 1)** [8].

* تملأ بمعرفة المريض : من فضلك أجب على الاستبيان التالي لمعرفة تأثير انسداد التنفس على حياتك اليومية. ما مدى تأثرك بهذه الأعراض في الشهر الماضي؟
من فضلك اختر الاجابة الأدق

	لا يوجد مشكلة	مشكلة بسيطة	مشكلة متوسطة	مشكلة سيئة إلى حد ما	مشكلة شديدة
احتقان أو تصلب بالأنف	0	1	2	3	4
انسداد بالأنف	0	1	2	3	4
صعوبة التنفس عن طريق الأنف	0	1	2	3	4
اضطرابات في النوم	0	1	2	3	4
عدم القدرة على التنفس جيدا من الأنف أثناء بذل مجهود اضافي	0	1	2	3	4

Figure 1: Arabic version of the NOSE scale (A-NOSE) [8].

Nasal examination including both septum and inferior and middle turbinate. Otoscopic examination including tympanometry preoperatively and eight weeks after surgery, investigational studies either radiological investigation as CT scan nose and para nasal sinus or laboratory investigation as preoperative routine laboratory (CBC, random blood sugar, kidney function, liver function, coagulation profile).

Statistical Analysis

The data were analyzed using SPSS version 26 (IBM Inc., Chicago, IL, USA). Quantitative data were described using the mean, standard deviation (SD), and range, while the paired Student's t-test was employed for comparing data before and after the intervention. On the other hand, qualitative data were summarized as counts and percentages (%) and were compared by chi^2 test. P value < 0.05 was considered significant.

RESULTS

Demographic data and laboratory investigations of the studied patients are mentioned in **Table 1**.

Table 1: Demographic data and laboratory investigations of the studied patients

		N=50
Age (years)	Mean ± SD	32.64 ± 8.93
	Range	18 - 50
Sex	Male	28 (56%)
	Female	22 (44%)
Hb (g/dl)	Mean ± SD	13.49 ± 1.16
	Range	11.5 - 15.2
PLT (*10^3 cells/ µL)	Median (Range)	295.56 (153 - 443)
RBCs (*10^3 cells/ µL)	Median (Range)	5.13 (4.1 - 6.1)
WBCs (*10^3 cells/ µL)	Median (Range)	8.03 (4.7 - 10.9)
RBS (mg/dl)	Median (Range)	103.94 (70 - 139)

Hb: hemoglobin, PLT: platelet count, RBCs: red blood cells, WBCs: white blood cells, RBS: random blood sugar.

Regarding ear history of the studied patients, sense of air fullness was the most common **(Table 2)**.

Table 2: Ear history of the studied patients.

	N=50
Tinnitus	5 (10%)
Sense of air fullness	10 (20%)
Diminished hearing	2 (4%)

Nose score values ranged from 10.4 to 56 with a mean of 17.34 ± 8.05 before surgery and from 1.6 to 24 with a mean of 9.6 ± 5.22 after surgery. Nose score values were significantly improved after surgery compared to before surgery (P value <0.001) **(Figure 2)**.

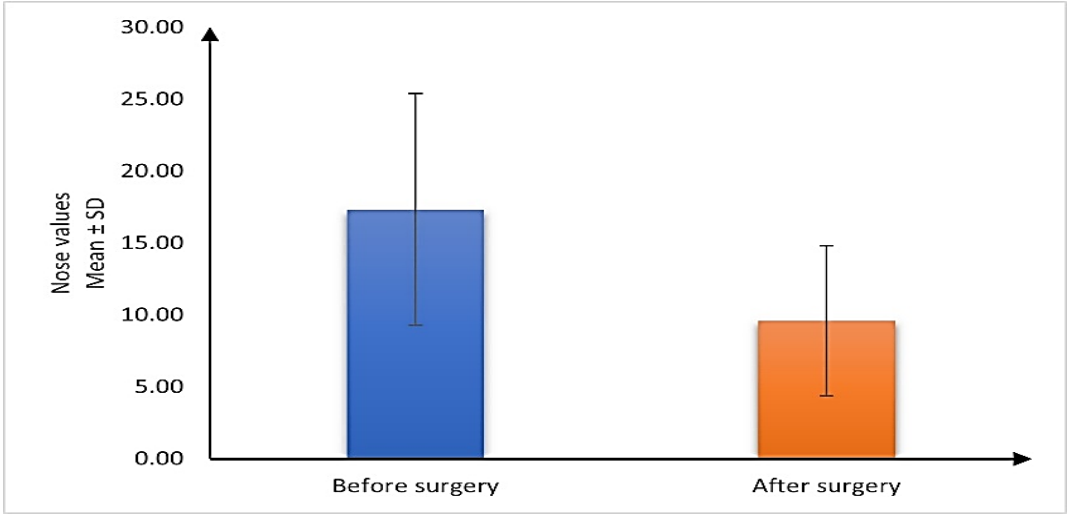

Figure 2: Nose score values before and after surgery of the studied patients.

Right and left ear tympanometric measurements were significantly improved after surgery compared to before surgery **(Table 3)**.

Table 3: Right and left ear tympanometric measurements before and after surgery of the studied patients

		Before surgery	After surgery	P value
Right ear tympanometry	A	37 (74%)	46 (92%)	**0.023***
	B	4 (8%)	3 (6%)	
	C	9 (18%)	1 (2%)	
Left ear tympanometry	A	34 (68%)	46 (92%)	**0.011***
	B	7 (14%)	2 (4%)	
	C	9 (18%)	2 (4%)	

Regarding the type of nasal septum of the studied patients, C-shape was the most common. The affected ears of 43 (86%) patients were on the same side of the deviated nasal septum **(Table 4)**.

Table 4: Type of nasal septum and side of affected ear of the studied patients

		N=50
Type of nasal septum	Septal spur	22 (44%)
	C-shape	25 (50%)
	S-shape	3 (6%)
	Caudal dislocation	0 (0%)
	Septal thickness	0 (0%)
Affected ear	On the same side	43 (86%)
	On the other side	7 (14%)

CASES

Case 1: Figure 3-5.

Figure 3: CT nose and PNS showing septal spur to the left.

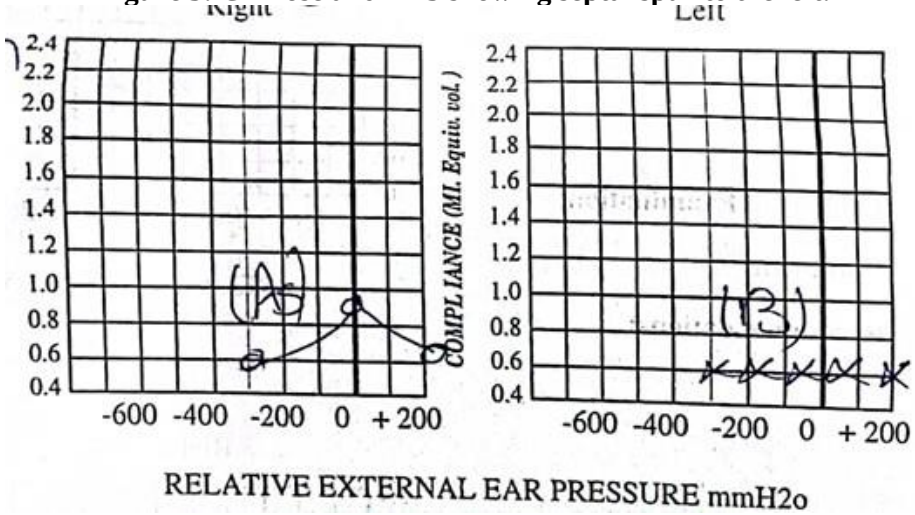

Figure 4: Tympanogram before the operation, RT ear type (A) and LT ear type (B).

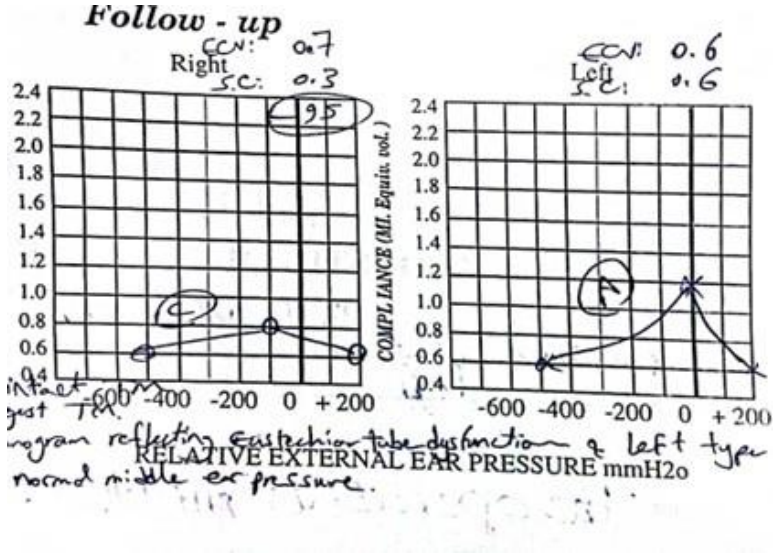

Figure 5: Tympanogram after the operation, RT ear type (C) and LT ear type (A).

DISCUSSION

Regarding demographics, **Shiryaeva *et al.*** reported an age range near to ours, as their cases had a mean age of 36.2 years (SD = 13.2) [9]. In contrast, **Şahin and his colleagues** included younger participants whose age ranged between 16 and 43 years (mean = 22.78 years) [10]. Also, **Bezerra *et al.*** also revealed a higher male gender prevalence in their selected sample of patients with NSD, as they represented 69.1% of the study population (28 out of 46) [11]. **Shiryaeva *et al.*** reported the higher prevalence of male gender in association with such pathology [9]. Meanwhile, **Al Karaki *et al.*** reported slightly higher prevalence of women, who constituted 51.7% of the study population (31 out of 60) [1].

Regarding ear history, **Hafez *et al.*** reported the prevalence of the same complaint was 20%, as it was present in 10 out of the included 50 patients with septal deviation [12], while **Nanda *et al.*** reported an incidence of 23% for the same complication (9 out of 40 patients) [13]. Also, **Abdel-Naby *et al.*** reported an incidence of 93.3% for the same symptom [14].

Regarding deviated septum, **Nanda *et al.*** reported that diminished hearing was present in 34% of their included patients with deviated septum [13]. **Abdel-Naby *et al.*** reported that diminution of hearing was reported by 40% of their participants [14].

Regarding nose score values, our results were in accordance with the previous findings of **Bezerra and his colleagues**, who reported that the same score had a median value of 75 (interquartile interval = 26) before the operation, which decreased down to a median of 10 (interquartile interval = 20) three months after septoplasty. That difference proved to be significant using the Wilcoxon T test [11].

Moreover, **Kaya *et al.*** reported a significant decline of the nose score after septoplasty ($p < 0.001$), as it decreased from 12.48 ± 4.78 before the operation down to 7.56 ± 3.4 eight weeks after it [3]. **Gandomi *et al.*** also confirmed the previous findings [15].

In the same context, **Şahin *et al.*** reported a significant decline in total nasal resistance after septoplasty ($p < 0.05$) indicating significant improvement of nasal obstructive symptoms. It decreased from 0.49 Pa/cm^3/s before the operation down to 0.34 and 0.27 Pa/cm^3/s after one and three months respectively [10].

Stewart and colleagues have documented a marked improvement in nasal obstruction for patients with nasal blockages and septal irregularities undergoing septoplasty, noting significant progress at three months post-operation, with these benefits persisting six months post-surgery [16].

Samad and Pirilä, among others, have demonstrated the effectiveness of septoplasty in enhancing nasal airflow and increasing patient satisfaction [17,18].

In the context of tympanic assessments post-surgery, **Low and Willatt** observed in a study of 40 patients that the average tympanometric peak pressure notably reduced following the procedure, indicating a substantial improvement ($p < 0.001$) [19]. **Deron and his team** applied a manometric test for tubal compliance during the Valsalva maneuver to investigate the impact of surgery for a deviated nasal septum on Eustachian tube (ET) functionality. They noted an enhancement in the pressure required for opening the tube on both the affected and opposite sides, both shortly and sometime after septoplasty [20].

A prospective investigation by **Salvinelli and associates** evaluated Eustachian tube functionality using the Toynbee and Valsalva maneuvers in 40 patients, before and after nasal septal surgery. The tests related to tube function showed significant improvements post-operation [21]. Furthermore, **Akyıldız and his team** reported a higher incidence of ET dysfunction in individuals with nasal septal deviation, with noticeable advancements in outcomes following septoplasty [22].

Similar to our findings, **Hafez and his associates** reported significant improvement of tympanometry in both ears after correction of the septal deviation ($p < 0.05$). In the right ear, the prevalence of type A tympanometry increased from 82% to 94% after the operation. Also, the prevalence of type B and C decreased from 4% and 14% before correction, down to 2% and 4% respectively after it. Regarding left ear findings, the prevalence of type A tympanometry increased from 80% to 96% after the operation. In addition, the prevalence of type B and C tympanometry decreased from 6% and 14% before the operation down to 0% and 4% respectively after it [12].

Furthermore, **Nanda and his colleagues** reported a significant increase in the prevalence of type A tympanometry from 64% before septoplasty up to 76% and 88% after 8 and 12 weeks respectively. Besides, the prevalence of type C tympanometry showed a significant decline from 36% before the procedure down to 24% and 12% at the same follow-up visits respectively [13].

In the previous Egyptian study conducted by **Abdel-Naby *et al.*,** patients who had type C tympanometry decreased from 21.6% before surgery to 10% after it. Conversely, type A tympanometry increased from 78.3% before septoplasty to 90% after it ($p < 0.001$) [14].

Contrary to earlier reports, **Şahin and colleagues** observed that the improvement of nasal airflow following septoplasty did not lead to significant adjustments in either middle ear pressure or Eustachian tube functionality [10].

This study is subject to certain limitations. Primarily, it was conducted at a single center and involved a comparatively limited number of participants. Additionally, there was a lack of both intermediate and long-term follow-up for the individuals studied. Therefore, it is advisable to undertake further research with larger participant groups across various ENT facilities to validate these findings in the future.

CONCLUSIONS

Nose score can be used as subjective tool for assessment of pre and postoperative nasal symptoms in addition to existing methods. Septoplasty in patients with septal deviation with concomitant middle ear dysfunction, might omit the need for Eustachian tube or middle ear surgery.

Financial support and sponsorship: Nil
Conflict of Interest: Nil.

REFERENCES

1. **Al Karaki V, Hallit S, Nacouzi M *et al.* (2020)**: Is there a relationship between Eustachian tube dysfunction and nasal septal deviation in a sample of the Lebanese population? Head Face Med., 16:23.
2. **Schilder A, Bhutta M, Butler C *et al.* (2015)**: Eustachian tube dysfunction: consensus statement on definition, types, clinical presentation and diagnosis. Clin Otolaryngol., 40:407-11.
3. **Kaya M, Dağlı E, Kırat S (2018)**: Does nasal septal deviation affect the Eustachian tube function and middle ear ventilation? Turk Arch Otorhinolaryngol., 56:102-5.
4. **Prakash P, Singh R, Sinha R (2023)**: The Impact of inferior turbinate reduction on middle ear function in adults with nasal obstruction. Cureus, 15:48535.
5. **Alghamdi F, Albogami D, Alsurayhi A *et al.* (2022)**: Nasal septal deviation: A comprehensive narrative review. Cureus, 14:31317.
6. **Taghiloo H, Halimi Z (2019)**: The frequencies of different types of nasal septum deviation and their effect on increasing the thickness of maxillary sinus mucosa. J Dent Res Dent Clin Dent Prospects, 13:208-14.
7. **El-Anwar M, Elnabtity N, Nada E *et al.* (2022)**: Relationship between nasal polyposis and Eustachian tube function. EJO., 38:1-5.
8. **Amer M, Kabbash I, Younes A *et al.* (2017)**: Validation and cross-cultural adaptation of the arabic version of the nasal obstruction symptom evaluation scale. Laryngoscope, 127:2455-9.
9. **Shiryaeva O, Tarangen M, Gay C *et al.* (2017)**: Preoperative signs and symptoms as prognostic markers in nasal septoplasty. Int J Otolaryngol., 2017:4718108.
10. **Şahin M, Güleç Ş, Perişan Ü *et al.* (2014)**: Does septoplasty affect middle ear pressure and eustachian tube function? Erciyes Medical Journal/Erciyes Tip Dergisi., 36:312-9.
11. **Bezerra T, Stewart M, Fornazieri M *et al.* (2012)**: Quality of life assessment septoplasty in patients with nasal obstruction. Braz J Otorhinolaryngol., 78:57-62.
12. **Hafez M, El Badryb M, Sadeka A *et al.* (2017)**: Effect of septal and turbinate surgery on middle ear function. MJMR., 82:123-29.
13. **Nanda M, Kaur M, Bhatia S (2018)**: Impact of septoplasty on hearing and middle ear function. Int J Res Med Sci., 6:1-4.
14. **Abdel-Naby O, Salama Y, El-Badry M (2014)**: Effect of nasal obstruction surgery on middle ear ventilation. EJO., 30:191-5.
15. **Gandomi B, Bayat A, Kazemei T (2010)**: Outcomes of septoplasty in young adults: the Nasal Obstruction Septoplasty Effectiveness study. Am J Otolaryngol., 31:189-92.
16. **Stewart M, Smith T, Weaver E *et al.* (2004)**: Outcomes after nasal septoplasty: results from the Nasal Obstruction Septoplasty Effectiveness (NOSE) study. Otolaryngol Head Neck Surg., 130:283-90.
17. **Samad I, Stevens H, Maloney A (1992)**: The efficacy of nasal septal surgery. J Otolaryngol., 21:88-91.
18. **Pirilä T, Tikanto J (2001)**: Unilateral and bilateral effects of nasal septum surgery demonstrated with acoustic rhinometry, rhinomanometry, and subjective assessment. Am J Rhinol., 15:127-33.
19. **Low W, Willatt D (1993)**: The relationship between middle ear pressure and deviated nasal septum. Clin Otolaryngol Allied Sci., 18:308-10.
20. **Deron P, Clement P, Derde M (1995)**: Septal surgery and tubal function: early and late results. Rhinology, 33:7-9.
21. **Salvinelli F, Casale M, Greco F *et al.* (2005)**: Nasal surgery and eustachian tube function: effects on middle ear ventilation. Clin Otolaryngol., 30:409-13.
22. **Akyildiz M, Özmen Ö A, Demir U *et al.* (2017)**: Impact of septoplasty on Eustachian tube functions. J Craniofac Surg., 28:1929-32.