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The Egyptian Journal of Otolaryngology (2023) 39:132
https://doi.org/10.1186/s43163-023-00498-w

The Egyptian Journal of Otolaryngology

ORIGINAL ARTICLE Open Access

Is endoscopic septoplasty effective in all types of septal deviations? An observational study on subjective and objective assessment of nasal airway

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Abstract

Background Endoscopic septoplasty has become the preferred choice for septal surgeries for most surgeons due to its precise manipulation and reduced wear and tear. However, the improvement of the airway may vary depending upon the type of septal deviation the patient presents with. Cottle in 1946 stated that just mere dealing with deviated septum alone would not ensure a good functional outcome and he further emphasized on addressing portions of the nose obstructing nasal airflow during surgery. The purpose of our study is to subjectively and objectively assess the effectiveness and corrective extent of endoscopic septal correction in different types of septal deviations (Mladina classification) using NOSE scores and Peak Nasal Inspiratory Flowmetry (PNIF). A prospective cross-sectional study was conducted in 87 patients presented in our department from July 2021 to June 2022 for endoscopic septoplasty.

Results Post-surgery 1-month follow-up (N1), the correction in terms of NOSE scores was highest in Mladina IV and least in Mladina I deviations, and at the end of 3 months (N2), the correction was best recorded in Mladina VI deviations while the least remained in Mladina I. Similarly, PNIF 1-month follow-up (P1) result had the best correction in the Mladina IV and V groups with the least in Mladina I. 3 months of follow-up (P2) ended up showing a maximum improvement in the Mladina VI group. Paired *t* test values for improvement of NOSE and PNIF scores were significant (p value < 0.001) between preoperative, 1-month, and 3-month follow-up values and also for repeated measure ANOVA.

Conclusion Our study reveals that the corrective power of endoscopic septoplasty differs with respect to different types of septal deviation in terms of nasal airflow, both subjectively and objectively. Thus, proper counseling and preoperative assessment is essential for better postoperative outcome and compliance.

Keywords Endoscopic septoplasty, NOSE scale, Peak nasal inspiratory flowmetry, Mladina septal deviation

Background

Nasal septum surgeries have come a long way from its inception. In the early eighteenth century, Quelmaltz [1] (1757) proposed daily digital pressure to correct the septum. Adams [2] recommended steel screw compressors to be worn by patients after forcible dilatation and fracture of the septum by subsequent splinting, continuously for 2–3 days. Ingals [2] removed deviated portions of septal cartilage with the preservation of bilateral

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mucosal flaps in the year 1882 which was called the window technique. In the twentieth century, Gustav Killian [3] (Germany) and Otto Tiger Freer [4] (USA) stated the importance of keeping the L-shaped dorsal and caudal strut for nose support which we employ in our modern sub-mucosal resection (SMR) surgeries to this day. Then came the endoscopic era which revolutionized septal surgeries and was first used by Lanza and Stammberger [5, 6] in 1991. Endoscopes allowed better visualization and lighting and deformities could be corrected with precise manipulation and limited wear and tear could be ensued. Easier transition from septal to sinus surgeries with associated/incidental pathologies was also an added advantage.

Deviated nasal septum (DNS) can come with different presentations such as nasal obstruction/stuffiness, headache, snoring, epistaxis, etc., and many classifications are mentioned in existing literature. One such classification made by Mladina [7] in 1987 on septal pathological deformities has addressed the different types of deviations concerning the Cottle areas. But the intention of the surgeon is not always just correcting the septum alone. Cottle [2] in 1946 stated that just mere dealing with deviated septum alone would not ensure a good functional outcome, and he further emphasized on addressing portions of the nose obstructing nasal airflow during surgery. Thus, the purpose of our study is to subjectively and objectively assess the effectiveness and corrective extent of endoscopic septal correction in different types of septal deviations (Mladina classification) using NOSE scores and Peak Nasal Inspiratory Flowmetry (PNIF).

Methods

A prospective study was conducted in the Department of Otolaryngology and Head Neck Surgery of a tertiary teaching institute in Kolkata, West Bengal, India, from July 2021 to June 2022. Patients aged more than 12 years with symptomatic septal deformity and persistent symptoms even after 3 weeks of medical therapy (topical nasal steroids with or without antihistamines) were included in the study. Patients with a history of local trauma, rhinosinusitis, nasal polyposis, atrophic rhinitis, features of Sino nasal malignancy, asthma, and chronic obstructive pulmonary disease were excluded from the study.

Eighty-seven patients fulfilled the above criteria. Some patients presented with more than 1 symptom due to DNS, but the primary symptom (a symptom of concern and trouble to the patient) was recorded. All patients underwent diagnostic nasal endoscopy (DNE) with supporting evidence of Ct scan using OsiriX software (Pixameo SARL, Switzerland) in some cases to correctly establish the type of septal deviation and segregated under Mladina classification of septal deviation (Table 1). Mladina classification was used in our study because it provides a comprehensive detail of the septal deviation type both in coronal and axial aspects and can be well corroborated with endoscopic septoplasty. It provides an overall range of variability of septum deviations from which maximum benefit can be obtained in this study. Patients were admitted to the ward and were asked to fill out the Nasal Obstruction Symptom Evaluation Scale (NOSE) (Table 2) sheet 3 days before surgery. The NOSE scale is a subjective quality-of-life questionnaire for patients with nasal obstruction. It has been translated into many languages and clinically validated. The patient is provided this questionnaire in his/her native language and asked to tick the severity of each of the symptoms given below in the chart. The Final Nose Score is calculated by a total score from the chart above and multiplying it by 5.

$$\begin{aligned}\text{Degree} = &\text{mild}\ (5-25), \text{moderate}\ (30-50),\\ &\text{severe}\ (55-75), \text{extreme}\ (80-100)\end{aligned}$$

Peak Nasal Inspiratory Flowmetry (PNIF) was performed 3 days prior to surgery. The device used to measure this is a portable Peak Nasal Inspiratory Flowmetry (Clement Clarke International Ltd.) (Fig. 1). The device was reset by returning the red cursor to its start position,

Table 1 Mladina classification of septal deviation

MLADINA classification	
Type I	The unilateral crest which does not disturb the function of the nasal valve. Maintains normal physiological valve angle
Type II	The unilateral vertical septal ridge in the valve region that touches the nasal valve, thus reducing the physiological valve angle
Type III	The unilateral vertical ridge that is located more deeply in the nasal cavity, opposite the head of the middle turbinate
Type IV	Bilateral deformity consisting of type II on one side and type III on the other
Type V	An almost horizontal septal spur that sticks laterally and deeply into the nasal cavity. The opposite side of the nasal septum is straight
Type VI	Massive unilateral sulcus runs through the caudal-ventral part of the septum, while on the other side is a ridge and accompanying asymmetry of the nasal cavity
Type VII	Variable combination of the previous types

Table 2 Nose scale

	Not a problem	Very mild problem	Moderate problem	Fairly bad problem	Severe problem
Nasal congestion/stuffiness	0	1	2	3	4
Nasal blockage/obstruction	0	1	2	3	4
Trouble breathing Via nose	0	1	2	3	4
Trouble sleeping	0	1	2	3	4
Unable to get enough Air via nose during exercise/exertion	0	1	2	3	4

Fig. 1 Nasal Inspiratory Flowmeter (Clement Clarke International Ltd.)

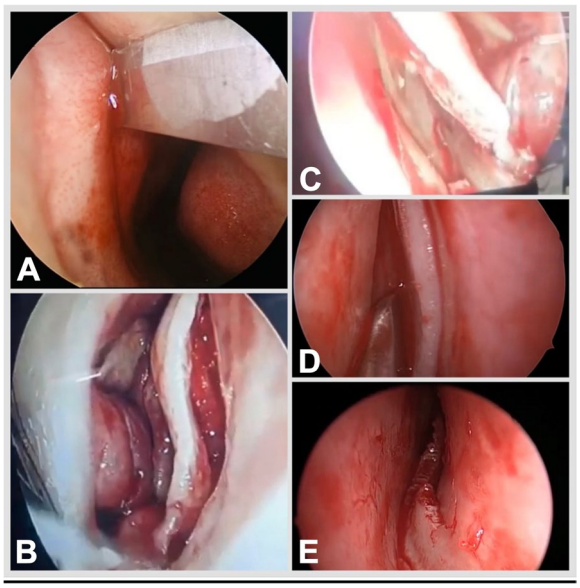

Fig. 2 **A** Incision made a little posterior than usual Killian's incision. **B** Mucoperichondrial and mucoperiosteal flap raised with cotton swab dissection. **C** White septum visualized and the maxillary crest is exposed before going to the other side. **D** Incision made on the septum to raise the opposite flap. **E** Part of deviated septum removed with remnant seen attached to the maxillary crest

and patients were asked to exhale completely. The device was held horizontally and the mask was put on the nose and mouth. An air-tight seal was ensured around the nose. The patient was instructed to close the mouth and inhale forcefully only through his/her nose in one single breath. Three successive readings were obtained, and the highest was recorded and rounded off to the closest number in multiples of 5 for ease of calculation.

All patients underwent endoscopic septoplasty under general anesthesia (Fig. 2) with a 0-degree Hopkins rod 4-mm endoscope (Karl Storz SE & Co. KG; Tuttlingen, Germany) by the same surgeon. The patients were packed with Merocel (Medtronic, USA) and were monitored for 48 h following surgery following which their nasal packs were removed and they were subsequently discharged. Nasal endoscopy, NOSE scale sheet fill-up, and PNIF measurement were done in follow-up at the end of 1 month and 3 months.

All data were compiled using Microsoft Excel software 2019 version (Microsoft Corporation; Redmond, Washington, USA). Data was analyzed and presented in pictorial and tabular forms through relevant statistical methods using SPSS (Statistical Package for Social Sciences) software version 25 (IBM Corporation; Armonk, New York, USA).

This study was approved by the Institutional Ethics Committee, and informed consent was obtained from each patient included in the study, investigations, and interventions were strictly according to the principles stated in the Declaration of Helsinki 1964 and its subsequent amendments.

Results

Out of 87 patients, 49 (56.32%) were male and 38 (43.68%) were female. The mean age of presentation was 32.95 years with the lowest being 13 years old and maximum being 61 years. The majority of patients belonged

to the age group of 21–30 years and the least belonged to the 51–60 years range. The septal deviation most commonly recorded was Mladina type III comprising 22.98% of the study population with the least belonging to Mladina type VI (8.04%) (Fig. 3). The main symptom recorded was nasal obstruction which was present in all patients. However, 28 patients presented with headache as a primary symptom and 9 patients with facial pain.

The mean NOSE scores obtained before surgery (N0) was 47.06 with the highest being in the Mladina VI (69.28) group of patients and least being in Mladina I (28.50) (Fig. 4). Post-surgery 1-month follow-up (N1), the correction in terms of NOSE scores was highest in Mladina IV and least in Mladina I deviations, and at the end of 3 months (N2), the correction was best recorded in Mladina VI deviations while the least remained in Mladina I. Similarly, the preoperative mean PNIF score (P0) was 55.17 with the lowest being in Mladina V (45.93) and the highest in Mladina II (70.00) (Fig. 5). One-month follow-up (P1) result had the best correction in Mladina IV and V groups with least in Mladina I. 3 months of follow-up (P2) ended up showing maximum improvement in the Mladina VI group. Paired *t* test values for improvement of NOSE and PNIF scores were significant (p value < 0.001) between preoperative, 1-month, and 3-month follow-up values (Table 3) and also for repeated measure ANOVA (Sphericity assumed). 55/87 subjects showed a unidirectional trend change in score for PNIF.

Among the rest 32, the change from baseline to 1st follow-up and change from 1st to 2nd follow-ups were not unidirectional. The differences were statistically significant (Mc Nemar test), $p = 0.002$ (Table 4). For NOSE scores the changes between three time points were unidirectional. Both the time for every subject, score was less than the preceding value.

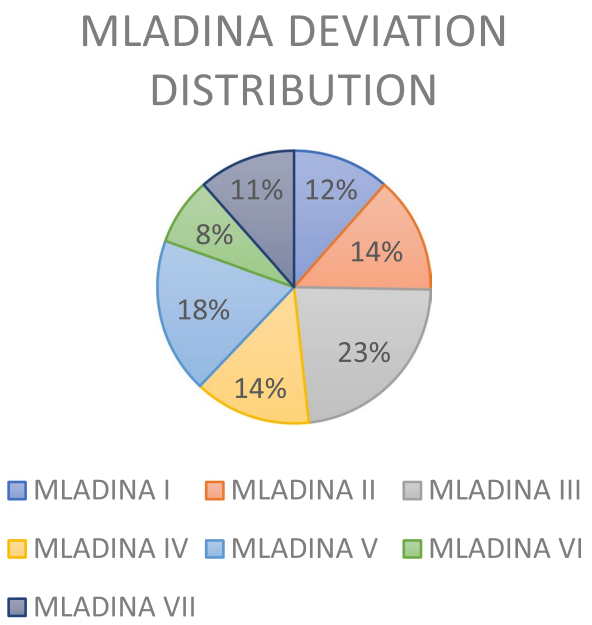

Fig. 3 Nasal septum deviation (Mladina) type distribution

Discussion

Since the development of endoscopic techniques for septoplasty, many studies have been done which highlight its importance in improving visualization during surgery. Getz et al. [8] mentioned that discrete septal pathologies such as isolated deflection, spurs, perforations, and contact points can be addressed in a directed fashion. A study done on the preceding 15-year retrospective endoscopic septoplasty case data at University

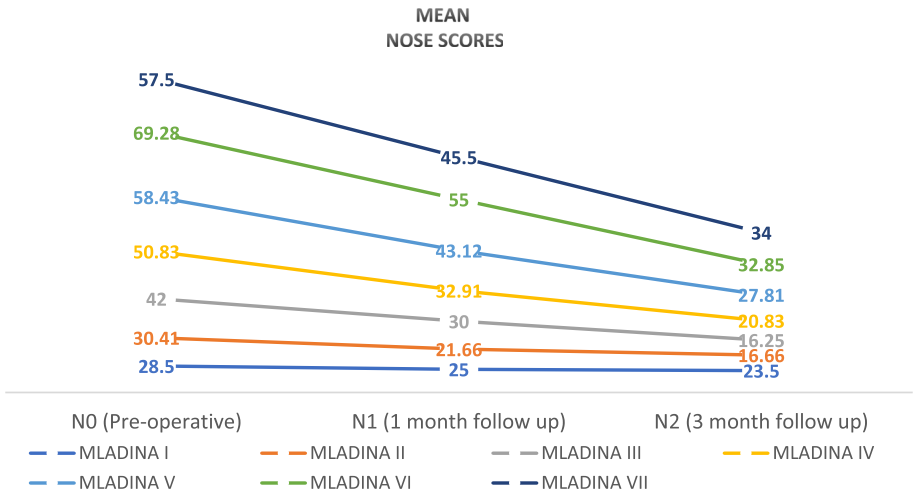

Fig. 4 Mean NOSE score comparison

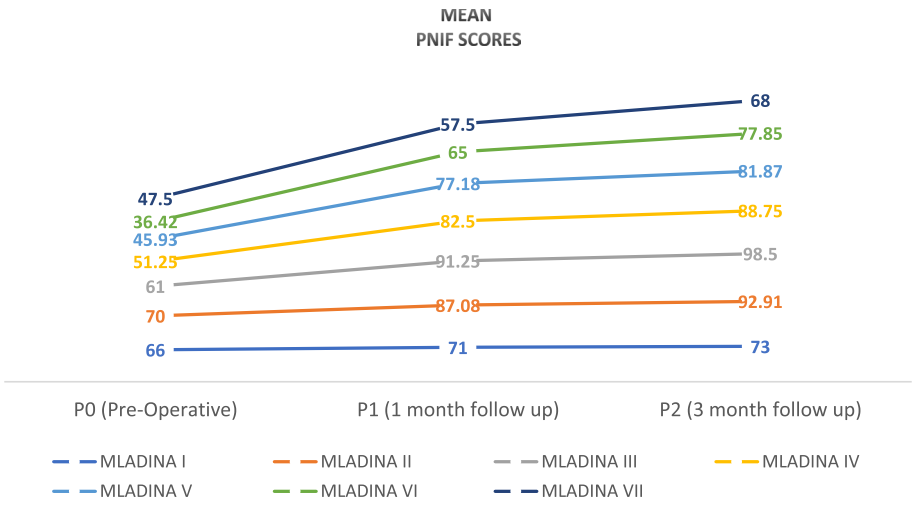

Fig. 5 Mean PNIF score comparison

Table 3 Paired *t* tests showing significances in NOSE and PNIF scores

Paired sample test					
NOSE score		Paired differences			Significance (two-tailed)
		Mean	Std. deviation	Std. error mean	
Pair 1	N0–N1	12.1839	9.1404	.9800	< 0.0001
Pair 2	N0–N2	23.7931	16.3353	1.7513	< 0.0001
Pair 3	N1–N2	11.6092	11.7754	1.2625	< 0.0001
PNIF		Paired differences			Significance (two-tailed)
		Mean	Std. deviation	Std. error mean	
Pair 1	P0–P1	− 23.3908	20.3243	2.1790	< 0.0001
Pair 2	P0–P2	− 30.0575	21.6001	2.3158	< 0.0001
Pair 3	P1–P2	− 6.6667	6.6327	.7111	< 0.0001

Table 4 Changes in unidirectional trend in PNIF scores

	Change of PNIF score from 1st follow-up to 2nd follow-up		**Total**
	Score 1st follow-up > 2nd follow-up	**Score 1st follow-up < 2nd follow-up**	
PNIF			
Baseline score > 1st follow-up	2	7	9
Baseline score < 1st follow-up	25	53	78
Total	27	60	87

Hospitals Leuven by Vandenbroeck et al. [9] found that spur resection and posterior septal deviation correction were specifically helpful by the endoscopic technique. Skitarelic et al. [10] found that endoscopic septoplasty is an effective procedure that gave stable results over time. Despite several studies mentioning the effectiveness of endoscopic septoplasty over conventional technique, a systematic review and meta-analysis of existing literature by Hong et al. [11] stated that, based on the quality assessment, the included studies had a moderate-to-high risk of bias. Thus, although their analysis indicated endoscopic septoplasty may have some advantages over open septoplasty, they cautioned against the findings as the studies might be suffering from poor quality. Additionally, a recent randomized study by Na'ara et al. [12] on 60 patients comparing the quality of life of patients undergoing endoscopic septoplasty to traditional trans-nasal septoplasty found similar improvement in patient outcomes in both groups and no significant differences in the two different study arms.

Kahveci et al. [13] evaluated the efficiency of the Nasal Obstruction Symptom Evaluation (NOSE) scale for septoplasty (without turbinate reduction) in comparison with other examination methods. In 27 patients

who underwent septoplasty, there was a very significant improvement in mean NOSE scores of patients and they concluded that the NOSE scale is a very useful tool to evaluate the effectiveness of pure septoplasty. Dutta et al. [14] stated that the NOSE score can be an effective tool to let the patient know about the expected outcome following septoplasty, which can help quantify the wide range of patient expectations regarding the result of the surgery. Other studies by Gandomi et al. [15] and Andre et al. [16] also mention the usefulness of the NOSE scale in post-septoplasty patients.

Sahin [17] investigated the usefulness of the peak nasal inflammatory flow (PNIF) and Nasal Obstruction Symptom Score (NOSE) questionnaire in the diagnosis and follow-up of nasal septum deviation surgery. He found that posterior located septal deviation PNIF scores changed postoperatively but NOSE scores do not change statistically. There was a statistically significant correlation in Pearson correlation analysis between NOSE and PNIF scores. He recommended using PNIF and NOSE scores in the evaluation of patients with septal deviation after correction. Fuller et al. [18] stated that PNIF is an easy-to-perform test that detects nasal obstruction and clinically significant improvements in airflow following functional septorhinoplasty. According to them, although PNIF does not correlate well enough with the patient experience of nasal obstruction to be used as a diagnostic tool, it gives complementary information useful for evaluating, understanding, and improving the effects of surgical techniques. Hence, the usage of the NOSE score and PNIF for parameters to assess nasal patency before and after septoplasty in the current study can be considered as a validation of the findings of all the previous studies. Orabona et al. [19] conducted a study similar to this present study where they evaluated the different types of nasal deviations based on the Mladina classification and the effectiveness of septal correction in improving NOSE scores in 59 patients. In their study, they demonstrated that the corrective power seems to be greater for deviation types 5 and 6, gradually decreasing in types 4, 1, and 7 and becoming minimal for types 3 and 2. In the case of the present study, the 1-month follow-up result had the best correction in Mladina IV and V groups with the least in Mladina I. 3 months of follow-up showed maximum improvement in the Mladina VI group. Septal correction can also lead to improvement of pulmonary function test (PFT), which can be extrapolated as a function of the patency of upper airway air passage. Interestingly, Singh et al. [20] in their study showed that in 50 patients who underwent septoplasty, most of them showed improvement in PFT values but only Mladina type II DNS patients showed significant improvement in PFT values ($p=0.05$). Their results matched the studies by Bulcun et al. [21] and Panicker et al. [22] who showed that there was improvement in pulmonary function test values after septoplasty. In the present study, the nasal symptoms were only assessed and pulmonary function improvement was not evaluated, but it can be a parameter to be studied in the future. Younger patients especially those aged from 12 to 18 years were operated on in our study who had had significant nasal obstruction which hampered their daily life activities, and thus, surgical option was given to them. In a study done by Tasca et al. [23], it was observed that the endo nasal approach towards septum correction in younger-aged children does not interfere with the normal nasal growing process.

To conclude, we can state that post-endoscopic septoplasty, all patient groups can expect improvement in their nasal breathing, but patients having Mladina type VI deviation had the maximum benefit, as is evident from the improved NOSE score and PNIF values in both groups 3 months after surgery.

Conclusion

Our study reveals that the corrective power of endoscopic septoplasty differs concerning different types of septal deviation in terms of nasal airflow, both subjectively and objectively. Though all patient groups can expect improvement in their nasal breathing, patients having posterior deviations (Mladina type VI in our study) have been shown to achieve maximum benefit, as is evident from the improved NOSE score and PNIF values in both groups 3 months after surgery from our study. However, a larger sample size and longer follow-up periods are necessary for the implementation of the appropriate selection of surgery for different deviation types. Also, proper counseling and preoperative assessment of septal deviation type is essential for better postoperative outcome and compliance especially in treating patients with type I and II septal deviations by endoscopic septoplasty.

Acknowledgements
The authors are grateful to all the patients who agreed to participate in this study and to all the ward and surgical staff of the ENT and Head and Neck Surgery Department of Medical College & Hospital, Kolkata.

Authors' contributions
MH designed the study. MH and TK assessed the symptoms and collected the preoperative data. Surgery was performed by MH. TK and DM analyzed the data. MH and TK wrote the manuscript draft. All authors contributed to reviewing and editing the manuscript. The authors read and approved the final manuscript.

Funding
Not applicable.

Availability of data and materials
The data used and/or analyzed during this study is available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
Informed consent from participants was obtained to participate in the study at the ENT Department, Medical College & Hospital, Kolkata, West Bengal, India. This study is approved by the Institutional ethical committee of Medical College & Hospital, Kolkata.

Consent for publication
Informed written consent was obtained from all the participants in the study and was duly signed.

Competing interests
The authors declare that they have no competing interests.

Received: 28 April 2023 Accepted: 4 August 2023
Published online: 28 August 2023

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