

Surgical Techniques to Improve the Soft Tissue Triangle in Rhinoplasty: A Systematic Review

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Abstract

In this systematic review we aim to (1) describe the anatomy and function of the soft tissue triangle, (2) identify the existing rhinoplasty literature that discusses the role of the soft tissue triangle, (3) provide a summary of the outcome measures for soft tissue triangle techniques in rhinoplasty, and (4) demonstrate the need for further research reviewing soft tissue triangle techniques in rhinoplasty. A systematic literature review was conducted from 2002 to 2019 utilizing MEDLINE/PubMed, Embase, Ovid, and Cochrane databases with the keywords, “rhinoplasty” and “soft tissue triangle” or “facet” to identify articles that describe the anatomical significance, clinical applicability, and rhinoplasty outcomes involving the soft tissue triangle. A total of 26 studies were identified as appropriate for inclusion. The vast majority describe the relationship of structure and function of the soft tissue triangle with particular focus on notching and retraction. The soft tissue triangle is an important area of the nose often neglected in rhinoplasty. This area is a common source of patient dissatisfaction and the need for revision rhinoplasty. Due to this fact, a formal evaluation of the role of the soft tissue triangle in nasal airway patency is needed. Specific validated outcome measures such as the NOSE (Nasal Obstruction and Septoplasty Effectiveness) score or the SCHNOS (Standardized Cosmesis and Health Nasal Outcomes Survey) should be employed in the evaluation of surgical intervention to the soft tissue triangle.

Keywords

- ▶ soft tissue triangle
- ▶ soft facet
- ▶ rhinoplasty
- ▶ infratip lobule

The soft tissue triangle or facet, also referred to as the “Bermuda triangle of the nose,” was first described by Converse as the area between the dome and the nostril rim “which consists of two juxtaposed layers of skin—the covering of the nose and the lining vestibular skin, separated by a loose areolar layer.”^{1–6} Others have referred to the soft tissue triangle as the caudal lobular notch, an area medial to the lower margin of the lateral crus of the lower lateral cartilage.⁷ The shape of the triangle is dependent on the

lower lateral cartilages due to absence of cartilage immediately underneath this triangle. Therefore, any changes in the lower lateral cartilages and the intermediate crura will impact symmetry, shape, and position of the triangle.^{2,3} This triangle is further divided into internal and external triangles.^{8,9} The internal triangle is tissue at the superior end of the membranous septum, while the external triangle is soft tissue draping over the fissure at the junction of the medial and lateral crura at the infratip lobule.⁸ The external

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and internal soft tissue triangles along with the intermediate crus and anterior aspect of the lower lateral crus contribute to the domal arch.⁹ The soft tissue triangle also serves as the lateral border of the infratip lobule, and therefore influences the nasal tip and lobule.^{4,10} The soft tissue triangle should be soft without overt definition, casting only an attenuated shadow. Otherwise, it would detract from the aesthetically pleasing tip lobule contour.^{5,6,11}

The soft tissue triangle is an area often neglected in rhinoplasty, despite its important role in maintaining the natural contour of the nasal tip lobule.⁵ Most of the reported surgical techniques concerning the soft tissue triangle are within the context of reconstructive rather than aesthetic surgery. Careful attention to the soft tissue triangle can help a surgeon avoid unsuccessful rhinoplasty results such as retraction and notching.^{2,3,5,12–14} In fact, soft tissue triangle deformity is a common complaint leading to revision rhinoplasty.^{2,14} Despite its importance, there are only a small number of published studies focusing on the management of the soft tissue triangle in rhinoplasty.^{1,2,5,6,13,15}

In this systematic review we aim to, (1) describe the anatomy and function of the soft tissue triangle, (2) identify the existing rhinoplasty literature that discusses the role of the soft tissue triangle, (3) provide a summary of management techniques for soft tissue triangle rhinoplasty, and (4) demonstrate the need for utilizing specific outcome measures in evaluating surgical intervention to the soft tissue triangle.

Methods

A systematic literature review was conducted from 2002 to 2019 utilizing the databases MEDLINE/PubMed, Embase, Ovid, and Cochrane. A search string strategy was employed with the keywords: “rhinoplasty” AND “soft tissue triangle” OR “facet.”

Inclusion criteria encompassed articles that described the anatomical and functional significance of the soft tissue triangle, its applicability to rhinoplasty, and outcomes following rhinoplasty with various soft tissue triangle techniques. All articles types were considered, including review articles, case reports, case series, and prospective studies. Exclusion criteria included articles discussing nasal reconstruction in the context of trauma, oncological defects, burns, and cleft/congenital rhinoplasty techniques. Articles drafted in a language other than English or without an available English translation were also excluded.

Two authors independently reviewed all search results at the title and abstract level for inclusion and exclusion criteria. Discrepancies between author article reviews were resolved through discussion. The search process and strategy were conducted in accordance with the PRISMA guidelines.¹⁶

Results

A total of 140 articles were identified during the database search and reviewed. Following removal of duplicate results, 108 articles remained at the level of the abstract. Each abstract was screened for eligibility, with 41 included for full article review. On full review, excluded articles consisted

of those with a focus on reconstruction, congenital abnormalities, and those with inadequate discussion of the soft tissue triangle. Twenty-six articles were deemed appropriate for final analysis (► **Fig. 1**).

Each article was reviewed in full and summarized based upon presented data discussing the soft tissue triangle (► **Table 1**). There are several anatomical characteristics that make the soft tissue triangle a unique subunit of the nose. There is dermis-to-dermis contact in this area, which puts it at increased risk of deformity including notching, retraction, and other tip distortions.⁶ Without any cartilaginous support, incisions that violate this delicate area during rhinoplasty can lead to uncontrollable deformity.^{2,3,5,12,13,15,17,18} There is a dearth of literature discussing management of the soft tissue triangle in rhinoplasty. Furthermore, there are few standardized outcome measures for the evaluation of surgical intervention to the soft tissue triangle.

According to Campbell et al, there are five interventions that preserve and augment the soft tissue triangle to prevent notching and aesthetic deformity. These include: (1) precise dissection and incision placement; (2) internal support with cartilage grafting if necessary (alar contour, infratip lobular, and morselized cartilage grafts); (3) closure of dead space; (4) avoiding undue tension during closure; (5) external support postoperatively.⁶ Other authors have reported additional ways to avoid tip deformities. Foda advocated for a marginal incision directed away from the cartilage and toward the alar rim. This helps to preserve the cuff of vestibular skin caudal to the domal angle, which is the internal lining of the soft triangle.⁵

Another study by Kayabasoglu and Nacar categorized patients at risk for postoperative notching into three groups based upon anatomical features. The first group had a narrow intermediate crus which provided little or no caudal support. This group was treated with grafts, caudally augmenting the intermediate crus. The second group had adequate cartilage support but lengthy soft triangle skin, which required bundle grafts (cartilage grafts wrapped in a “bundle” of soft tissue, placed under the soft tissue triangle). The third group had no anatomical problems of the soft triangle but had a wide middle crural angulation due to a cephalic orientation of the lateral crus, requiring either a bundle graft, extension graft, or both. The authors believed that patients with cephalic positioning of the lateral crura are at the highest risk for notching. This is because separating the intermediate crus cartilaginous structure from the overlying vestibular skin creates a space between two previously fused structures, giving rise to wound healing and scarring. In this study, 6/127 (4.7%) total patients had postoperative notching: 1/31 patients in the first group, 2/24 patients in the second group, and 3/72 patients in the third group. All patients were offered revision surgery and four underwent auricular cartilage grafting into the tip via a closed rhinoplasty approach.¹³

Nonsurgical interventions to improve notching include surgical massage in the opposite direction of the contracture, steroid injections, taping, and elastic impression dressing placement.¹⁹ Notching and retraction can be also addressed surgically through the placement of grafts. Placing soft pieces of cephalic trim cartilage or thin pieces of shaved septal

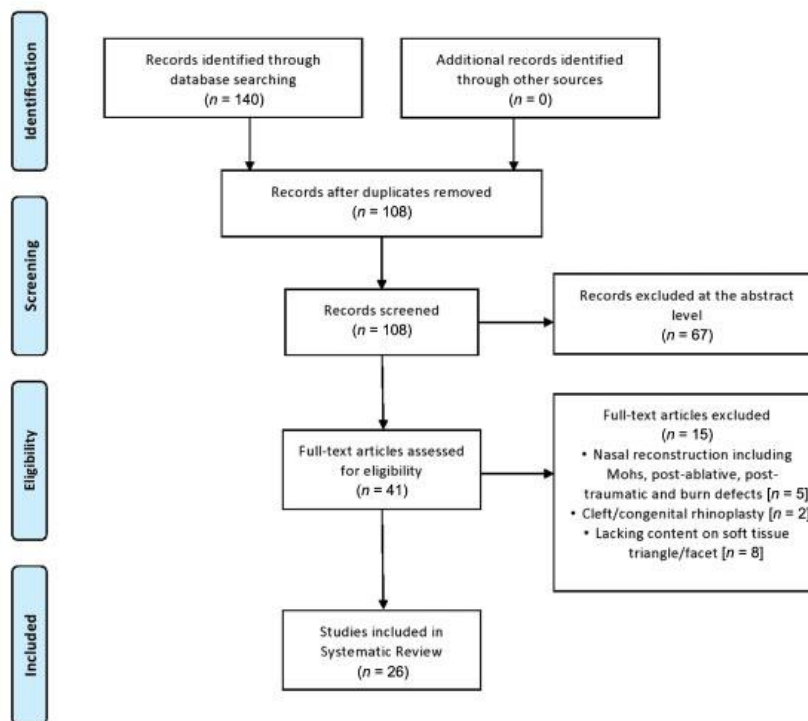


Fig. 1 Flow chart—soft tissue triangle systematic review database search.

cartilage behind the skin of the soft facet can help to address notching and retraction.^{4,6} Severe notching can be corrected by harvesting a composite ear cartilage graft from the triangular fossa to recreate the soft tissue triangle. A malpositioned medial crura can be corrected with either domal sutures or soft facet grafts.⁴ Alar rim grafts can be used to address notching and should be placed along the nostril rim from the soft tissue triangle down into the alar base.²⁰ Alar rim grafts have also been described to address notching and retractions of the soft tissue triangle.^{6,15,21} Articulated or cantilevered rim grafts can provide additional stability across the soft triangle region.²² Soft tissue triangle reconstruction with z-plasty has also been reported to correct notching.³

Discussion

The soft tissue triangle area is unique in each patient, making detailed analysis and individualized surgical planning crucial.^{13,15} Rhinoplasty surgeons should be cognizant of the soft tissue triangle during operative planning because of its influence on maintaining the natural contour of the nasal tip.⁵ For example, grafts or flaps, repositioning of lower lateral cartilages, lateral crural spanning sutures, cephalic trim, incomplete closure of marginal incisions, and dome/tip correction all potentially cause wound contraction and contribute to soft triangle irregularities.^{6,15}

The variation of the soft tissue triangle is due to many components, including differences in angulations at the junction of the medial and lateral crura, stability of the lower

lateral cartilage, skin and cartilage thickness, tip projection and rotation, nostril length and spatial location of the lower lateral crura.^{13,15} The caudal border of the cartilage is easily visualized in thin-skinned patients but requires internal examination in others. Preoperative photographs taken without a flash from the basal view are the best for displaying the soft triangle. Additionally, one can press the area with a curette to assess the tension, softness, length, and support from nearby cartilaginous tissues.¹³ A thorough evaluation and manipulation of the soft tissue triangle preoperatively is important in recognizing patients at risk for notching. Features that suggest an increased risk of notching include thin skin, fragile triangles, and cephalically positioned lateral crura.⁶ In the senior author's opinion (Y.D.), this can be best accomplished on nasal base view (→ **Fig. 2**).

Some authors have emphasized the importance of the incision, cartilage graft placement, and manner of closure in the soft tissue triangle area. Bayram et al introduced a modified incision and closure technique with crushed cartilage to fill the soft triangle area and prevent tip notching and retraction.¹⁷ However, this cartilage is not anchored, making it prone to shifting and more likely to fail to correct an existing rim retraction.^{13,15} Therefore, morselized cartilage grafts are only used when a soft tissue triangle indentation is present at the time of closure. Campbell et al advocate closing the columella but leaving the medial half of the marginal incision and the soft tissue triangle incision open. This allows for placement of morselized cartilage into a precise pocket while avoiding tension on the triangle to prevent retraction. The placement of morselized cartilage is performed in

Table 1 Summary of included studies from systematic review

| Study (Y) | Aim/Objective | Study size | Study design | Importance of soft tissue triangle | Outcome measures | Level of evidence |
|-------------------------|---|--|-------------------------|---|---------------------|-------------------|
| Ali-Salaam et al (2002) | Examine cadaveric adult human noses to further elucidate the region of the soft triangle of the nose. | Five cadaveric noses | Basic science | Perpendicular incisions within any of the three zones of the soft tissue triangle can result in unfavorable notching and tip deformity. Therefore, incisions should be planned parallel to the soft triangle. | N/A | V |
| Lam and Williams (2002) | Detailed anatomical overview of the internal and external nose in planning rhinoplasty. | N/A | Basic science | The internal and external soft tissue triangles help in defining the angle created at the junction of the intermediate and lateral crura of the lower lateral cartilages. | N/A | V |
| Guyuron et al (2005) | Describe the specific role of alteration of the soft triangle, alar rim, and cartilaginous framework in correcting the short nostril and achieving a balanced nostril/lobule ratio. | 200 patients undergoing rhinoplasty, of which 27 underwent soft triangle excision. | Retrospective review | The short nostril can be corrected by removing the soft triangle lining to allow elevation of the nostril apex. This should be done conservatively to avoid notching. | N/A | IV |
| Toriumi (2006) | Describe refined surgical techniques in controlling the nasal tip in rhinoplasty. | N/A | Review | Emphasis on subtleties of soft tissue triangle in rhinoplasty to avoid tip shadowing. | N/A | V |
| Daniel (2007) | Demonstrate the classification and treatment of saddle nose deformity. | 25 patients with saddle nose deformity. | Prospective case series | Importance of anatomical understanding of the soft tissue triangle in placing alar rim grafts. | N/A | IV |
| Dayan (2007) | Modifications and evolution of one surgeon's rhinoplasty techniques. | N/A | Review | Asymmetry of the soft tissue triangles is one defect noticed in revision rhinoplasty. Patients with prominent soft tissue triangles have a triad of thin skin, lower lateral cartilages that are cephalically oriented, and overprojected noses. Therefore, cartilaginous alar grafts should be placed under the soft tissue triangle and sutured to the intermediate crura. Severe notching can be corrected by harvesting a composite ear cartilage graft from the triangular fossa to recreate the soft tissue triangle. Notching may also be avoided by ensuring the medial end of a cartilage graft does not extend into the soft tissue triangle. | N/A | V |
| Nguyen et al (2008) | Reconstruction of the soft tissue triangle using the z-plasty technique for notching. | One patient | Case report | Soft tissue triangle z-plasty can be used to address notching. | Patient "satisfied" | V |
| Ansari et al (2008) | Illustrate the importance of grafts and implants in rhinoplasty. | N/A | Systematic review | Alar rim cartilaginous grafts can be utilized to avoid/reconstruct notching and retractions of the soft tissue triangle. | N/A | V |

(Continued)

Table 1 (Continued)

| Study (Y) | Aim/Objective | Study size | Study design | Importance of soft tissue triangle | Outcome measures | Level of evidence |
|------------------------------|---|---|-------------------------|--|--------------------------------|-------------------|
| Higuera et al (2009) | Understanding the anatomical differences and appropriate techniques in Hispanic rhinoplasty. | N/A | Retrospective review | Careful dissection and undermining the soft tissue just superficial to the lower lateral cartilage reduces the risk of inadvertent damage to soft tissue triangle and subsequent notching. | N/A | V |
| Jung et al (2009) | Correction of alar retraction with alar cutaneous rotation flap and batten grafts. | 13 patients undergoing correction of alar retraction with alar cutaneous rotation flap and batten grafts. | Case series | Meticulous multilayered suturing, which relieves tension, can avoid future alar notching in cases where incisions are placed in the soft tissue triangle. | Alar retraction: 0% recurrence | IV |
| Funk et al (2009) | The M-arch model and vertical lobular division in tip repositioning. | 41 patients undergoing open septorhinoplasty and vertical lobular division. | Retrospective review | Manipulation of intermediate crus at different lengths and locations can affect the appearance of the external soft tissue triangle. | Revision rate: 2.4% | IV |
| Koppe et al (2011) | Review basic structures necessary for functional and aesthetic rhinoplasty. | N/A | Review | The soft tissue triangle, also known as the caudal lobular notch, is an area medial to the lower margin of the lateral crus of the lower lateral cartilage. | N/A | V |
| Rohrich and Liu (2012) | Classify deformities causing excess intratip lobule projection and present a surgical algorithm for addressing the intratip lobule. | Combination of patient (two) and cadaver models. | Retrospective review | The soft tissue triangle is the lateral border of the intratip lobule. | N/A | V |
| Lee et al (2013) | Identify the most common deformities seen in secondary rhinoplasty patients and the required surgical maneuvers to correct them. | 100 secondary cosmetic rhinoplasty patients. | Retrospective review | In revision rhinoplasty, soft tissue triangle grafts were placed in 18% of cases. | N/A | IV |
| Rowe-Jones (2014) | Describe the crucial anatomy contributing to the nasal tip, with particular focus on the medial and lateral crura. | N/A | Review | The soft facet influences the nasal tip and lobule. A malpositioned medial crura can also cause a soft facet deformity. This can be corrected with either domal sutures or soft facet grafts. | N/A | V |
| Choi et al (2014) | Investigate the problems resulting from nasal tip surgical procedures using a septal extension graft. | 44 patients who underwent nasal tip-plasty using a septal extension graft. | Retrospective review | Proper suturing of the soft tissue triangle will help to prevent infection and graft extrusion. | Patient satisfaction: 86% | IV |
| Kayabasoglu and Nacar (2015) | To focus on the soft triangle, a lesser mentioned topic in aesthetic nose operations. | 127 patients undergoing primary rhinoplasty at risk for postoperative notching. | Prospective case series | Three groups of patients at risk for postoperative notching—(1) narrow cartilaginous structure of the middle crus providing little or no caudal support; (2) adequate cartilage support with a lengthy soft triangle; (3) no anatomical problem with the soft triangle with a wide middle crural angulation due to a cephalic orientation of the lateral crus. | Postoperative notching: 4.7% | IV |

Table 1 (Continued)

| Study (Y) | Aim/Objective | Study size | Study design | Importance of soft tissue triangle | Outcome measures | Level of evidence |
|------------------------------|---|--|----------------------|--|--|-------------------|
| Casanueva and Gerecci (2016) | Determine whether the dome binding suture or hemitransdomal suture technique results in an objectively satisfactory outcome in nasal tip contouring when assessed from the perspective of the basal view. | 112 Hispanic/Mestizo patients who underwent cosmetic rhinoplasty procedures. | Retrospective review | The hemitransdomal suture preserves the facet triangle and helps with nasal tip contouring. | Tip-lobule line: 93.3% hemitransdomal, 22.7% dome binding. | III |
| Goodrich and Wong (2016) | Highlight the use of the alar articulated rim graft to improve the function and cosmetic appearance of the soft tissue triangle, alar rim, and alar lobule. | Two case examples | Review | Articulated alar rim grafts provide support to the soft tissue triangle to counter or correct retraction. | N/A | V |
| Bayram et al (2016) | Introduce a modified incision and closure to prevent notching and to provide support for the soft triangle. | One patient | Case report | Modified incision and closure and filling with crushed cartilage prevents tip notching and retraction. | N/A | V |
| Foda (2016) | Identify the anatomical variations and surgical maneuvers predisposing to soft triangle deformities and to describe soft triangle grafts that can be used to prevent soft triangle retraction and/or notching in noses. | 150 patients in which a soft tissue triangle graft was used. | Case series | Soft triangle grafts result in effective long-term correction of retraction and notching. | Revision rate: 2.5% | IV |
| Çakır et al (2016) | Define the ratio of caudal and cephalic excess of the lower lateral cartilage and evaluate whether it is possible to eliminate nostril asymmetries and alar retractions by means of a lower lateral rim flap. | 498 primary rhinoplasty patients | Retrospective review | The soft tissue triangle plays a significant role in the appearance of the nasal tip. Irregularities of the soft tissue triangle is a source of patient dissatisfaction. | Patient satisfaction: 98% | IV |
| Foulad et al (2017) | Discuss the technical details and experiences with lateral crural tensioning in both functional and aesthetic rhinoplasties. | 114 lateral crural tensioning rhinoplasties. | Retrospective review | Articulated or cantilevered rim grafts supply stability across the soft tissue triangle region. | Revision rate: 5.3% | IV |
| Campbell et al (2017) | Study the anatomy of the soft tissue triangle and describe methods to maximize the preservation and augmentation of the soft tissue triangle to prevent notching and aesthetic deformity. | Two cadaver models and one case presentation. | Basic science | The preservation and augmentation of the soft tissue triangle to prevent notching and aesthetic deformity is accomplished by five key interventions: 1. Precise dissection and incision placement. 2. Internal support with cartilage grafting if needed (alar contour, infratip lobular, morselized). 3. Closure of dead space. 4. Avoiding undue tension during closure. 5. External support postoperatively. | N/A | V |

(Continued)

Table 1 (Continued)

| Study (Y) | Aim/Objective | Study size | Study design | Importance of soft tissue triangle | Outcome measures | Level of evidence |
|---------------------------|--|------------|--------------|---|------------------|-------------------|
| Sawhney et al (2017) | Review interventions that improve soft tissue healing and long-term outcomes. | N/A | Review | Soft tissue trauma can result in wound contracture and notching, which is difficult to treat. Some interventions include surgical massage in the opposite direction of the contracture, steroid injections, taping and elastic impression dressing placement. | N/A | V |
| Rohrich and Afrooz (2018) | Describe the butterfly graft, which is a simple, reliable, and predictable method of providing support in the region of the soft triangle. | N/A | Review | The soft tissue triangle lacks structural support and is prone to a recessed appearance. It can receive support and volume with an infratip lobule butterfly graft. | N/A | V |

approximately 15% of all primary rhinoplasty and 50% of secondary rhinoplasty cases. Some authors have also recommended placement of bacitracin-soaked Surgicel into the vestibular surface of the open soft tissue triangle incision at the end of a rhinoplasty. Doyle splints are then placed, tape is applied across the nasal dorsum from the radix to the supratip break, followed by the application of a Denver splint for external support. These all act as a buttress for appropriate support, closure of dead space, limitation of edema, and contouring of the soft tissue triangle.⁶ The senior author (Y.D.) prefers to tape in layers starting horizontally in increasing incremental length. This is followed by vertical taping from the radix to the soft tissue triangles and columella to prevent notching (► Fig. 3).

Dayan pointed out that patients with prominent soft tissue triangles have a triad of thin skin, lower lateral cartilages that are cephalically oriented, and overprojected noses. Therefore, he proposes prophylactic cartilaginous alar grafts which are placed under the soft tissue triangle and sutured to the intermediate crura for this group of patients.² Foda has extensively described soft triangle grafts to prevent deformities. Rather than attributing deformities to thin skin, he believes most are a result of a wide vertical domal angle between the lateral and intermediate crura and increased length of intermediate crura. For a soft triangle graft, he recommends a 4- to 6-mm triangular or oval graft excised from the cephalic parts of the lateral crura. These grafts are pliable, easily shaped, and rarely show through the skin. In revision cases, stronger septal or conchal cartilage grafts are used with beveled edges to blend with the surrounding tissues. The graft is then secured to the caudal edge of the intermediate and lateral crura. He also describes a triangular extended graft, which is used for retraction accompanied with alar notching. These grafts were effective in correcting soft triangle retraction and notching without infection, displacement, or extrusion. However, three patients required revision surgery with septal cartilage extended grafts to correct a visible caudal edge of the graft.⁵ In one series, soft tissue triangle grafts were placed in 18% of revision rhinoplasty cases.²³

Patients with shorter nostrils tend to have longer soft triangle skin.¹³ Guyuron et al describe correcting the short nostril by removing the soft triangle lining to allow elevation of the nostril apex through other modalities, such as tip suturing techniques.²⁴ Conservative resection and undermining just superficial to the lower lateral cartilage reduce the risks of soft tissue triangle notching.²⁵ Removal of the soft triangle lining can be performed through an open or closed technique. Although the surgeon evaluates the soft triangle at the beginning of the operation, excision is performed as one of the last steps.²⁴ After extending an incision through the soft tissue triangle, suturing should be meticulous to avoid notching. The most critical suture is placed along the alar rim region to reestablish the natural contours of the ala.¹² Meticulous suturing of the soft tissue triangle is also important in preventing infection and graft extrusion.²⁶ A hemitransdomal suture preserves the facet and helps with tip contouring.²⁷ Funk et al reported how vertical dome division with manipulation of intermediate crus at different points can affect the

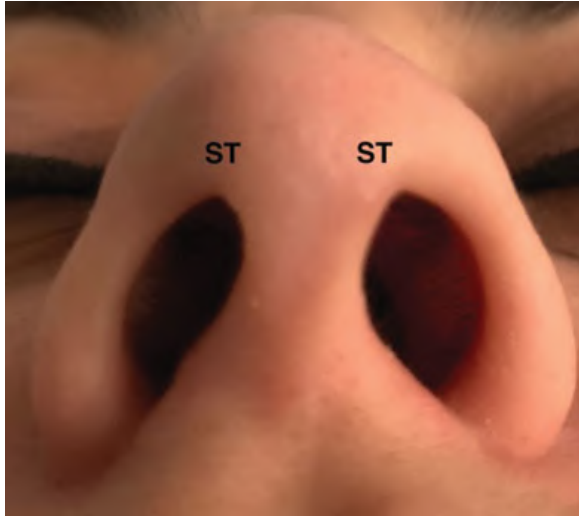


Fig. 2 Nasal base view of a patient evaluated preoperatively for rhinoplasty, which can be used to identify risk factors for alar notching (ST = soft tissue triangle).

appearance of external soft tissue triangle. For example, shortening the intermediate crura will shorten the length of the infratip lobule and increase the angle of the domal arch, rounding the external soft tissue triangle.⁹

A limitation of the current available literature includes a lack of high-quality level of evidence studies and lack of validated outcome measures employed. As discussed, most articles deemed appropriate for inclusion were unilateral arm studies lacking a comparative group, making more definitive conclusions difficult to achieve. Additionally, studies did not use any validated outcomes to capture effectiveness, instead relying on more subjective patient satisfaction or request for a revision. Moving forward, this may strengthen the evidence pool in support of particular techniques.

Conclusion

The soft tissue triangle is an important area of the nose often neglected in rhinoplasty. This area is a common source of patient dissatisfaction and the need for revision rhinoplasty. We highlighted the basic science anatomy, clinical significance, and treatments of the soft tissue triangle. Specific validated outcome measures such as the NOSE (Nasal obstruction and Septoplasty Effectiveness) score²⁸ or the SCHNOS (Standardized Cosmesis and Health Nasal Outcomes Survey)²⁹ should be employed in the evaluation of surgical intervention to the soft tissue triangle.

Conflicts of Interest

The authors have none to disclose.

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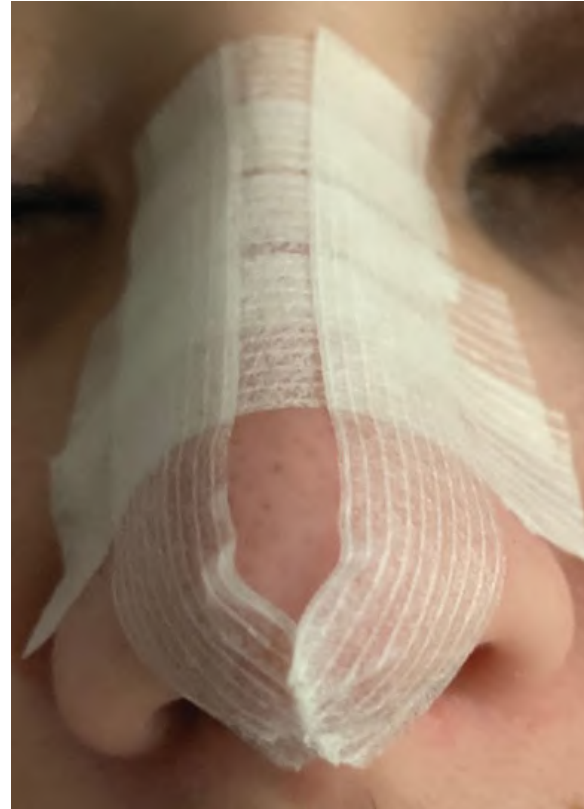


Fig. 3 Demonstration of taping to avoid notching. First, tape is placed in layers horizontally in increasing incremental length. Vertical taping is then performed from the radix to the soft tissue triangles and columella.

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