Role of columellar strut in long-term maintenance of tip support in primary Rhinoplasty

Original Article

Amr T. Ahmed, Ahmed M.S.E. Elbadawy, Hany S. Setta and Raghda E. Talal

Department of Plastic, Burn, and Maxillofacial Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt.

ABSTRACT

Background: The nasal tip can be enhanced or improved using several different procedures. To get the intended outcome, these procedures frequently make use of undetectable grafts and stitching methods. The literature provides a thorough description of the earlier techniques. Among these later methods, the columellar strut continues to be a widely used and successful type of invisible graft in rhinoplasty. The goal of this research is to clarify whether or not the columellar strut graft is a necessary step in maintaining tip support during a primary rhinoplasty.

Aim: Debatable has been the impact of a columellar strut graft on the ultimate location of the nasal tip. The objective of this research was to conduct a prospective analysis of thirty consecutive primary rhinoplasty instances, both with and without the use of columellar strut grafts. The study specifically aimed to compare the changes in nasal tip position that occurred before and after surgery.

Patients and Methods: The Plastic, Burn, and Maxillofacial Surgery Department at Ain Shams University Hospital carried out this 2-year, two-arm, randomized control clinical study between 2020 and 2022. There were two groups: the first had a rhinoplasty with a columellar strut, while the second group had surgery without a strut graft.

Results: The examination of the changes in nasal tip rotation and projection was the primary focus of postoperative assessment. This was achieved by measuring and comparing the nasolabial angle and Goode ratio (preoperative and 6 months postoperative). With the columellar strut group, we saw a considerable improvement in tip rotation and projection postoperatively, which was in line with the patient's satisfaction with the ultimate cosmetic results.

Conclusion: This study shows that, when compared with preoperative measurements, postoperative nasal projection and the nasolabial angle (NLA) are raised and stabilized. This implies that the columellar strut graft is a useful tool for supporting the nasal tip and improving the success of rhinoplasty.

Key Words: Columellar strut, nasal tip, rhinoplasty.

Received: 22 February 2024, **Accepted:** 3 March 2024, **Publish:** 7 July 2024

Corresponding Author: Amr T. Ahmed, Department of Plastic, Burn and Maxillofacial Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt. **Tel.:** +01110847843, **E-mail:** amr65148@gmail.com

ISSN: 1110-1121, July 2024, Vol. 43, No. 3: 928-938, © The Egyptian Journal of Surgery

INTRODUCTION

The nose is the visual focal point of the face, and a good rhinoplasty is thought to be among the most difficult cosmetic surgeries to execute. To accomplish consistent outcomes in rhinoplasty, open rhinoplasty is a potent method for accessing the nasal tissues, carrying out a range of procedures, and implanting grafts[1]. Both main and minor support systems are traditionally regarded as being present at the nasal tip. The size, shape, and resilience of the lower lateral cartilages' medial and lateral crura, the medial crura's fibrous attachment to the cartilaginous septum's caudal border, and the cephalic border of the alar cartilages' fibrous attachment to the upper lateral cartilages' caudal border are the main support mechanisms[2].

The length and strength of the crura, the integrity of the intercrural ligament, the thickness of the skin, and soft tissues, domal suture methods, tip grafts, and possibly most importantly grafts to ensure lower limb support between the paired medial crus and infralobule are all important factors in open rhinoplasty tip support and the columellar strut graft is the most successful[1]. A different school of thinking emphasizes how crucial the caudal septum's midline location is to the integrity of the nasal tip. A quantitative assessment of the effects of certain surgical procedures on nose tip projection has been conducted by Adamsetal[3]. Septal removal was observed to result in the most decrease of nasal tip projection in both open and closed rhinoplasty.

Beatyetal[4] has also conducted quantitative measurements of the effect on nose tip support of several surgical techniques. Their findings show that the septum's relationship with the nasal domes through central suspending ligaments causes the nasal tip to be cantilevered, or nearly hanging, at the anterior septal angle. Merely disrupting this ligamentous framework led

DOI: 10.21608/EJSUR.2024.357145

to a thirty-five percent reduction in tip support. Moreover, Westreichetal's[5] quantitative nasal tip resilience/cartilage elasticity experiments revealed that the anterior septal angle was the most supporting component.

Apart from their visual appeal, the columnar elements can also serve as a core support system, maintaining equilibrium and stability for the surrounding buildings. Therefore, adding a cartilaginous strut to the columellar region can help provide the lower lateral cartilage with the much-needed structural support it needs[3]. When the columellar strut graft is positioned correctly, suturing procedures can typically be used to correct buckling or malpositioning of the crura. The medial crura's innate asymmetry can be corrected by the columellar strut. In essence, the strut offers a framework that may be utilized for any kind of tip correction. Suture procedures could potentially be included in this. When utilized correctly, the strut gives the bottom section of the nose, especially the lower crura, an additional degree of structural integrity[6].

The columellar strut itself has the potential to contribute to nasal tip projection; however, this is more closely linked to the additional strength the strut offers for medial crural location than to the strut's length. The enhanced tip definition is a result of the medial crural augmentation, which also explains why using a strut graft is crucial[7].

On the other hand, Rohrich *et al*.[7] concluded that the routine use of the columellar strut graft does not necessarily imply an increase in nasal tip projection but rather serves as a means of unifying the nasal tip.

In our study we address the role of the columellar strut in primary rhinoplasty and if it is mandatory step in every rhinoplasty to restore and maintain tip support over a long period of time and evaluate the method used with nonsubjective methods.

PATIENTS AND METHODS:

This two armed, randomized control clinical trial was conducted at Plastic, Burn and Maxillofacial Surgery department-Ain Shams University Hospital for 2 years. 30 female patients were divided I into two groups: 1st group underwent rhinoplasty using columellar strut and 2nd group underwent rhinoplasty without using strut graft.

Egyptian females between18 and 40 years of age with droppy nasal tip with class I molar and canine relationship, normal over-jet and overbite, no crowding, competent lips, no previous rhinoplasty, no previous orthognathic treatment, no significant medical history, no craniofacial deformities, and no tip grafts used in operation other than columellar strut graft were included in the study. While patients less than 18 years with previous rhinoplasty and nasal pathology related to tumor or rhinophyma were excluded from the study.

Sampling method

The patients undergoing surgery were randomized into two groups by random sequence.

Patient counselling and consent

The Ain Shams University Research Ethics Committee for the Faculty of Medicine gave its approval to the project. Patients were fully told about the procedure's processes, associated risks, photography, and publishing, and they provided their signed consent.

Preoperative

Pre-operative assessment

i. Accurately collecting a history includes noting conditions such allergies, airway blockage, ruptured septum, and nasal trauma or surgery.

ii. Physical examination.

a. Accurate facial analysis, excluding patients with deviant facial features, such as midface or mandibular disproportions.

b. Evaluation of nasal skin thickness, primarily in the caudal third.

c. Internal nasal examination to measure the length of the nasal septum, any septal perforations, and any hypertrophy of the turbinate's; this provides information about the strength of the septum and LLC (lower lateral cartilage), as well as the resilience of the medial crura. This method of assessment of the integrity and degree of nasal tip support involves palpating and pressing the tip inferiorly.

iii. Photography: preoperative, 1-month, and 6-month postoperative photos of the face, comprising the frontal, basal, and lateral views, were obtained.

The lateral views were processed by Computer software program Rhino base using Borland Delphi 4.0 for Windows (Inprise Corp.ScottsValley, Ca), version 1.1 to help in the measurements of tip projection parameters. The Rhinobase software, unlike other software programs, does not require photographs to be later processed to reproduce the images in real-size or life-size dimensions due to previous calibration with the use of a ruler. Specific landmarks were marked on the pictures, and the program calculated distances (linear measurements) and angles automatically and displayed them in a continuous frame (Figs 1–4).

Nasal tip projection was measured by Goode's method: the length of a horizontal line drawn from alar-crease-to-the-tip is divided by the length of line drawn from nasion-to-tip should give a ratio of 0.67 (Fig. 2).

Nasolabial angle (NLA): Angle between columellar point to subnasale and subnasale to labralesuperioris lines was measured on lateral view through the line drawn through the midpoint of the nostril aperture and a line drawn perpendicular to the Frankfort horizontal plane while intersecting subnasale (Fig. 3).

Lateral cephalometry radiography. All of the lateral cephalometric radiographs will be taken while the teeth are in the intercuspal position with the lips at rest and the head in a natural position, as indicated by both the ear rods and the head supporting device to measure nasal tip parameters (Fig. 5).

Operative technique

(a) 1st group: 1 rhinoplasty with using columellar strut.

(b) 2nd group:1 rhinoplasty without columellar strut.

The same physician performed all of the procedures under general anesthesia, employing an open rhinoplasty technique. An infracartilagenous incision, subperichondrial dissection, and subperiosteal dissection in an avascular plane completed a transcolumellar incision. The nasal septum is used to extract the columellar strut, resulting in an L-shaped strut for the dorsal and columellar support (Fig. 6).

(a) The septal cartilage graft was placed into a pocket that was created caudal to the edge of the septum tracking down to the premaxilla anterior to the nasal spine (Fig. 7).

(b) A 4–0 polyprolen monofilament nonabsorbable interdomal suture was placed, and the lower lateral cartilages were held through sutures to secure the floating columellar strut to the medial crura.

(c) The columellar incision was then closed using 6–0 polyprolene sutures.

(d) Finally, dressing of the nose was done by using Steri-Strip. A plaster of Paris splint was applied over the strips.

Postoperative Assessment: was done at 1 month and 6 months periods after surgery.

(a) Computerized Rhinobase using Borl and Delphi 4.0 for Windows (Inprise Corp. Scotts Valley, Ca), version 1.1.

(b) Lateral cephalometry radiography

(c) The participating patients were asked about the aesthetic result after surgery and evaluated this on a Likert analogue scale from very good to bad (very good, good, moderate, and bad)

(d) Possible complications will be reported and analyzed.

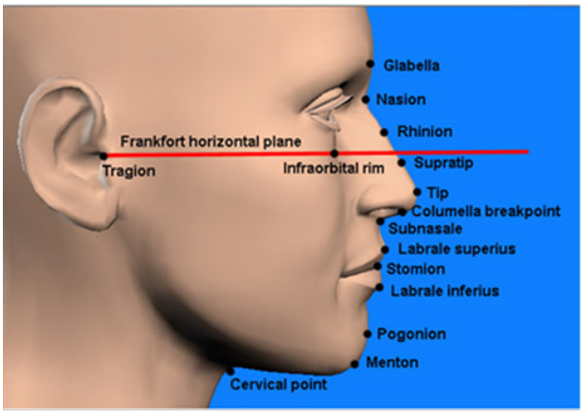

Fig. 1: Specific points for measurements (Rhino base software Image).

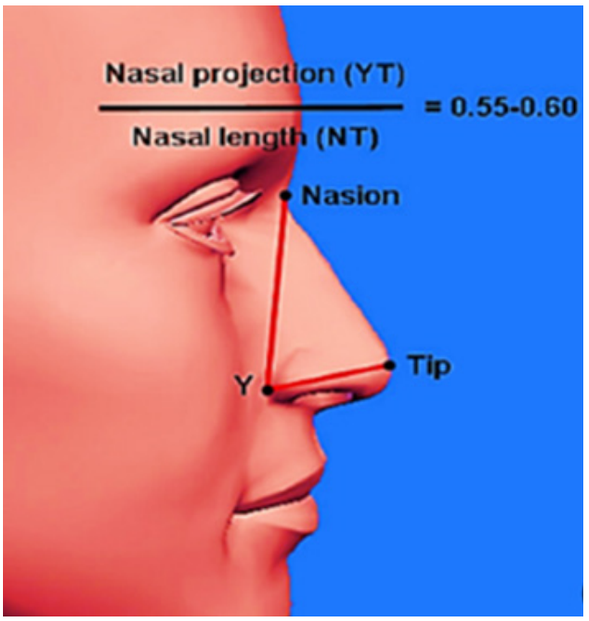

Fig. 2: Measurement of the nasal tip projection (Rhinobase_ software image).

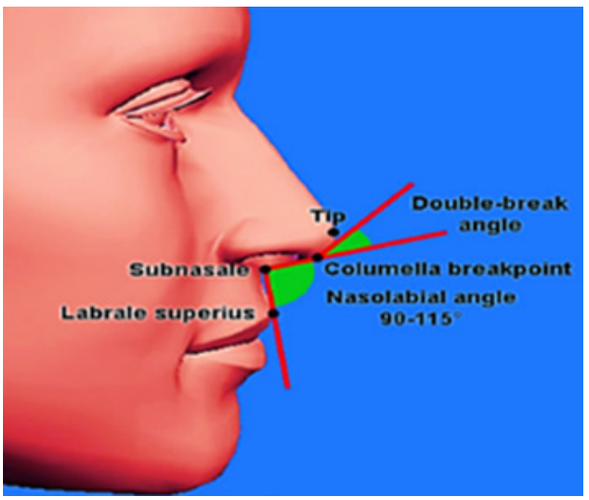

Fig. 3: Measurement of the nasolabial angle (Rhinobase_ software image).

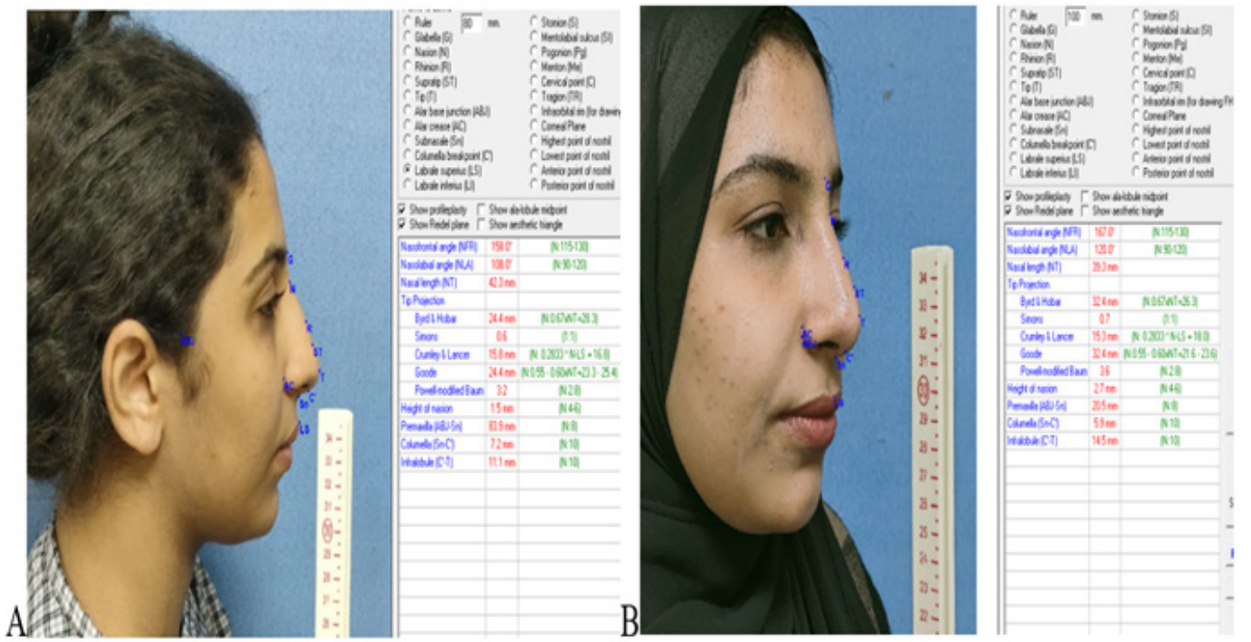

Fig. 4: A) Preoperative and B) Postoperative measurements with rhinobase programme.

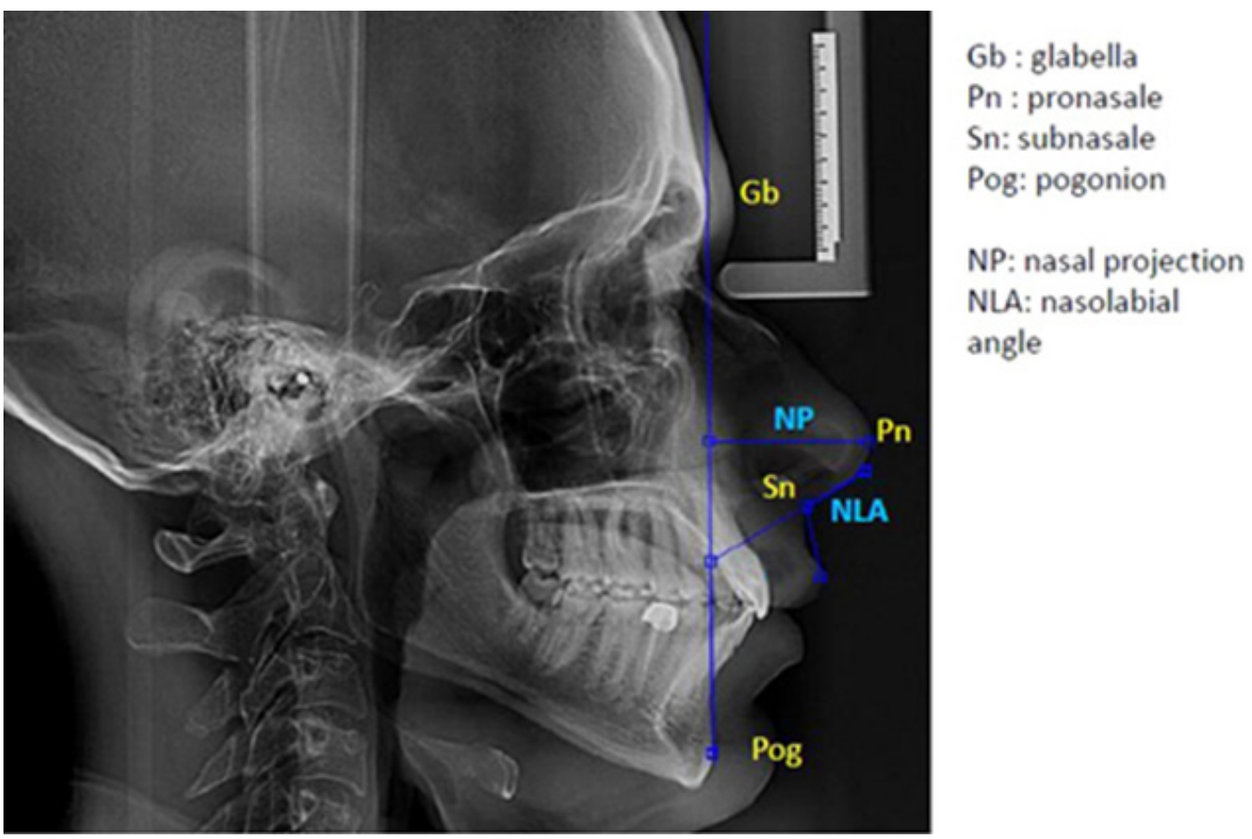

Fig. 5: Cephalometry measurements.

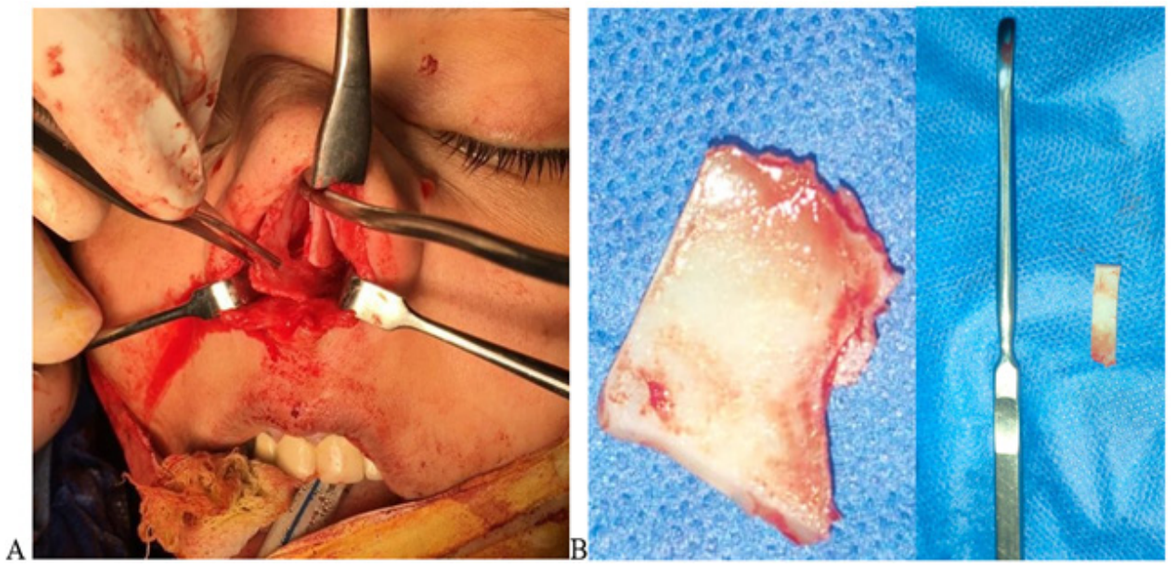

Fig. 6: A) L shaped septal strut while harvesting the columellar strut. B) The harvested strut.

Fig. 7: Placing the columellar strut.

RESULTS:

Thirty female individuals with droopy nasal tips were included in this investigation; their mean age was 25. The average nasal projection index was 53.0, and the average nasolabial angle was 89.8°. Patients were split into two groups of 15 each; one group was treated with a columellar strut, while the other group received simple tip suturing care. To evaluate the effect of each procedure on nasal tip rotation and projection, we evaluated the preoperative and postoperative data.

Statistical analysis

Numbers and percentages were used to represent categorical variables. Such as standard deviation and mean in numerical terms. Pearson's correlation was used to determine the correlation between two numerical variables. When the *P value* was less than or equal to 0.05, it was deemed significant.

Effects on nasal projection

The preoperative nasal projection index did not significantly differ between the two groups, according to the Goode ratio (*P=0.357*). Following surgery, we observed a persistent rise in nasal tip projection in group I and a noticeable drooping in group II throughout a 6-month follow-up period (*P value=0.000*) (Table 1).

Table 1: Comparison between group I and group II regarding NP Goode method pre-operative, post-operative and difference (pre, 1 month, 6 month) by A) Rhinobase method and B) cephalometry

A						B					
NP goode method	Group I No.=15	Group II No.=15	Test value	*P* value	Significance	Nasal projection	Group I No.=15	Group II No.=15	Test value	*P* value	Significance.
Pre						Pre					
Mean ±SD	0.53±0.04	0.52±0.03	0.936•	0.357		Mean ±SD	0.49±0.05	0.50±0.01	−1.286•	0.209	NS
Range	0.49–0.59	0.48–0.6				Range	0.42–0.57	0.5–0.53			
1 month						1 month					
Mean ±SD	0.68±0.06	0.69±0.06	−0.206•	0.838		Mean ±SD	0.65±0.05	0.63±0.00	1.716•	0.097	NS
Range	0.59–0.82	0.64–0.83				Range	0.59–0.72	0.63–0.63			
6 month						6 month					
Mean ±SD	0.64±0.06	0.57±0.03	4.178•	0.000		Mean ±SD	0.62±0.04	0.58±0.03	2.600•	0.015	S
Range	0.59–0.78	0.54–0.65				Range	0.55–0.69	0.55–0.62			
Repeated measure ANOVA test	98.849	208.375				Repeated measure ANOVA test	670.940	227.588			
P value	<0.001 (HS)	<0.001 (HS)				*P* value	<0.001 (HS)	<0.001 (HS)			
Difference (pre- month)						Difference (pre- 6 month)					
Mean ±SD	0.11±0.05	0.05±0.01	−3.289≠	0.001		Mean ±SD	0.13±0.02	0.08±0.03	−3.972≠	0.000	HS
Range	0.03–0.19	0.04–0.08				Range	0.1–0.16	0.05–0.13			

P value greater than 0.05: non significant (NS); *P value* less than 0.05: Significant (S); *P value* less than 0.01: highly significant (HS).
•Independent t-test.
‡Mann–Whitney test.

Effect on nasal tip rotation

When it came to the preoperative nasal tip rotation, there was no difference between the two groups. When comparing the postoperative nasolabial angle changes, we observed that group I's nasal tip rotation increased during the course of the 6-month follow-up, while group II's nose tip rotation significantly decreased (*P value=0.000*) (Table 2).

Table 2: Comparison between group I and group II regarding NasoLibial angle preoperative, postoperative, and difference (pre, 1 month, 6 months) by A) Rhinobase method and B) cephalometry

A						B					
NasoLibial angle	Group I No.=15	Group II No.=15	Test value	*P* value	Significance	Nasolibial angle	Group I No.=15	Group II No.=15	Test value	*P* value	Significance
Pre						Pre					
Mean±SD	101.28±11.56	106.67±5.16	−1.648•	0.111	NS	Mean±SD	89.79±10.57	89.26±9.71	0.142•	0.888	NS
Range	76.6–115	102–112				Range	72.9–106.3	81.5–111.3			
Post 1 month						1 month					
Mean±SD	119.25±7.65	117.47±5.79	0.721•	0.477	NS	Mean±SD	120.54±10.25	115.43±1.94	1.896•	0.068	NS
Range	106.9–130	106–128				Range	103.8–130.7	111–117			
Post 6 month						6 month					
Mean±SD	116.23±7.66	110.60±4.10	2.510•	0.018	S	Mean±SD	118.07±9.75	101.11±7.96	5.217•	0.000	HS
Range	103.2–129	105–118				Range	101.7–129.6	90.5–113.2			
Repeated measure ANOVA test	70.425	40.173				Repeated measure ANOVA test	74.457	59.340			
P value	<0.001 (HS)	<0.001 (HS)				*P* value	<0.001	<0.001 (HS)			

Difference (pre- month)						Difference (pre- month)					
Mean±SD	14.95±7.47	3.93±2.58	–3.932≠	0.000	NS	Mean±SD	28.29±7.52	11.85±7.88	–4.047≠	0.000	HS
Range	2–28.7	1–9				Range	15.4–39.8	1.7–31.7			

P value greater than 0.05: non significant (NS); *P value* less than 0.05: Significant (S); *P value* less than 0.01: highly significant (HS).
•Independent t-test.
‡Mann–Whitney test.

Regarding patient's satisfaction

The patients were asked about their satisfaction regarding the aesthetic outcome. In group I 9 cases expressed their satisfaction as very good, 4 cases as good, 2 cases as moderate and no cases asked for reoperation. While in group II 5 cases expressed their satisfaction as very good, 5 cases as good, 3 cases as moderate and 2 cases asked for secondary rhinoplasty (Fig. 8).

Clinical cases (Figs 9–12).

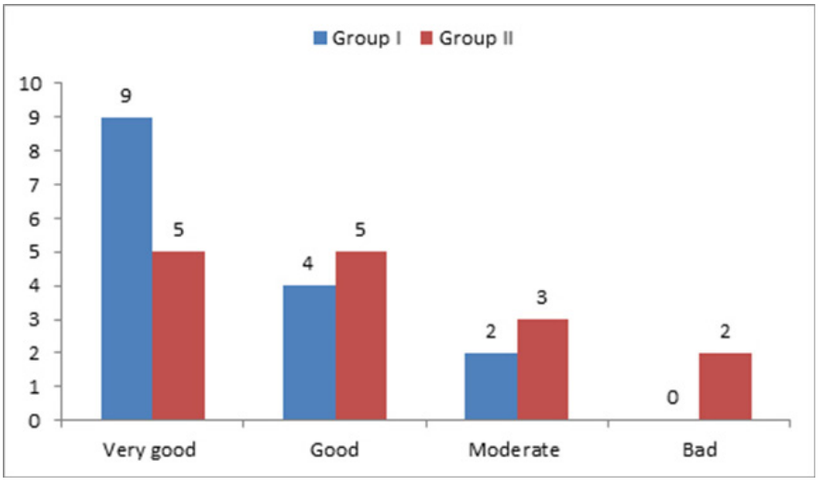

Fig. 8: Satisfaction among studied patients.

Fig. 9: A 22-year-old female with a droopy nasal tip. (A): Preoperative frontal and lateral view, (B): 6 months postoperative frontal and lateral view (group I).

Fig. 10: A 21-year-old female with a droopy nasal tip. (A): Preoperative frontal and lateral view, (B): 6 months post-operative frontal and lateral view (group I).

Fig. 11: A 29-year-old female with a droopy nasal tip. (A): Preoperative frontal and lateral view, (B): 6 months postoperative frontal and lateral view (group II).

Fig. 12: A 32-year-old female with a droopy nasal tip. (A): Preoperative frontal and lateral view, (B): 6 months postoperative frontal and lateral view (group II).

DISCUSSION

One of the most difficult cosmetic procedures is rhinoplasty. One of the most difficult aspects of rhinoplasty is still being able to make accurate and consistent alterations to the location and form of the nasal tip[8]. The secret to a successful cosmetic procedure during rhinoplasty is the ability to consistently acquire and maintain nasal tip projection and rotation in the under-projected nose. Columellar struts, lateral crural steal techniques, medial crural-caudal septal imbrications, medialization of the medial crural footplates, premaxillary grafting, shield type tip grafts, a variety of tip onlay grafts, suture techniques, and some other cartilage remodeling and suturing techniques are among the techniques that can be used to increase tip projection and/or rotation[9].

Columellar strut grafting is one of these; it offers adequate structural tip support for projection and, to a certain extent, rotation. There is little to no data regarding the significance of a columellar strut graft in the long-term preservation of tip projection and rotation, despite its well-known benefits in restoring tip strength, projection, and rotation[9]. Using a columellar strut graft to evaluate the degree of nasal tip rotation following rhinoplasty was emphasized as a primary focus of interest due to the potential problems and considerable disagreement that different surgical techniques for managing drooping nasal tips represent[10].

Our findings concur with those of earlier research by Karaiskakis *et al*.[11], who carried out a prospective study involving 109 patients who had primary rhinoplasty using tongue-in-groove and columellar strut techniques, demonstrating a significant increase in nasal tip rotation following the use of the CST. In addition, following rhinoplasty with the columellar strut, 90% of the patients expressed satisfaction with the cosmetic outcome. In the groove group, there was no statistically significant variation from the tongue.

Furthermore, Pedroza *et al*.[12] discovered that one week after surgery, the mean NLA rose from 92.7° to 105.5° and continued to rise for 6 months. These outcomes are in line with our findings, which showed that the mean NLA increased from 89.79° to 118° after surgery.

Atighechi *et al*.'s prospective study[8] examined the elasticity of the nasal tip 1 year after rhinoplasty using the columellar strut graft versus tongue in Groove method. The results showed that patients in

both groups had increased NLA postoperatively, with no statistically significant difference between the two groups. The mean NLA increased from 97.01° to 112.78° in the columellar strut group.

Bucher *et al*.'s retrospective cohort study, which enrolled 173 open septorhinoplasty patients using the columellar strut graft technique, is in line with our findings. It aimed to clarify the changes in nasolabial angles and nasal tip projections following exclusive columellar strut graft implantations, as well as other surgical procedures. The results showed that columellar strut grafts only improve nasal tip rotations and projections when specifically intended to. Following the implantation of columellar strut grafts, there may be notable alterations in nasolabial angles and tip projections if an upward rotation of the nose tip was specified as a specific surgical aim. Furthermore, nasal tip projections and nasolabial angles can both be improved using columellar strut grafts without the need for a separate surgical procedure, and still represents a meaningful tool.

This is also in line with a study by You *et al*.[9], which involved 135 female patients who had rhinoplasty procedures performed using a new graft design for the columellar strut that resembles a comma mark. The patients reported high levels of satisfaction with the overall improvements made to their noses, and the comma strut served as a dependable support system for the nasal tip; its dual curved structure is crucial in defining the lobular-columellar angle.

Furthermore, our findings corroborate those of earlier research by Alghonaim *et al*.[10], who carried out a prospective study in which 25 patients undergoing primary rhinoplasty using a columellar strut graft were enrolled to examine the degree of nasal tip rotation three months following rhinoplasty. The study's findings showed that the mean NLA increased straight after surgery, from 91.44° preoperatively to 108.84^. The mean NLA dropped from 108.84^ immediately postoperatively to 97.2^ 3 months postoperatively (*P value=0.000*), and this was statistically significant.

Our results concur with those of Emad[13], who carried out a prospective study involving 50 patients with droopy nasal tips who had open rhinoplasty. The study analyzed pre and postoperative data to determine the effect of each technique on nasal tip rotation and projection, and it found that all groups treated with tongue-in-groove and columellar strut techniques experienced a significant increase in nasal projection following surgery. When the preoperative and postoperative changes in the Nasolabial angle were compared, it was discovered that all operated groups had significantly improved nasal tip rotation.

It may not be desirable cosmetically to have a secondary nasal tip falling, and there are several reasons why this decrease in NLA may occur. These factors include pull-down action of the depressor septinasi muscle, scar contractures at the septo-columellar suture line, weight of the lobule, and ultimately failure of surgical procedures[10], which may account for the conflicting findings in the studies that differ from ours.

Sadeghi *et al*.[14] studied the long-term effects of two techniques on tip projection and rotation in two groups of unselected cases before 3, 6, and 12 months after surgery, one using a columellar strut and the other without. The study involved 92 patients who underwent primary rhinoplasty, and it was found that both groups' postoperative intragroup analysis of tip projection (using Good's and Byrd's method) and rotation showed a significant improvement (3, 6, and 12 months postoperatively) based on photographic and clinical evaluations. Comparing the intergroup data for tip projection and rotation, however, did not reveal any statistically significant differences either before surgery or 3, 6, or 12 months after surgery.

The difference between these results and ours could be attributed to the larger sample size and the brief follow-up period following the study procedure. It is commonly believed that the ultimate outcome of anesthetic rhinoplasty is visible at least a year after the procedure, if not longer. A 1-year follow-up and evaluation may be appropriate to compare one approach with another, even if progressive changes in the nasal tip position are predicted to occur during healing and it is impossible to foresee when the alterations settle[14].

CONCLUSION

This study shows that, when compared with preoperative measurements, postoperative nasal projection and NLA are enhanced and stabilized. This implies that the columellar strut graft is a useful technique for supporting the nasal tip and improving the success of rhinoplasty.

STUDY LIMITATIONS

A few noteworthy drawbacks include a comparatively lower sample size than in other research and a short-term postoperative patient follow-up period that may have an impact on patients' long-term results.

CONFLICT OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Sawh-Martinez R, Perkins K, Madari S, Steinbacher DM. Control of nasal tip position: quantitative assessment of columellar strut versus caudal septal extension graft. Plast Reconstr Surg 2019; 144:772e-780ee.

2. Papel ID, (Ed.). Facial plastic and reconstructive surgery. Johns Hopkins University USA: Thieme Medical Publishers; 2009.

3. Adams WP, Rohrich RJ, Hollier LH, Minoli J, Thornton LK, Gyimesi I. Anatomic basis and clinical implications for nasal tip support in open versus closed rhinoplasty. Plast Reconstr Surg 1999; 103:255-261.

4. Beaty MM, Dyer WK II, Shawl MW. The quantification of surgical changes in nasal tip support. Arch Facial PlastSurg 2002; 4:82–91.

5. Westreich RW, Courtland HW, Nasser P, Jepsen K, Lawson W. Defining nasal cartilage elasticity. Arch Facial Plast Surg 2007; 11:412-423.

6. Gunter JP, Rohrich RJ, Friedman RM, Hackney FL. Importance of the alar-columellar relationship. Dallas rhinoplasty: nasal surgery by the masters. 2nd ed. St. Louis, MO: Quality Medical Pub; 2007. 401-409.

7. Rohrich RJ, Hoxworth RE, Kurkjian TJ. The role of the columellar strut in rhinoplasty: Indications and rationale. Plast Reconstr Surg 2012; 129:118e-125ee.

8. Atighechi S, Dadgarnia M, Vaziribozorg S, Baradaranfar M, Zand V, Meybodian M, *et al*. Changes in elastic properties of the nasal tip using Columellar strut graft versus tongue-in-groove method over one year after rhinoplasty. Eur Arch Otorhinolaryngol 2020; 277:147-150.

9. You J, Wu L, Xu Y, Fan F, Wang H. Comma-shaped columellar strut for nasal tip plasty in East Asian rhinoplasty. Aesthetic Plast Surg 2021; 45:244-251.

10. Alghonaim Y, Alobaid F, Alnwaiser J, Alnwaiser J. The nasal tip rotation after primary rhinoplasty using columellar strut graft. Cureus 2021; 13:156-167.

11. Karaiskakis P, Bromba M, Dietz A, Sand M, Dacho A. Reconstruction of nasal tip support in primary, open approach septorhinoplasty: a retrospective analysis between the tongue-in-groove technique and the columellar strut. Eur Arch Otorhinolaryngol 2016; 273:2555-2560.

12. Pedroza F, Santos EE, Espinosa F, Velásquez CJ, Gutiérrez AF, Serrano-Cruz EF. Association of nasal tip rotation outcome estimation with the new domes technique in primary rhinoplasty. JAMA Facial Plast Surg 2018; 19:254-267.

13. Emad A. Droopy Nasal Tip: Causes and Different Methods for Management. Egypt J Plast Reconstr Surg 2022; 46:223-230.

14. Sadeghi M, Saedi B, Sazegar AA, Amiri M. The role of columellar struts to gain and maintain tip projection and rotation: a randomized blinded trial. Am J Rhinol Allergy 2009; 23:e47-e50.