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A Comparison of the Lateral Crural Suspension Flap and Tongue in Groove Techniques in Rhinoplasty Patients with Hanging Columella

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Abstract **Objectives: Background:** Many methods have been proposed to improve the rotation and projection of the nasal tip and thus achieve the desired appearance. TIG is one of the most successful and minimally invasive surgical procedures, which is conservative to control projection and rotation of the tip and to correct the deviation of the caudal septum and stabilize the base of the nose. The lateral crura suspension method is a simple and stable method that uses the cephalic parts of the lower lateral crura cartilages in the form of two flaps to suspend the tip of the nose to the septum to correct and stabilize the nasolabial angle. This technique is also easily repeatable. According to the mentioned materials, we decided to investigate the results of lateral crural suspension flap and TIG in patients with hanging columella at Imam Khomeini Hospital in Ahvaz. **Methods:** In this retrospective comparative study, documents of patients who referred to Imam Khomeini Hospital in Ahvaz for rhinoplasty were examined. Digital photographic images were prepared according to clinical standards before and six months after the operation, in the left and right lateral, anterior and basal views. In lateral images, Goods ratio, nasolabial angle, ala-columella ratio were examined. After general anesthesia, with open rhinoplasty technique and transcolumellar incision, all incisions were made in perichondrial and subperiosteal planes. After incision and skin flap, one of the two techniques of lateral crural suspension or TIG was applied to create the desired position of the nasal tip for the patient. All patients were followed up for 6 months and changes in nasolabial angle and nasal tip projection were evaluated by statistical tests. **Results:** In this research, 50 people with an average age of 26.5±4.23 years were examined. Half of the investigated people, 25 people, were in the lateral crural suspension group and the other half were in the TIG group. According to the Mann-Whitney test, the nasolabial angle of patients after rhinoplasty was compared, in both groups the angle was increased after the operation and this average difference between the two groups was not statistically significant ($p>0.05$). The Goode ratio of patients in both groups was increased after surgery and this average difference between the two groups was not statistically significant ($p>0.05$). The alar-columella ratio of patients after rhinoplasty decreased in both groups and this difference in the average of the two groups was not statistically significant ($p>0.05$). **Conclusion:** Either TIG and lateral crural suspension flap significantly improve postoperative aesthetic results and there was no statistically significant difference between them.

Key Words Lateral Crural Suspension, Tongue in Groove, Hanging Columella

INTRODUCTION

Patients seeking rhinoplasty are often dissatisfied with the appearance of the nasal dorsum in profile view or the shape of the nasal tip in frontal view. Consequently, the primary focus of many rhinoplasty procedures is on these structures [1]. The columella is a significant aesthetic component of the face, playing a key role in determining nasal tip projection and the nasolabial angle, as well as influencing the relationship between the nasal base and the alar rim. In profile view, the columellar show should ideally extend 2–4 mm below the alar margins. If it extends beyond this range, the condition is referred to as a hanging columella; if it is less than this, it is known as columella retraction [2]. The objective of nasal tip considered the most important elements of nasal tip aesthetics.

Various surgical techniques have been introduced to enhance the rotation and projection of the nasal tip, thereby achieving a more desirable appearance. These techniques include the columellar strut, Tongue-in-Groove (TIG), septocolumellar sutures and lateral crural suspension [3]. The TIG technique is regarded as one of the most effective and least invasive surgical procedures. It is a strong suture method used conservatively to manage nasal tip projection and rotation, adjust the alar–columellar relationship, correct caudal septal deviation and stabilize the nasal base. This technique can be applied in both open and closed rhinoplasty approaches and is suitable for many primary cases as well as the majority of revision cases. It is also easily combinable with other surgical methods [4,5,6]. The fundamental principle of this approach is to secure and reposition the medial crura in the correct and stable location before suturing. The end of the cartilaginous septum is placed into a groove created surgically between the medial crura [3,5]. The placement of the suture plays a crucial role in determining tip rotation and projection. Positioning the suture higher along the longitudinal axis of the septum increases both rotation and projection. Additionally, shifting the suture along the horizontal axis of the septum enhances rotation without significantly altering projection [4,7].

An appropriate nasolabial angle is a key determinant in achieving a satisfactory aesthetic result in cosmetic rhinoplasty. Increasing this angle leads to an upward tilt of the nasal base and a reduction in nasal length. Various techniques have been introduced to enhance this angle, including different suture methods, cartilage grafts and trimming of nasal cartilages. However, all of these methods come with significant limitations, such as inadequate rotation, partial or complete relapse and nasal tip distortion [8]. The fundamental approach to tip rotation involves removing factors that resist the movement of the lower lateral cartilages, creating adequate space for repositioning, rotating the cartilages to the desired position and stabilizing them. Cephalic trimming of the lateral crura helps achieve these goals. The lateral crural suspension technique is a straightforward and reliable method that uses the cephalic portions of the lower lateral cartilages as two flaps to suspend the nasal tip to the septum, effectively correcting and stabilizing the nasolabial angle. In the lateral crural suspension technique, the cephalic parts of the lower lateral cartilages-typically resected in conventional rhinoplasty-are preserved and shaped into two flaps. These flaps are then sutured to the nasal septum. Preserving the continuity of the lower lateral cartilages, especially in the dome area, provides firm support for the nasal tip in its new position. This method is repeatable and allows for multiple adjustments during surgery to achieve the ideal tip position and nasolabial angle. The final suture is placed only after the optimal result is achieved [8]. Based on these considerations, we aimed to assess the outcomes of the lateral crural suspension flap technique and the Tongue-in-Groove (TIG) method in patients presenting with hanging columella at Imam Khomeini Hospital in Ahvaz.

METHODS

This study involved a retrospective review of patient records from individuals who underwent rhinoplasty at Imam Khomeini Hospital in Ahvaz during the year 1401 (2022-2023). The inclusion criteria comprised patients who presented to the hospital specifically for rhinoplasty procedures. As both surgical methods-lateral crural suspension and Tongue-in-Groove (TIG) are well-established and commonly performed techniques, neither posed significant aesthetic or clinical risks. Informed consent was obtained from all patients before surgery and the potential benefits and risks were thoroughly explained. It is important to note that the cartilage grafts used in these techniques were harvested exclusively from the nasal region, eliminating the need for grafts from alternative donor sites such as the ribs or ears. As is standard in routine rhinoplasty, septal cartilage was typically used for grafting. This research was approved by the Research Ethics Committee of Ahvaz Jundishapur University of Medical Sciences under the ethical code IR.AJUMS.REC.1401.348. Exclusion criteria included patients with cleft palate, craniofacial or jaw abnormalities, those who had undergone closed rhinoplasty, a history of nasal trauma, unavailability of follow-up data, or a record of previous revision septorhinoplasty or rhinoplasty. Additionally, patients with a normal nasolabial angle (90-110 degrees) and normal tip projection (55–60%) according to the Goode method were excluded from the study.

The Variables Assessed in This Study Included

The nasolabial angle, Goode ratio, alar-columellar ratio and the surgical technique applied.

The medical records of patients who underwent rhinoplasty at Imam Khomeini Hospital in Ahvaz were evaluated. Digital clinical photographs were obtained in accordance with standard protocols, taken preoperatively and six months postoperatively in the left and right lateral, anterior and basal views. In the lateral view photographs, the following measurements were analyzed: Goode Ratio: In the profile view, a vertical line perpendicular to the Frankfort Horizontal Plane (FHP) was drawn through the alar crease. From the point where this line intersected the alar crease, a straight line was extended to the nasal tip and the length of this segment was measured.This value was then divided by the distance between the nasion and the nasal tip. The ideal Goode ratio is considered to fall within the range of 0.55 to 0.65.

Nasolabial Angle (NLA)

This angle was used to evaluate nasal tip rotation. In the profile view, it is defined as the angle formed between a line drawn through the most anterior and posterior points of the nostrils and a line perpendicular to the Frankfort Horizontal Plane (FHP). The desirable range is 90–95 degrees for men and 95–100 degrees for women.

Alar-Columellar Ratio

This refers to the maximum distance between the alar rim and the columella to the longitudinal axis of the nostrils.

Ideally, these distances should be equal and range between 1–2 millimeters.

The data obtained from lateral view photographs taken six months postoperatively were compared with those taken before surgery.

Surgical Procedure

Following general anesthesia, an open rhinoplasty was performed through a transcolumellar incision. All incisions were made in the submucoperichondrial and subperiosteal planes. After elevation of the skin flap, one of the two following techniques was employed to achieve optimal nasal tip positionin.

Tongue-in-Groove (TIG) Technique

After lifting the membranous septum via subchondral dissection of the caudal septum and medial crura, a groove was created between the medial crura. The caudal septum was then sutured to the medial crura at two or three points along the flat midline ("tongue"). Posterior and superior repositioning of the medial crura resulted in ideal nasal tip rotation and projection. This technique was applied in patients with a midline and appropriately long caudal septum.

Septal Extension Graft

In cases of a short nose or insufficient caudal septal length, a septal extension graft was used to provide adequate length, support and structural framework for repositioning the medial crura using the TIG method. The graft material selected had to be a relatively flat piece of cartilage. The graft's size, shape and placement were determined by the desired projection, tip derotation, or to augment the nasolabial angle. In patients with a short and straight septum, the extension graft was secured using at least three figure-of-eight sutures with 6-0 non-absorbable thread, either in line with or overlapping the septum.

Lateral Crural Suspension Technique

The cephalic margins of the lateral crura were dissected and their medial edges incised while keeping the medial flap attachments intact. Two lateral crural flaps were used to reposition the nasal tip and a needle was passed through them to maintain their position adjacent to the septum. Once the optimal tip position was achieved, the superior lateral portions of the cartilage flaps were secured using horizontal mattress sutures (Figure 1-3).

It is important to note that in cases of retracted alae or alar cephalic malposition, cartilage grafts-including alar rim grafts, alar contour grafts, Gunter grafts and articulated rim grafts-were utilized in both groups. However, alar rim flaps and lateral crural repositioning flaps were not used under any circumstances. All patients were followed up for six months and postoperative photographs were obtained. The person performing the postoperative photographic measurements was blinded to the surgical technique used. Changes in the nasolabial angle and nasal tip projection were assessed using statistical analysis.

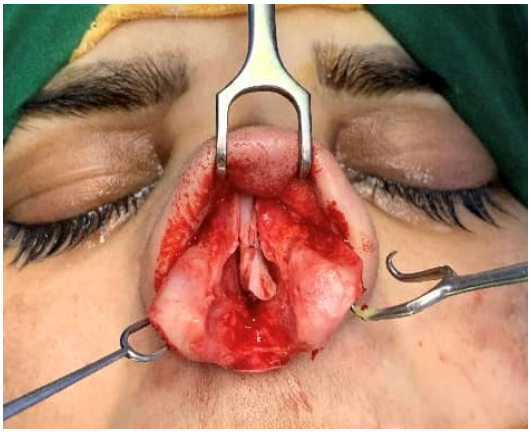

Figure 1: Sided Septal Extension Graft: In Case of Insufficient Caudal Septal Length

Figure 2: Lateral crural suspension flaps creation and elevation. Cephalic margins of lateral crural cartilages are dissected but medial portion are preserved so flaps are attached from medial points

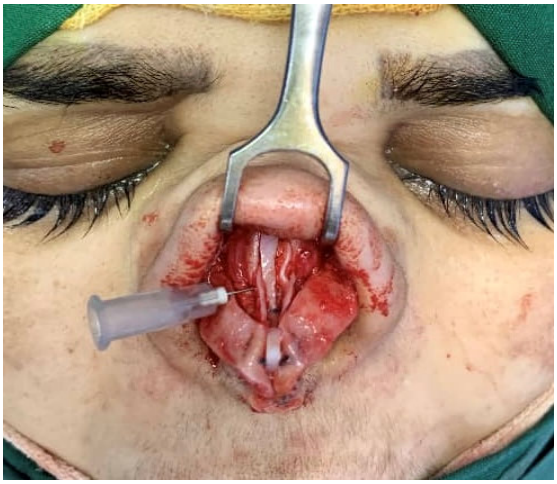

Figure 3: The 2 lateral crural suspension flaps are placed besides of nasal septal lateral surfaces. Optimal tip position and rotation are achieved via changing the lateral crural flaps position against the lateral surfaces of nasal septum

Table 1: Descriptive Information of the Studied Indices by Group

Group		Nasolabial Angle Before Surgery	Nasolabial Angle After Surgery	Goode Ratio Before Surgery	Goode Ratio After Surgery	Alar-Columella Ratio Before Surgery	Alar-Columella Ratio After Surgery
Lateral crural suspension	Mean	87.68	94.22	56.34	57.38	2.72	1.90
	Standard Deviation	7.12	3.43	6.46	4.66	0.44	0.46
	Minimum	70	89	2.20	1	53	49
	Maximum	98	100	3.50	3	66	69
TIG	Mean	83.90	94.48	56.31	57.54	2.83	1.90
	Standard Deviation	8.70	3.16	6.44	4.69	0.43	0.50
	Minimum	60	85	50	53	2.20	1
	Maximum	94	100	69	67	4	3

Table 2: Comparison of the Nasolabial Angle of Patients before and After Rhinoplasty in Each Technique

Significance Level*	Z-Score	Mean difference	
<0.001	-3.41	6.54	The *lateral crural suspension* group
<0.001	-4.29	10.5	Group TIG

* Wilcoxon signed-rank test

Table 3: Comparison of the Goode Ratio of Patients before and After Rhinoplasty in Each Technique

Significance Level*	Z-Score	Mean difference	
0.092	-1.68	1.05	The *lateral crural suspension* group
0.022	-2.95	1.23	Group TIG

*Wilcoxon signed-rank test

Table 4: Comparison of the Alar-Columella Ratio of Patients before and After Rhinoplasty in Each Technique

Significance Level*	Z-Score	Mean difference	
<0.001	-4.23	0.82	The *lateral crural suspension* group
<0.001	-4.24	0.93	Group TIG

* Wilcoxon signed-rank test

Table 5: Comparison of the Nasolabial Angle of Patients after Rhinoplasty between the Two Groups

Significance Level*	Z-Score	Mean difference	
0.725	-0.35	24.78	The *lateral crural suspension* group
		26.22	Group TIG

*Mann-Whitney test

Table 6: Comparison of Goode Ratio of Patients after Rhinoplasty in the Two Groups

Significance Level*	Z-Score	Mean difference	
0.806	-0.24	25.00	The *lateral crural suspension* group
		26.00	Group TIG

*Mann-Whitney test

Table 7: Comparison of the Alar-Columella Ratio of Patients after Rhinoplasty in Both Groups

Significance Level*	Z-Score	Mean difference	
0.991	-0.011	25.52	The *lateral crural suspension* group
		25.48	Group TIG

*Mann-Whitney test

Descriptive statistics (mean and standard deviation) were used to describe the variables. The Shapiro–Wilk test was employed to evaluate the normality of the data. To compare pre- and postoperative means in paired samples, the Wilcoxon test was used. For comparing means between two independent groups, the Mann-Whitney U test was applied. All data were analyzed using SPSS software, version 23.

RESULTS

This study involved 50 participants with a mean age of 26.5±4.23 years. Half of the participants, 25 individuals, were assigned to the lateral crural suspension group, while the other 25 were in the Tongue in Groove (TIG) group. Among those in the lateral crural suspension group, 20 individuals (80%) were female and in the TIG group, 21 individuals (84%) were female. Thus the demographic data indicated a very high portion of female patients.

To test the hypotheses, the normality of the scores obtained in both groups, before and after surgery, was examined using the Shapiro-Wilk test. The results indicated that the assumption of normality was not satisfied ($p<0.05$). As a result, to compare the scores before and after surgery, the non-parametric equivalent of the paired t-test, the Wilcoxon test, was applied. The nasolabial angle scores of the patients before and after rhinoplasty were compared. In both the lateral crural suspension and TIG groups, the nasolabial angle increased following surgery and the mean difference before and after surgery was statistically significant ($p<0.05$).

The Goode ratio of patients before and after rhinoplasty was analyzed using the Wilcoxon test. In both the lateral crural suspension and TIG groups, the Goode ratio increased; however, this increase was not statistically significant in the lateral crural suspension group ($p>0.05$).

On the other hand, in the TIG group, the difference in mean values was statistically significant ($p<0.05$).

The Alar-Columella ratio was compared before and after rhinoplasty in both groups using the Wilcoxon test. In both the lateral crural suspension and TIG groups, the Alar-Columella ratio decreased following surgery. The difference in the mean values before and after surgery was statistically significant in both groups ($p<0.05$).

To analyze the postoperative changes between the two groups, the Mann-Whitney test was used to compare the mean scores of the three variables in both groups. The nasolabial angle scores of patients were compared before and after rhinoplasty. In both the lateral crural suspension and TIG groups, the nasolabial angle increased after surgery. However, the mean difference between the two groups was not statistically significant ($p>0.05$).

The Goode ratio scores of patients after rhinoplasty were evaluated. In both the lateral crural suspension and TIG groups, the ratio improved following the surgery, but the difference in mean scores between the two groups was not statistically significant ($p>0.05$).

The alar-columella ratio scores of patients were compared before and after rhinoplasty. In both the lateral crural suspension and TIG groups, the ratio decreased after the surgery, but the mean difference between the two groups was not statistically significant ($p>0.05$).

DISCUSSION

Correcting the position of the nasal tip and the nasolabial angle during rhinoplasty presents a challenge. Several factors contribute to the rotation of the nasal tip. Fibrous attachments from the lower lateral cartilage to the skin, the upper lateral cartilages, the piriform aperture and the caudal septum provide support and play a significant role in the positioning of the nasal tip. Tip rotation can be increased using a variety of techniques, either alone or in combination. These techniques enable upward movement and rotation of the nasal tip. Surgical maneuvers such as the transfixion incision, cephalic trim, cartilage incisions and division of the lower lateral cartilage disrupt the support of the tip, allowing these cartilages to rotate. Insufficient rotation of the nasal tip, complete or partial relapse, the need for additional cartilage to correct tip positioning and deformities of the tip are some of the reasons that lead to the exploration of alternative methods to improve the nasolabial angle. Webster and colleagues were among the first to describe different options for tip rotation. These methods were based on various types of trimming and cutting of the lateral crural cartilage. Their initial descriptions evolved into more cautious cephalic resections, a V-shaped resection of the nasal septum and careful trimming of the anterior borders of the medial crural cartilages. Davidson and Murakami suspended the lower lateral cartilages with sutures to the upper lateral cartilages and septum. In techniques with many modifications, the lower lateral cartilages are sutured in different areas and suspended to the septum. The tightness of the suture typically determines the degree of tip rotation. However, the lack of stability in the suture suspension is a major limitation of these techniques. Cartilage grafts help reinforce the support of the nasal tip or improve the shape of inadequate cartilages. For instance, the columellar strut is commonly used to increase tip support and adjust its spatial positioning. However, recent studies indicate that the columellar strut does not necessarily result in an increased nasolabial angle in all cases.

Tip grafts, button grafts and indirect plumbing grafts all influence the nasolabial angle. The cephalic margins of the lower lateral crura are connected by fibrous connective tissue to the caudal margins of the upper lateral cartilages, which play a role in tip support. The resistance created by the fibrous attachments of the lateral crura and upper lateral cartilages is eliminated by intralateral cartilage incisions or resections of the cephalic margins of the lateral crura. As a result, the lateral crura no longer resist rotation, allowing them to freely rotate upwards. For lateral crural suspension flaps, the cephalic parts of the lower lateral cartilages, which are typically resected in rhinoplasty, are planned as two flaps. These flaps are sutured to the nasal septum. The integrity of the lower lateral cartilage in certain areas provides fixed support for the nasal tip in its new position. This technique is easily repeatable and can be performed multiple times to achieve the best tip position and nasolabial angle. Once the optimal position is achieved, final sutures are placed on the flaps. The main limitation of this technique is the need for broad lateral crural cartilage. It is evident that in many cases of secondary rhinoplasty or some primary rhinoplasty cases, this requirement is not met, making the technique unsuitable. However, it is believed that this technique is straightforward, highly effective and repeatable. It can be used as an adjunct to other standard methods to help stabilize results or applied as an alternative technique in certain rhinoplasty cases.

Despite advancements in technique, rhinoplasty is moving towards less invasive surgical approaches. Tip Intranasal Graft (TIG) is among the most effective, yet least invasive, methods. Initially described by Kridel *et al.* in 1999, it was subsequently explored and refined by Miller, Shah, Toriumi, Guyuron and Brow. The positive effects of TIG are particularly evident in addressing tip deformities, septal deviations in the lower third and columellar issues, resulting in excellent aesthetic and functional outcomes. Unlike previously described techniques, TIG does not depend on graft harvesting for medial crural replacement and also plays a crucial role in tip projection, rotation, improving the nasolabial angle and correcting septal deviations. Furthermore, in contrast to routine maneuvers that can lead to unpredictable contraction of the nasal tip, TIG provides a more controlled result. Patients do not report the rigid or abnormal sensation often caused by the use of columellar grafts. Caudal septal deviation is also corrected without obstruction in the septum, which would otherwise lead to a drooping nasal deformity. Recently, Lohuis and Datema published a description of the benefits of TIG in revision rhinoplasty, particularly when combined with graft augmentation. Consequently, TIG is a versatile and valuable technique for correcting excessive columellar show, short noses, drooping noses, reshaping septal deviation and tip-plasty. It is also effective in improving the nasolabial angle and

adjusting tip projection. Khabir and colleagues studied the advantages of TIG in improving the nasolabial angle and tip projection in the Iranian population, noting that this technique is not only predictable but also repeatable. The primary benefit of this method is its minimally invasive nature, making it suitable for modern rhinoplasty techniques. It enables proper positioning of the medial crura and is considered a stable, long-term solution with favorable functional and aesthetic outcomes. According to the experimental results provided by the guiding professors and consultants in this study, TIG typically provides minimal projection (contrary to common belief) and usually requires a skin or cap graft. Finally, this point should be mentioned, since our study has non-random assignment and because of small sample size and potential for bias, which limits the generalizability of the findings to other surgeons, the senior person of this research strongly recommend to planning another strong research to compare these techniques.

CONCLUSION

As a result, either TIG or lateral Crural suspension flap are predictable and reliable techniques to improve postoperative aesthetic results and there was no statistically significant difference between these two techniques according to outcomes.

Funding

This research did not receive any financial support.

Conflicts of Interest

The authors declare no conflicts of interest.

Ethical Statement

This research was approved by the Research Ethics Committee of Ahvaz Jundishapur University of Medical Sciences under the ethical Code IR.AJUMS.REC.1401.348.

Informed Consent Statement

Consent forms were given to all 50 patients in order to do surgery and plans for the research.

Clinical Trial Registration

This research involved a retrospective review of patients and does not involve any clinical trials.

Availability of Data and Material

The data will be available at department of Oral and Maxillofacial surgery, Imam Khomeini Hospital, Ahvaz and will be received via corresponding author upon request via email.

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