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Evaluation of nasal tip shape in patients with severe caudal septal deviation after modified extracorporeal endonasal septoplasty

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ABSTRACT

Objectives: The aim of this prospective study was to evaluate the effect of modified extracorporeal endonasal septoplasty on nasal tip shape and function in patients with severe caudal septal deviation.

Methods: The study population comprised of 55 patients undergoing modified extracorporeal endonasal septoplasty, which called marionette septoplasty. To analyse the aesthetic objective outcomes, postoperative photographs were measured for projection index (PI), tip projection (TP), nasolabial angle (NLA), tip deviation angle (TDA), nasofrontal angle (NFA), supratip height (STH), columellar height (CH), at three times (2 weeks, 3, and 6 months after surgery) and were compared with preoperative photographs. Functional and aesthetic outcomes were also evaluated using nasal obstruction symptom evaluation (NOSE) scale and standardized cosmesis and health nasal outcomes survey (SCHNOS).

Results: Between the pre- and post-operative 6th-month examinations, a significant increase in PI and TP were 7%, and 5% respectively. There was a significant alteration in the NLA and TDA values following the last examination (mean difference ± standard error of mean 9.68 ± 0.9° and 1.5 ± 0.8°, respectively). Moreover, the technique did not make a significant change in the final NFA, STH, and CH, measurements. Following surgery, the NOSE and SCHNOS scores were decreased significantly and the improvement continued over time until the last examination.

Conclusion: The present study findings suggest that the marionette septoplasty technique is an effective to correct and stabilize severe caudal septal deviations. This technique also can provide tip support and protection with a low incidence of dorsal irregularity.

1. Introduction

Septum has an important role not only in the breathing function but also in the external form of the nose and its support [1]. Considering the importance of septum in the normal formation of the external nose, it is thought that surgical procedures on septal cartilage may affect the postoperative nasal shape. In particular, this issue is more common in the treatment of caudal septal deviations, as it is known that the loss of the relationship between the anterior nasal spin and caudal septal cartilage is associated with external nasal deformity [2]. Therefore, the caudal septum pathologies have

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become a major problem of otolaryngologists since 1929, when it was first described [3]. The technique of swinging door, batten grafts, extracorporeal septoplasty, scoring, tongue – in groove and many other surgical methods have been defined to solve this problem [3–8].

Marionette septoplasty (MS), which is previously described by Kayabasoglu et al. [1], is a procedure of modified extracorporeal endonasal septoplasty (MEES). This technique is lesser invasive method than open septoplasty methods used for the repair of severe caudal septal deviations. Because MS has shorter recovery time and operation period and does not cause unnecessary scarring and edema, it may be a good alternative to open techniques. However, the open septoplasty provides excellent exposure to the nasal tip and cartilaginous vault and possibly more stable fixation of the corrected septum [9].

When planning the operation technique of septoplasty, aesthetic outcomes must be taken into consideration especially in the patients with caudal septal deviation. To our knowledge, although there are a few studies about addressing the effect of the open procedures on the nasal shape, no prospective report has been analysed the effect of MEES without rhinoplasty procedure on the quantitative aesthetic outcomes in the English literature [10,11]. Thus, the aim of this study is to evaluate the effect of MS technique on the nasal tip shape and function.

2. Materials and methods

2.1. Patients

Fifty-five patients with severe caudal septal deviations were enrolled in this prospective study in our department of otolaryngology, between December 2017 and April 2019. Ethics committee approval was obtained by Local Ethical Committee. (Ethics Committee No: 22) Informed consent was obtained from each patient after discussing the full details of the surgical procedure. All patients were preoperatively assessed by using anterior rhinoscopy, nasal endoscopy, computed tomography scanning, and tip-support test. Valve stenosis (VS) was determined in the patients by positive Curette and Cottle tests. Moreover, the patients were classified as to whether the presence of internal and/or external valve stenosis. Enrolment criteria were based on clinical features of the patient, including the presence of C-shape or S-shape antero-posterior caudal septal deviation. Patients had the VS caused by the dynamic collapse abnormality of the lateral sidewall and/or patients who underwent revision septoplasty, septorhinoplasty, and open-approach septoplasty were not included in the study. Preoperative, postoperative (2nd-week, 3rd, and 6th -months) photographs were taken with a standard procedure by the same author (HE) [Fig. 1]. To confirm the efficacy of MS, the severity of subjective nasal obstruction was measured by using nasal obstruction symptom evaluation (NOSE) scoring preoperatively and at the follow-up periods. Aesthetic outcomes were also evaluated using standardized cosmesis and health nasal outcomes survey (SCHNOS) preoperatively and at the postoperative 6th month. The same surgical technique was used, and only additional procedures such as inferior turbinate lateralization and/or radio-frequency turbinate reduction were performed to all patients.

2.2. Surgical technique

All surgical procedures were performed by two authors (DD, and MG) under general anesthesia. Following local infiltration, bilateral submucoperichondrial flap elevation was performed after hemitransfixion incision [Fig. 2]. Vertical and horizontal chondrotomies were made to excise the entire deviated septum while preserving at least 1.5 cm of the dorsal septal cartilage in front of the keystone area. The harvested cartilage and bone were used to create a straight L-shaped strut. The dimensions of L-shaped strut are determined by the length of caudal and dorsal edges of harvested septum. If the caudal cartilage part is created longer than desired, its length can be decreased until the desired projection is obtained. Moreover, precise is required to create as appropriate as possible the length of dorsal part to prevent the formation of short or tension nose. Subsequently, the L-shaped strut was sutured with 4/0 rapid vicryl at three points (the points corresponding to the key area, the middle of the medial crura and the anterior nasal spine). The purpose of these sutures was to make sure that the L-shaped strut was placed in the right place between the mucoperichondrial flaps and to ensure its stabilization. After stabilizing with three sutures, the dorsal cephalic part of the L-strut was fixed to the remaining dorsal septal cartilage with polydioxanone suture (PDS). The caudal part of the L-shaped was fixed with 4/0 vicryl rapide between the medial crura. It also was sutured to the maxillary spine using PDS. Transseptal suturing was then performed to increase the stabilization of the L-shaped strut. The hemitransfixion incision was closed with 4/0 vicryl rapide and bilateral silicon splints were placed. Splints were removed after one week.

2.3. Assessment of outcomes

All photographs were evaluated by using MB-Ruler (version 5.0; Markus Bader MB Software Solutions, Germany, Baden Wurttemberg) software. MB-Ruler is freeware for private and non-commercial use. The photographs were taken with a Nikon D60 camera with a wide-angle lens (18–55 mm), a distance of 1,2 m, and the same zoom ratio was used in all photographing process. The patient was asked to keep her jaw in a comfortable position and to keep her eyes parallel to the Frankfurt horizontal line. The photographs were taken at seven different angles. The projection index (PI), tip projection (TP), nasolabial angle (NLA), nasofrontal angle (NFA), supratip height (STH), and columellar height (CH), and, were measured from lateral photographs. Tip deviation angle (TDA) was evaluated in frontal view based on the study by Jong Sook Yi et al. [2]. Tip defining point (TDP), columella (C), glabella (G), nasion (N), the superior point of the upper lip (P), the inferior of the upper lip (L), supratip break point (S) and mid-alar crease (MAC) were used as the guide points. According to Goode; the PI can be calculated by the

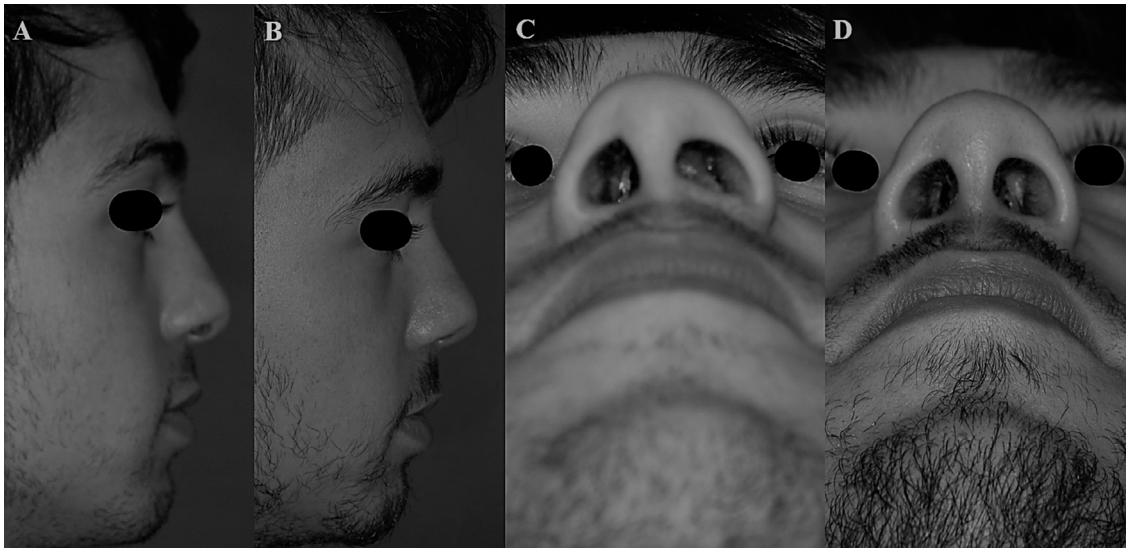

Fig. 1. Photos showing the nasal base and lateral views of the patient before (A) and (C) and 6 months after (B) and (D) the surgery.

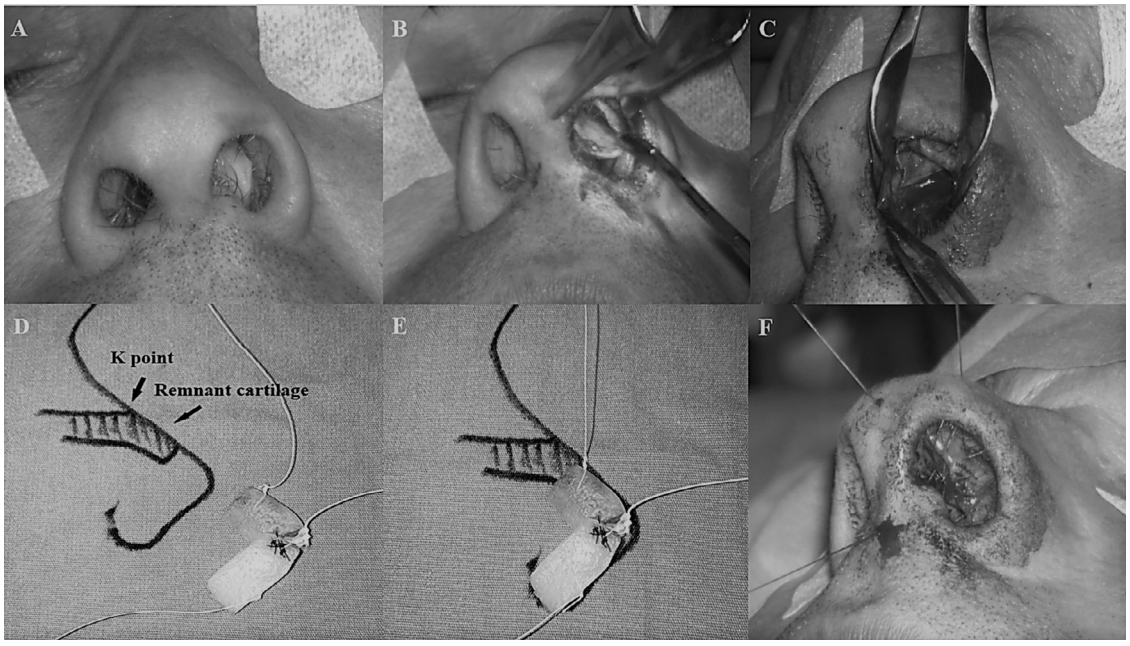

Fig. 2. (A) Photo shows the nasal base view of patient with severe caudal septal deviation. (B) Bilateral submucoperichondrial flap elevation is performed after hemitransfixion incision. (C) The septal dorsal cartilage is left after the resection of deviated caudal septum. (D) The pieces of harvested cartilages are used to form a straight L-shaped strut. (E) Photo shows the topographic depiction of placement of the graft with three absorbable sutures. (F) The three sutures are used to stabilize the graft.

ratio of the lines [12]. The first line was drawn between nasion and alar crease that is perpendicular to a line drawn between TDP and alar crease, the second one was drawn from nasion to TDP. The length from TDP to the alar crease was divided by the second line. The tip projection was defined from the TDP to the MAC. NLA was formed by drawing a line tangential to columella from subnasale to TDP that intersects a line drawn from subnasale to the upper lip. The TDA was defined as an angle by drawing a vertical midline drawn from the glabella to the P point. The other line was drawn from the nasion to the most prominent point of the nasal tip. The TDA was measured between those two lines. For the NFA, the angle between the line drawn from the nasion to TDP and the line drawn between the nasion and the glabella was used. STH was defined as the length from supratip break point to the line drawn from TDP to nasion. CH was defined as the distance drawn from columella to alar margin [Fig. 3].

2.4. Statistical analysis

To calculate the necessary sample size, the effect size was calculated as a 0.35 with using information from the previous study [13]. The total sample size was calculated as 52, assuming an effect size of 0.35, type 1 error (alpha) = 0.05, and

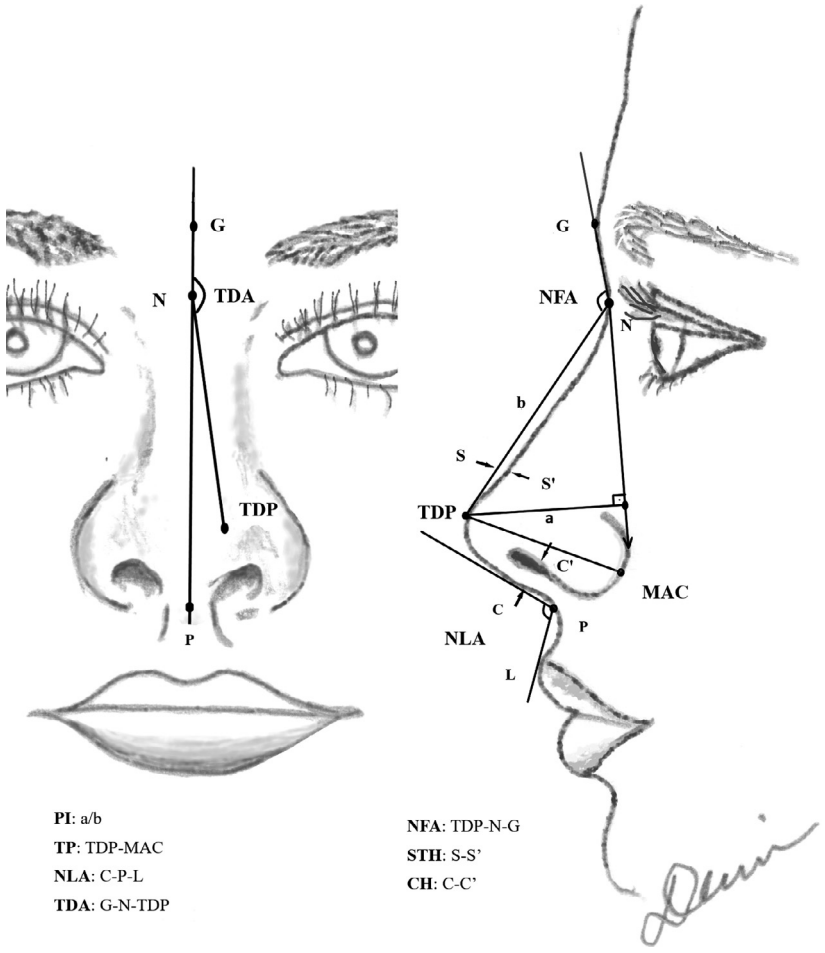

Fig. 3. The illustrate shows the nasal anthropometric landmarks and the measurements [Abbreviations: Projection index (PI), Tip projection (TP), Nasolabial angle (NLA), Tip deviation angle (TDA), Nasofrontal angle (NFA), Supratip height (STH), Columellar height (CH), Tip defining point (TDP), Columella (C), Glabella (G), Nasion (N), Philtrum (P), Lip (L), Supratip break point (S), Mid-alar crease (MAC)].

type 2 error = 0.20 with power = 80 percent. We opted to included 55 patients in our study. Power analysis was performed using G*Power statistical power analysis program (version 3.1.9, Franz, Faul, Universitat, Kiel, Germany)

Descriptive analysis was performed to provide information on the general characteristics of the study population. Quantitative and qualitative data are presented as mean ± standard deviation and frequency (percentage) in the results section. Kolmogorov–Simirnov test was used to determine whether the distribution of variables was normal. Repeated measures ANOVA as a main statistical method was used for evaluating intra-group comparisons (Bonferroni adjustment for multiple comparisons). Sphericity assumption was evaluated using Mauhcly's test, and when it was violated, Greenhouse–Geisser was adopted. All variables were not normally distributed. Therefore, the Friedman test was used to analyse PI, TDA, NFA, and NOSE values in the four-time periods (for post-hoc comparisons, Bonferroni adjusted Wilcoxon test was used). Mann Whitney *U* test was used to compare NOSE scores between the two groups. Moreover, the intraclass correlation coefficient (ICC) was used to assess the reliability of measurements. For test–retest reliability, 15 of all measurements were randomly selected to evaluated again according to Munro [14] 0.00–0.25 indicated no correlation, 0.26–0.49 indicated low correlation, 0.5–0.69 indicated moderate correlation, 0.7–0.89 indicated a high correlation, and 0.90–1.00 indicated a very high correlation. A p value < 0.05 was considered to indicate a significant difference. Statistical analyses were performed using IBM SPSS version 24.0 for Windows statistical software (IBM Corporation, Armonk, New York, USA).

3. Results

Test-retest reliability results are presented in Table 1. The mean of ICC varied between 0.809–0.999, interpreting that the measurements were reliable.

Of the 58 patients who met the enrolment criteria for the study, only 55 patients continued postoperative follow- up for at least six months were included in the study. There were 46 (83.6%) males and 9 (16.4%) females with a mean age of 34.58 ± 11.05 (18–58) years. Revision surgery was not needed in any patients during the follow-up period. Postoperative saddle nose or any surgical complication such as infection, septal perforation, severe epistaxis was not experienced. However irregular contour of the lower dorsum was seen in the two patients.

Table 1. The evaluation of the reliability of the anthropometric measurements.

	PI [ICC- (CI)]	TP [ICC- (CI)]	NLA [ICC- (CI)]	TDA [ICC- (CI)]
Preoperative	0.987 (0.942–0.997)	0.999 (0.997–1.00)	0.999 (0.995–1.00)	0.980 (0.911–0.996)
Postoperative 2nd -week	0.852 (0.330–0.970)	0.997 (0.987–0.999)	0.996 (0.982–0.999)	0.971 (0.869–0.994)
Postoperative 3rd -month	0.852 (0.331–0.970)	0.997 (0.987–0.999)	0.990 (0.953–0.998)	0.969 (0.860–0.994)
Postoperative 6th -month	0.809 (0.135–0.961)	0.997 (0.88–0.999)	0.997 (0.989–0.999)	0.984 (0.927–0.997)
	NFA [ICC- (CI)]	STH [ICC- (CI)]	CH [ICC- (CI)]	
Preoperative	0.993 (0.970–0.999)	0.963 (0.831–0.992)	0.989 (0.949–0.998)	
Postoperative 2nd -week	0.996 (0.980–0.999)	0.986 (0.935–0.997)	0.887 (0.488–0.977)	
Postoperative 3rd -month	0.999 (0.996–1.00)	0.981 (0.915–0.996)	0.897 (0.533–0.979)	
Postoperative 6th -month	0.999 (0.995–1.00)	0.991 (0.958–0.998)	0.916 (0.621–0.983)	

Mean measure of Intraclass Correlation Coefficients (ICC) and 95% Confidence Interval (CI).

Comparisons of the mean anthropometric measurements from preoperative to three times of postoperative follow-up are presented in Table 1. A postoperative increase in PI ($p < 0.001$), TP ($p < 0.007$), NLA ($p < 0.001$), TDA ($p < 0.001$) was noted in all patients in the different degrees at the postoperative 2nd -week. However, PI ($p < 0.001$), the NLA ($F = 109.38$, $p < 0.001$), and TDA ($p < 0.001$) values, there was a significantly decrease over time after the first postoperative examination. Significantly change difference in TP value was not noted between the postoperative 2nd -week and 3rd-month (mean difference ± SEM, 0.026 ± 0.1), however, there was a significant decrease between the postoperative 3rd and 6th-months (0.36 ± 0.05). Although there was a decrease over time after surgery in these measurements, the significant increase in those was observed at the postoperative 6th-month comparing to their preoperative values. [PI, ($p < 0.001$); TP, ($p < 0.047$); NLA, ($p < 0.001$); TDA, ($p < 0.001$)].

Considering NFA, there was a significant reduction at the postoperative 2nd-week (1.64 ± 0.95°, $p = 0.009$), after then we revealed a significant increase in the angle over time (Table 2). However, the comparison of postoperative 6th-month with preoperative values showed no significant change of the NFA. (0.88 ± 0.93°, $p = 0.198$).

The mean STH, and CH values did not significantly change after surgery ($F = 0.82$, $p = 0.39$; $F = 1.170$, $p = 0.291$, respectively).

Of all patients, 38 (69.1%) patients who had a history of trauma and 43 (78.2%) patients with VS were evaluated preoperatively. There was no significant effect of the history of trauma and the presence of preoperative VS on the postoperative anthropometric measurements ($p > 0.05$).

In the patients with and without VS, the mean NOSE scores were observed to significantly improve from the preoperative to the postoperative 2nd-week ($p < 0.001$, $p < 0.001$, respectively), and no significant differences were found in the other follow-up comparisons. The surgical technique provided a significant improvement in the NOSE scores in the two groups (preop. median; 18, 16.8; postop 6th-month 2, 3, respectively). The differences of NOSE scores between the two groups were not significant preoperatively ($p = 0.6$), and postoperatively (follow-up period of 2nd-week, 3rd-month, 6th-month, respectively, $p = 0.74$; $p = 0.20$; $p = 0.13$ The median SCHNOS score was significantly decreased in the postoperative 6th -month [Fig. 4].

4. Discussion

Anterior-caudal dislocation of the nasal septum, with concomitant nasal airway obstruction, is regarded as an aesthetic abnormality. The distorted or weak cartilage of the septum may lead to tip ptosis, dorsal and columellar irregularities. When repair is needed, the nasal tip support mechanism will be at risk because of the involvement of caudal septum in the septal deviation. There have been many techniques described including tension-relaxing method [15], fishing-line [16], cutting and suture techniques [17], batten graft procedure [18] and modified extracorporeal septoplasty [19] in the literature. However, few studies addressing the sole effect of the correction of the caudal septum on the changes in the nasal shape have been conducted [2,11,19]. This may be due to the fact that many anterior-caudal septal deviations can be repaired by simultaneous rhinoplasty.

Marionette technique has been found to be reliable for achieving better functional results but, aesthetic outcomes have not been analysed by using the quantitative measurements [1]. In our study, the rotation was stated by measuring NLA. There was a statistically significant value of rotation generated following the last examination (9.68 ± 0.9°). The final NLA values in the men and women were obtained within the favorable range (respectively, 94.16 ± 1.47°; 93.21 ± 2.71°) [13]. Unsal et al. compared short-term (<12 months) and long-term (>12 months) of anthropometric values of total 32 patients after external extracorporeal septoplasty in the retrospective study [11]. They showed that all postoperative NLA values were determined to be significantly lower than the preoperative values. In another study, Song et al. examined prospectively external morphological alteration and structural stability in total of 69 patients who underwent septoplasty using the swing door and cutting and suture techniques [19]. The comparison of the mean values of NLA from preoperative to postoperative 6th-month showed no statistically significant difference. Yi and Jang evaluated retrospectively the aesthetic outcomes after endonasal septoplasty using a caudal septal batten graft in total of 52 patients [2]. They reported no significant change in the NLA value from preoperative to 1 to 2 months postoperative follow-up period.

The mean duration of edema in the marionette technique was 11.5 days according to the previous study [1]. Thus, the postoperative 2nd-week outcomes were considered as the operatively nasal projection measurements. In the present study,

Table 2. The table indicates the pairwise comparisons of the pre- and postoperative mean anthropometric measurements and the NOSE scores.

Measure	Time	Values	Pairwise comparison test p value[a]	Pairwise comparison test p value[b]	Repeated measure test p value
PI	Preoperative	0.553 [0.521–0.589]	< **0.001**	< **0.001**	< **0.001****
	Postoperative 2nd -week	0.606 [0.564–0.661]			
			< **0.001**		
	Postoperative 3rd -month	0.601 [0.560–0.661]			
			< **0.001**		
	Postoperative 6th -month	0.594 [0.556–0.640]			
TP	Preoperative	29.48 ± 0.77	**0.007**	< **0.001**	**0.02***
	Postoperative 2nd -week	31.46 ± 0.75			
			1.00		
	Postoperative 3rd -month	31.43 ± 0.75			
			< **0.001**		
	Postoperative 6th -month	31.07 ± 0.73			
NLA	Preoperative	84.31 ± 1.5	< **0.001**	< **0.001**	< **0.001***
	Postoperative 2nd -week	95.89 ± 1.38			
			< **0.001**		
	Postoperative 3rd -month	95.51 ± 1.35			
			< **0.001**		
	Postoperative 6th -month	94.00 ± 1.3			
TDA	Preoperative	176,5 [174,1-178,1]	< **0.001**	< **0.001**	< **0.001****
	Postoperative 2nd -week	178,6 [177,4- 179,2]			
			0.028		
	Postoperative 3rd -month	178,6 [177,2–179,2]			
			< **0.001**		
	Postoperative 6th -month	178,1 [176,8–179,1]			
NFA	Preoperative	138.2 [126.9–143.4]	**0.009**	0.198	< **0.001****
	Postoperative 2nd -week	135.6 [125.8–141.6]			
			0.027		
	Postoperative 3rd -month	136.6 [126.1–141.3]			
			0.003		
	Postoperative 6th -month	137.1 [126.3–141.5]			
STH	Preoperative	2.75 ± 0.13	1.00	0.323	0.291*
	Postoperative 2nd -week	2.50 ± 0.19			
			1.00		
	Postoperative 3rd -month	2.50 ± 0.18			
			1.00		
	Postoperative 6th -month	2.54 ± 0.18			
CH	Preoperative	5.16 ± 0.25	1.00	0.751	0.39*
	Postoperative 2nd -week	5.03 ± 0.26			
			1.00		
	Postoperative 3rd -month	4.97 ± 0.24			
			0.63		
	Postoperative 6th -month	5.07 ± 0.24			
NOSE	Preoperative	18 [14–20]	< **0.001**	< **0.001**	< **0.001****
	Postoperative 2nd -week	2 [0–4]			
			0.951		
	Postoperative 3rd -month	0 [0–3]			
			0.162		
	Postoperative 6th -months	2 [0–5]			

Data shown as mean ± standard error of mean or median [Interquartile range].

[a] indicates the pairwise comparisons of pre-post 2 w, post 2w-post 3 m, and post 3m-post 6 m.

[b] indicates the pairwise comparisons of pre-post 6 m.

* ANOVA test.

** Friedman test,Projection index (PI), Tip projection (TP), Nasolabial angle (NLA), Tip deviation angle (TDA), Nasofrontal angle (NFA), Supratip height (STH), Columellar height (CH), Nasal obstruction symptom evaluation (NOSE).Note: Values in bold indicate statistical significance.

significantly higher TP and PI values in the postoperative 6th-month examination indicated that a significant amount of nasal projection has been obtained by using this technique. We found that the loss of TP was detected in only 9% of our patients in the last examination. In contrast to our study, Unsal et al. found that the postoperative PI was significantly lower compared with the preoperative value and the projection was observed to be decreased in 84.4% of the cases [11]. Daudia et al. also examined prospectively the aesthetic

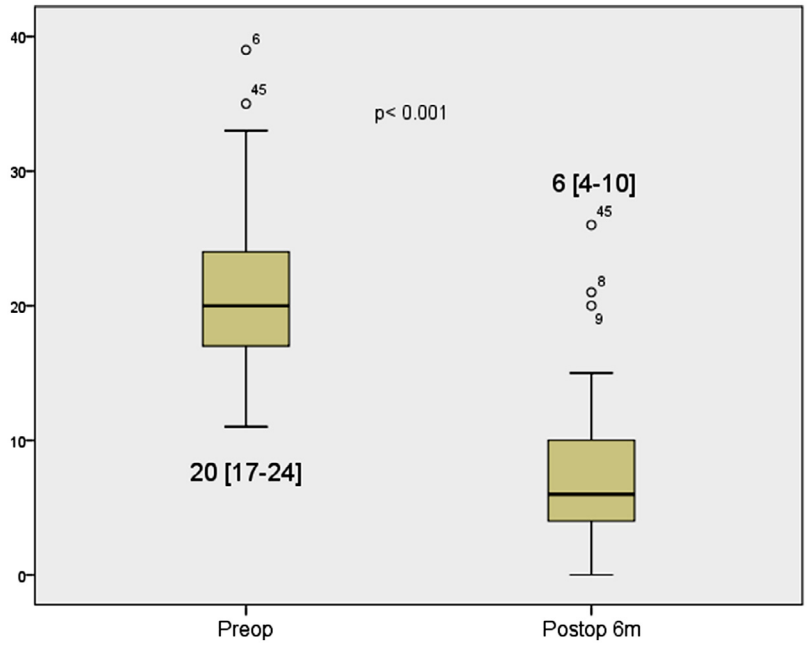

Fig. 4. The figure shows the comparison of pre- and post-operative SCHNOS scores (median [interquartile range]) of the patients.

sequelae of septoplasty in total 75 patients [20]. They noted an improvement of the TP in 18% of the patients.

In our study, significantly fall of the nasal tip was determined during the follow-up period (seen as reduced TP after the postoperative 3rd-month and as reduced rotation after the postoperative 2nd -week), but we have not noticed this 1% change to be clinically significant. This change may have been attributable to the absence of using septocolumellar sutures in the marionette technique. The disrupted septocolumellar connective tissue supporting nasal tip needs to be reapproximated with sutures having a slow absorption rate during surgery. Otherwise, the weight of combining both of skin-soft tissue envelope and lower lateral cartilage may lead to decrease nasal tip in the course of time. Antunes et al. evaluated the changes in the rotation of the nasal tip along the first postoperative year after rhinoplasty with tongue-in-groove technique [21]. They believed that the responsible factor for the loss of rotation in their technique could be the using of plain gut sutures.

The final TDA was closer to maximum possible correction (180°) in most of our patients. We obtained an unfavorable change in the angle in 7% of the patients and the angle was not changed in 3% of the patients. Few studies examined a change of TDA after septoplasty in the patients with caudal septal deviation using objective measurements. A study by Yi and Jang demonstrated that deviation types that involve straight bony pyramid showed better deviation angle outcomes after septoplasty. Moreover, the success rate of correction is related to not only the type of deviation but also the severity of deviation [2].

The present study, like others, demonstrated that the technique did not make a significant change in the final NFA, STH, and CH, measurements [2,19,20]. Although PI and TP values were significantly increased in the last examination, NFA was decreased but not significantly changed. We think that the significant alterations on the planar area (TP) did not make the same effect in the angle area (NFA). However, other studies either examined the changes that happened in the short follow-up period [2] or compared preoperative and postoperative values [19,20]. No other study, to our knowledge, investigated the course of changes in the measurements from the operative values. Moreover, our complication rate was acceptable when compared with other studies. We did not notice any complication except for the dorsal irregularities in the 2 (3%) patients. Gubisch reported that nearly 8% patients complained of irregularities of the dorsum after extracorporeal septoplasty [22].

The NOSE score is the most widely used scale, but it measures nasal obstruction alone [23]. The SCHNOS can be used currently to analyse both functional and aesthetic outcomes [24,25]. In our study, the SCHNOS was used and the survey scores were decreased postoperatively consistent with the NOSE scores. The previous study compared the NOSE scores of MS with those of open approach septoplasty [1]. The two groups experienced a important improvement between their pre- and post-operative NOSE scores. We acquired similar results. The NOSE scores reduced dramatically after MS and the significant changes were unaffected between 3rd and 6th months in both the patients with VS and the patients without VS. Moreover, no significant differences in the NOSE scores were determined postoperatively over time between the two groups.

Our study has a few limitations. First, we used the measurements of dorsal and caudal edges of anterior harvested septum to determine the dimensions of L-shaped strut. Hereby, the postoperative nasal length, rotation, and projection values can be affected from the dimensions and placement of the new graft. Second, we examined the subjec-

tive assessment of nasal obstruction by using the NOSE scale. Objective methods such as acoustic rhinometry may be give a better information especially about the patency of internal valve area.

Conclusions

Considering the result of the study, the MS is an effective technique to correct and stabilize severe caudal septal deviations. The technique can provide tip support and protection with a low incidence of dorsal irregularity. However, further studies are needed to analyse long-term of functional and aesthetic outcomes of this technique comparing open approach procedures.

Declaration of Competing Interest

None.

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None.

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