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ORIGINAL ARTICLE RHINOPLASTY

Single-Stage Total Alar Reconstruction Using an Integrated Lining Nasolabial Flap

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Abstract

Introduction Total alar reconstruction is challenging because it requires recreating a unique, multilayered anatomy with dynamic characteristics. Conventional techniques are often multistage and require additional donor sites for internal lining and cartilage grafting, thereby increasing donor-site morbidity. Secondary thinning procedures are often required, and long-term alar stability outcomes remain variable. We present the Integrated Lining Nasolabial Flap, a single-stage technique in which the internal lining is derived from dermal and epidermal layers of the flap itself, thereby eliminating additional donor-site morbidity. We report functional and aesthetic outcomes and assess postoperative alar stability, focusing on the potential role of sustained nasal dilator use as a non-cartilage-based supportive strategy.

Patients and Methods Twenty patients who underwent single-stage total alar reconstruction with the Integrated Lining Nasolabial Flap were retrospectively reviewed. Patients with at least 6 months of follow-up were included in the analysis. Early and late postoperative complications were recorded. Postoperative alar collapse was assessed and analyzed in relation to nasal dilator compliance. Cosmetic outcomes were evaluated using a visual analog scale and the FACE-Q "Satisfaction with Nostrils" module, and the association with patient age was examined.

Results Twenty patients (mean age, 60.2 ± 7.9 years) underwent single-stage reconstruction with this technique and were included in the analysis, with a median follow-up of 12.5 months (range, 6–32 months). Early complications occurred in 2 patients (10%) and were limited to superficial wound dehiscence, which was managed conservatively. No flap loss, vascular compromise, or internal lining necrosis was observed. Late complications were observed in 8 patients (40%), including alar retraction in 2 (10%), isolated alar collapse in 1 (5%), combined alar collapse with retraction in 2 (10%), and alar asymmetry in 3 (15%). No patient required a secondary thinning procedure. Alar collapse (isolated or combined) occurred in three patients (15%), all of whom were noncompliant with nasal dilator use; no collapse was observed among compliant patients (P = 0.004). The median cosmetic VAS score was 60 (range, 50–90), and the median FACE-Q "Satisfaction with Nostrils" score was 72 (range, 44–91). No significant correlation was found between age and aesthetic outcomes.

Conclusion The Integrated Lining Nasolabial Flap allows single-stage total alar reconstruction by creating the internal lining from the flap itself, avoiding additional donor sites and secondary thinning procedures. In this Level IV study, sustained postoperative nasal dilator use was significantly associated with improved alar stability.

Clinical Relevance Statement This technique offers a single-stage solution for total alar reconstruction by integrating the internal lining into the nasolabial flap design, potentially reducing surgical complexity and donor-site morbidity.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

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Keywords Single-stage alar reconstruction · Non-cartilaginous alar repair · Nasal dilator · Nasal dilator compliance · Mechanical stress–mediated tissue remodeling · Alar stability

Introduction

Total alar defects, most commonly resulting from oncologic resection, trauma, or iatrogenic causes, pose significant reconstructive challenges because of the region's unique anatomy [1, 4]. Successful reconstruction requires restoring both internal and external coverage and providing structural stability to prevent alar collapse, particularly during deep inspiration [3, 4].

Numerous techniques have been described for total alar reconstruction; however, many remain multistage and technically demanding, often requiring additional donor sites for internal lining or alar stability, typically achieved with cartilage grafts [5–10]. Cartilage grafts provide rigidity, yet long-term functional outcomes may vary, influenced by tissue integration and potential graft deformation [11–15].

Single-stage techniques aim to simplify reconstruction; however, donor-site morbidity remains a concern as additional grafts are needed for alar stability or internal lining. Alternatively, when folded-flap designs are used to provide both internal lining and external coverage in a single stage, bulkiness may become a significant limitation, necessitating secondary thinning procedures [3, 16–18].

These considerations reflect the complexity of optimizing both lining and alar stability in a single-stage procedure while minimizing donor-site morbidity.

In this study, we present a modification of the traditional nasolabial folded flap for total alar reconstruction, which we term the Integrated Lining Nasolabial Flap. In this design, the internal lining consists exclusively of epidermal and dermal layers derived from the flap itself, resulting in a thinner, more anatomically contoured internal surface. As a non–cartilage-based strategy, it relies on the hypothesis that alar stability may be supported by controlled postoperative tissue remodeling, potentially facilitated by sustained use of nasal dilators.

Patients and Methods

Between 2020 and 2024, 26 patients underwent single-stage total alar reconstruction with the Integrated Lining Nasolabial Flap in the Department of Plastic, Reconstructive, and Aesthetic Surgery at Balıkesir University.

This retrospective study included patients with complete medical records, available preoperative photographic documentation, and at least 6 months of postoperative follow-up who consented to follow-up evaluation. Accordingly, 20 patients comprised the final study cohort. Patients with incomplete clinical records, unavailable preoperative photographic documentation, or insufficient follow-up were excluded from the final analysis. No statistical imputation methods were used for missing data.

Ethical approval was obtained from the Clinical Research Ethics Committee of Balıkesir University, and the study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participating patients for the use of their clinical data and photographs.

All cases involved full-thickness total alar defects with complete loss of the skin and internal lining. The defects were primarily confined to the alar subunit, with or without minimal extension into adjacent nasal or cheek subunits.

Beginning on postoperative day 10, patients were instructed to use a nasal dilator for at least 10 hours per day for 12 weeks. The recommended duration and frequency were based on institutional clinical practice, as no standardized guidelines currently exist for nasal dilator use in alar reconstruction.

Early complications were retrieved from medical records. Minor complications included superficial infection and minor wound dehiscence that resolved with local wound care and/or oral antibiotic therapy. Major complications were defined as events requiring surgical intervention or compromising flap vascularity or lining viability.

Late complications were also documented. Alar asymmetry was defined as visible differences in nostril size, contour, or alar thickness in the basal view. Alar retraction was defined as upward displacement of the alar margin, resulting in increased nostril show compared with the opposite side.

Patients with at least 6 months of follow-up were evaluated for alar collapse as part of the study protocol. Compliance with nasal dilator use was assessed through standardized questioning during routine follow-up visits, documented in medical records, and re-evaluated at the outcome assessment. Patients who used the nasal dilator for $\geq$10 hours per day for 12 weeks were classified as compliant; those using $<$10 hours per day were considered noncompliant. Compliance was based on patient self-report, as no objective monitoring methods were employed.

Alar collapse was evaluated and defined as dynamic medial displacement of the alar rim, resulting in marked narrowing of the external nasal valve and partial or total obstruction of the nasal airway. Assessment was performed under direct clinical observation during forced deep inspiration while seated. The presence or absence of collapse was recorded as a binary variable. No formal grading or scoring system was used.

The impact of the nasal dilator compliance on alar collapse was assessed.

Cosmetic outcomes were evaluated by a blinded plastic surgeon using a visual analog scale ranging from 0 (unsatisfactory) to 100 (excellent), and patient-reported outcomes were assessed using the FACE-Q "Satisfaction with Nostrils" module. Associations between late complications and outcome scores (visual analog scale and FACE-Q scores) were analyzed. In addition, a subgroup analysis was performed to evaluate the association between postoperative alar asymmetry and these outcome measures. Associations between age and these scores were also examined.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 25 (IBM Corporation, Armonk, NY, USA). The normality of continuous variables was assessed using the Shapiro–Wilk test. Categorical variables were expressed as frequencies (n) and percentages (%), whereas continuous variables were presented as means ± standard deviations or medians (minimum–maximum), depending on data distribution.

Fisher's exact test was used to evaluate the association between nasal dilator compliance and alar collapse.

Cosmetic and FACE-Q scores were compared between patients with and without late complications using the Mann–Whitney U test. The same test was used for subgroup analysis of postoperative alar asymmetry. Correlations between age and outcome scores were evaluated using Spearman's rank correlation coefficient. A two-sided p-value < 0.05 was considered statistically significant.

Surgical Technique

After the full-thickness alar defect was identified, the nasolabial flap was designed to place the resulting scar within the nasolabial fold . The flap was planned to be slightly wider than the defect, typically by 1–2 mm, to compensate for anticipated tissue contraction and reduce the risk of postoperative alar retraction. The flap length was calculated as approximately three times the width (flap length = width × 3) (Fig. 1). The distal end of the flap was shaped as an ellipse to prevent dog-ear deformity at the donor site.

The flap was elevated from distal to proximal in the subcutaneous plane, above the SMAS, preserving the thin subcutaneous layer. Small perforators encountered during dissection were cauterized as needed. Because the flap was designed as a random-pattern flap with a 1:3 width-to-length ratio, it did not rely on angular artery perforators.

After flap elevation, the lower third elliptical portion was discarded. The middle portion of the flap was thinned by defatting and folded inward to serve as the internal nasal

Fig. 1 Intraoperative view of flap design. The proximal portion formed the skin cover, the middle portion constituted the mucosal lining, and the distal elliptical extension was discarded to prevent dog-ear formation at the donor site

lining. The upper third remained as a skin flap, constituting the alar skin (Fig. 2A, B).

The flap was transposed 90 degrees into the defect (Fig. 2C). The epithelial surface of the thinned distal segment was folded inward to reconstruct the nasal lining and sutured to the mucosal margin (Fig. 3A–C). The upper portion was then secured to the skin margins to restore external coverage (Fig. 4A, B).

After hemostasis was achieved, the donor site was closed with subdermal and dermal sutures. Nasal packing, consisting of an ointment-impregnated mesh dressing, was inserted to fill the nasal cavity and provide controlled internal pressure to the flap. The internal pressure was adjusted clinically to generate gentle tension without compromising flap vascularity, as assessed by flap color and capillary refill.

Patients were evaluated on postoperative days 3 and 6, when the packing was replaced. Beginning on postoperative day 10, a tubular nasal dilator was introduced to provide controlled mechanical support within the nasal passage. The size was selected using the same principle as postoperative nasal packing, to maintain gentle internal pressure and support the reconstructed ala without excessive compression (Fig. 5). After flap edema subsided—typically by the second postoperative week—the dilator could be upsized as needed. Patients were instructed to use the dilator for at least 10

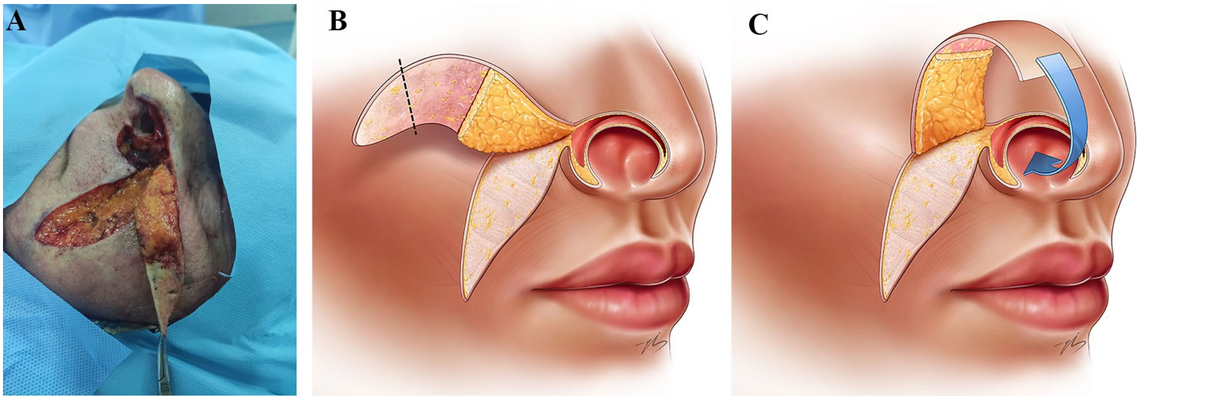

Fig. 2 **A** Intraoperative view showing that, after defatting, the portion designated for internal lining reconstruction consists of the epidermal and dermal layers of the flap. **B** Schematic illustration demonstrating the portion distal to the dashed line discarded to prevent dog-ear formation at the donor site. **C** Schematic illustration demonstrating the transposed flap, in which the epithelial surface of the selectively defatted segment forms the internal nasal lining

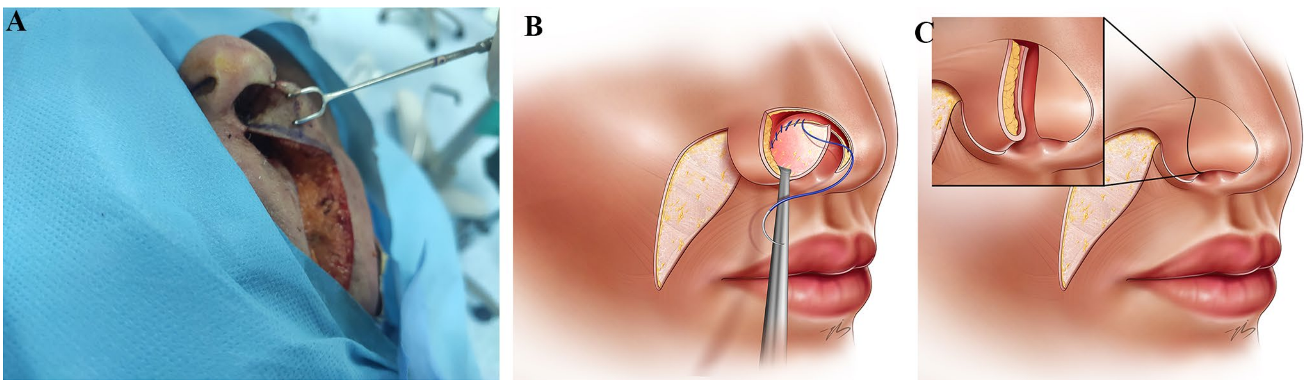

Fig. 3 **A** Intraoperative view demonstrating the selectively defatted flap segment forming the internal nasal lining, visualized at the tip of the surgical hook following inset. **B** Schematic illustration showing the selectively defatted flap segment inset and sutured to the mucosal defect to form the internal nasal lining. **C** Schematic illustration demonstrating the proximal portion of the flap adapted to the skin defect, with a cross-sectional view showing intimate contact between the flap and the selectively defatted flap segment

hours daily for 3 months; thereafter, intermittent use was optional (Fig. 6).

Results

Table 1 presents descriptive statistics for the patients' demographic and clinical characteristics. In the present study, data from 20 patients were analyzed. The mean age was 60.2 ± 7.9 years; 11 (55.0%) were men and 9 (45.0%) were women. Basal cell carcinoma (BCC) was the most common etiology (n = 12, 60.0%). The median follow-up period was 12.5 months (range, 6–32 months)(Figs. 7A–D, 8A–D)

Early postoperative complications occurred in 2 of 20 patients (10%) and consisted of superficial wound dehiscence at the flap inset site. These were managed conservatively with local wound care and healed by secondary intention without further surgical intervention. No flap-related vascular compromise, infection, partial or total flap loss, lining necrosis, or lining failure was observed in any patient.

Late complications were observed in 8 patients (40%), including alar retraction in 2 (10%), isolated alar collapse in 1 (5%), combined alar collapse and retraction in 2 (10%) (Fig. 9A–D), and alar asymmetry in 3 (15%).

No patient with late complications requested or accepted secondary revision surgery.

Flap bulkiness was not observed in any patient, and no secondary thinning procedures were performed.

The median cosmetic score was 60 (range, 50–90). No statistically significant correlation was found between age and the cosmetic score (r = 0.171, p = 0.470). The median FACE-Q "Satisfaction with Nostrils" score was 72 (range,

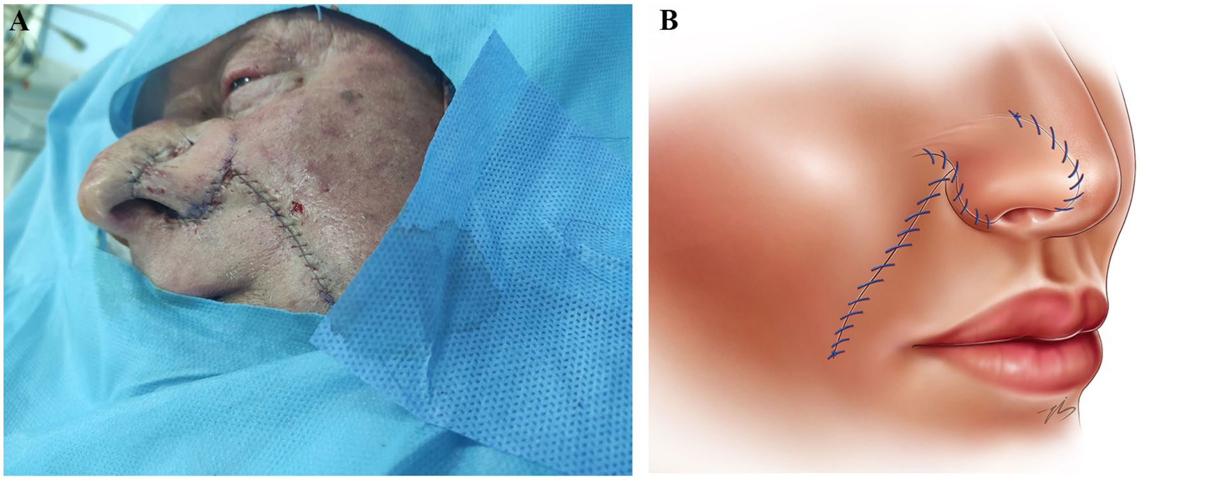

Fig. 4 **A** Intraoperative view demonstrating transposition of the proximal flap segment for reconstruction of the external skin defect, with the donor site closed using dermal sutures. **B** Schematic illustration demonstrating the proximal flap segment transposed to reconstruct the external skin defect; donor site closed with dermal sutures

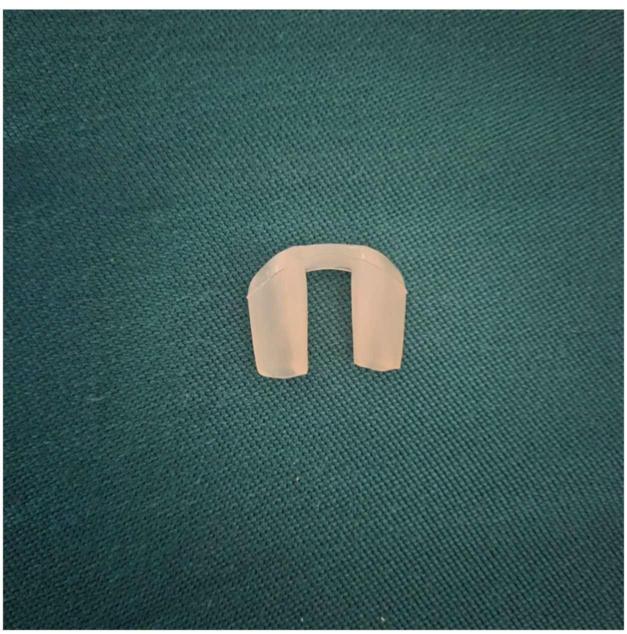

Fig. 5 The tube-shaped nasal dilator used in our patients

Fig. 6 Patient with the nasal dilator in place at postoperative week 3

44–91), and no significant correlation was observed between age and FACE-Q scores (r = –0.14, p = 0.56).

Patients with late complications had significantly lower aesthetic outcomes than those without complications. The median cosmetic VAS score was 57.5 in patients with late complications, compared with 70 in those without (P = 0.037). Similarly, the median FACE-Q "Satisfaction with Nostrils" score was 64 in the complication group, compared with 78 in patients without late complications (P = 0.041).

When specifically analyzing postoperative alar asymmetry, patients with asymmetry had lower median FACE-Q scores; however, the difference was not statistically significant (median 55 vs 78, P = 0.06). Cosmetic VAS scores were also not significantly different between patients with and without asymmetry (median 55 vs 60, P = 0.18).

"Nasal dilator compliance" was recorded in 16 patients (80.0%), whereas alar collapse was observed in 3 patients

Table 1 Demographic and clinical characteristics of the cases

	n=20
Age (years) *	60.2±7.9
Range of age (years)	46-72
Gender	
Men	11 (55.0%)
Women	9 (45.0%)
Etiology	
BCC	12 (60.0%)
SCC	4 (20.0%)
Intermedial nevus	2 (10.0%)
Actinic keratosis	1 (5.0%)
Scar	1 (5.0%)
Complication	
Early complication	2 (10.0%)
Late complications	8 (40%)
Alar retraction	2 (10.0%)
Alar collapses	1 (5.0%)
Alar collapses and retraction	2 (10.0%)
Asymmetry	3 (15.0%)
Compliance with nasal dilator	16 (80.0%)
Cosmetic scores **	60 (50-90)
FACE-Q scores **	72(44-91)
Alar collapses	3 (15.0%)
Follow-up (months) **	12.5 (6-32)

Descriptive statistics for continuous variables were shown as * mean ± SD or ** median (min-max); where appropriate. *BCC* basosquamos cell carcinoma, *SCC* squamos cell carcinoma

(15.0%), all of whom were noncompliant with nasal dilator use (Table 2). Notably, none of the compliant patients experienced alar collapse (Video 1).

Discussion

Total alar reconstruction is complex due to its multilayered architecture, and conventional approaches often require separate donor sites for each structural component. This multilayer strategy may increase donor-site morbidity and procedural complexity.

When skin grafts are used for internal lining reconstruction, risks such as partial graft loss, infection, and wound-healing–related complications may compromise both functional and aesthetic outcomes [2]. In this design, the internal lining is formed from the flap itself and remains integrated within its structural framework, potentially enhancing tissue viability and reducing the risk of healing-related complications. Consistent with this rationale, no internal lining–related healing complications were encountered in our series.

Folded-flap techniques provide a vascularized lining but may result in postoperative bulkiness. In a previously reported series of 7 patients, secondary thinning was required in 4 cases [18]. In a larger study of aesthetic outcomes after alar reconstruction, thicker flaps were reported in 58% of patients, and a thicker alar rim in 86% [3]. By selectively thinning the distal flap to match nasal mucosal thickness, our technique allows contour refinement during the initial procedure. In our series, no patient required secondary thinning procedure .

Restoration of long-term alar stability has traditionally relied on structural cartilage grafting. Septal, auricular, or costal grafts are commonly used to reinforce the alar rim and prevent collapse [3, 11–15]. Although biomechanically intuitive, cartilage grafting entails additional donor-site morbidity and may be associated with warping, contour irregularities, graft visibility, and unpredictable long-term

Fig. 7 **A** Preoperative view showing a squamous cell carcinoma involving the right alar region. **B** Frontal view at postoperative year 1 in a patient with poor compliance with nasal dilator use, revealing mild alar retraction and signs of alar weakness. **C** Lateral view at postoperative year 1 showing noticeable alar retraction. **D** Basal view at postoperative year 1, revealing structural weakness and a lack of alar stability

Fig. 8 **A** Patient with basal cell carcinoma involving the left alar rim. **B** Frontal view at postoperative year 2 in a patient with good compliance to nasal dilator use. **C** Lateral view at postoperative year 2 demonstrating well-maintained alar projection and contour. **D** Basal view at postoperative year 2

Fig. 9 **A** Preoperative view showing squamous cell carcinoma (SCC) involving the left alar rim. **B** Frontal view at postoperative year 2 in a patient with good compliance with nasal dilator use, demonstrating a stable alar contour. **C** Lateral view at postoperative year 2 demonstrating well-aligned alar contours. **D** Basal view at postoperative year 2 showing well-preserved alar contours with no evidence of collapse

Table 2 Relationship between alar collapse and nasal dilator compliance

	No compliance	Compliance	p-value
Alar collapses			0.004[2]
No	1 (25.0%)	16 (100.0%)	
Yes	3 (75.0%)	0 (0.0%)	

behavior [19, 20]. In their series on alar reconstruction using a cartilage-supported nasolabial folded flap, Arden et al. reported a 37% rate of nasal obstruction, with cartilage-related deformation contributing to collapse in a subset of patients [15]. In another 22-patient series, alar collapse was reported in 5 patients despite cartilage grafting [14].

These findings indicate that, while conceptually sound, cartilage grafting may yield variable long-term outcomes in clinical practice, prompting consideration of alternative strategies to achieve alar stability.

Sustained nasal dilator use has been shown to influence soft-tissue shaping in patients with cleft lip nasal deformities in both the preoperative and postoperative settings [21, 22]. In total alar reconstruction, however, nasal dilators are primarily used to maintain early airway patency, and their potential role in alar stability has not been specifically addressed in the literature.

In our series, the nasal dilator was not used solely for airway maintenance but as a means of providing controlled internal mechanical loading to the flap. During the first 10 postoperative days, this mechanical loading was achieved with nasal packing to maintain close contact between the internal lining and the flap (Fig. 3C). This precaution was taken because the early perfusion dynamics of the selectively thinned lining component—whether functioning purely as a vascularized flap extension or behaving in part like a skin graft—cannot be fully predicted in the immediate postoperative period.

After the initial 10 postoperative days, once internal lining healing was achieved, the nasal packing was removed and replaced with a nasal dilator. Patients were instructed to continue using the nasal dilator for at least 10 hours per day for 3 months. Dilator size was progressively increased as edema subsided. Although this protocol was not derived from established guidelines—because no standardized regimen exists in the literature—it was designed to provide internal mechanical loading during wound healing.

In our series, alar collapse was observed in 3 patients (15%). All cases were noncompliant with the prescribed nasal dilator regimen, whereas no collapse was observed among compliant patients. This clinical observation suggests a potential association between postoperative internal mechanical loading and alar stability.

The present study focused on clinical outcomes and did not include histologic assessment. However, experimental and animal studies have demonstrated that mechanical tension regulates fibroblast differentiation, extracellular matrix organization, and scar architecture through mechanotransduction pathways [23–25]. Cyclic or sustained mechanical loading has been shown to enhance collagen synthesis and promote collagen fiber alignment, ultimately contributing to greater tissue stiffness and resistance to deformation [26–29]. These findings suggest that mechanical conditioning during the remodeling phase may modulate scar tissue and structural resilience.

In this context, our non–cartilage–based approach may represent a biologically adaptive alternative for total alar reconstruction.

Several studies on alar reconstruction report generally favorable patient satisfaction outcomes, largely independent of the specific technique used. However, secondary revision procedures have been reported at rates of 11% to 54%, undertaken for both aesthetic and functional concerns [3].

In our series, alar retraction was observed in 2 patients (10%), isolated alar collapse in 1 (5%), combined alar collapse and retraction in 2 (10%), and alar asymmetry in 3 (15%). These patients had lower cosmetic scores than the rest of the cohort, but all scores remained above the midpoint. None requested or accepted revision procedures. There was no significant association between patient age and cosmetic scores. Taken together, these findings support overall aesthetic acceptability within this cohort.

From a technical standpoint, precise defect-to-flap matching was associated with postoperative retraction. In contrast, incorporating a slight overcorrection of approximately 1 mm into the flap design prevented retraction. Based on this experience, we recommend incorporating minimal overcorrection to reduce the risk of postoperative retraction and optimize aesthetic outcomes.

This study has several limitations. The retrospective design, lack of a comparative control group, and relatively small sample size limit the strength of causal inferences and the generalizability of the findings. Although the mean follow-up of 12.5 months (range, 6–32 months) allowed evaluation beyond the early remodeling phase, longer-term observation would be valuable to assess the durability of alar stability over extended periods.

Second, although the association between structured nasal dilator use and alar stability is clinically suggestive, histologic or mechanobiologic validation was not conducted. Therefore, the proposed relationship between controlled mechanical loading and tissue remodeling remains theoretical.

Third, objective functional assessments, such as rhinomanometry, were not routinely incorporated, and functional outcomes were primarily evaluated through clinical examination and patient-reported measures. In addition, compliance with nasal dilator use was assessed by patient self-report rather than objective monitoring, potentially introducing reporting bias.

Finally, although standardized guidelines for postoperative mechanical support to maintain alar stability are lacking, we propose a nasal dilator regimen informed by wound-healing and mechanotransduction studies, along with clinical experience. This study may provide a preliminary clinical framework for non–cartilage-based strategies to achieve alar stability and guide future research in this area.

Conclusion

The Integrated Lining Nasolabial Flap enabled single-stage total alar reconstruction without secondary thinning or additional donor sites. Satisfactory aesthetic and functional outcomes were achieved in this series. Postoperative nasal dilator compliance was significantly associated with improved alar stability, underscoring the role of mechanical support in preventing alar collapse after total alar reconstruction.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00266-026-05854-8.

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Author Contributions Bilgen Can conceived and designed the study, developed the methodology, and formulated the main hypothesis. She drafted the manuscript, particularly the introduction, methodology, results, and discussion sections, and performed critical revisions to improve intellectual content, clarity, and overall quality. She also supervised the project and performed all manuscript revisions and prepared the responses to the reviewers. Tahir Aziz Eser acquired the clinical data, including patient records and images; conducted data curation and formal analysis; performed an extensive literature search; reviewed and selected relevant references; and ensured accurate formatting according to the journal's requirements. He also managed the technical preparation of the manuscript, including formatting, figure organization, and submission in accordance with the journal's guidelines. Both authors contributed to the original draft, reviewed and approved the final version of the manuscript, and agreed to be accountable for all aspects of the work.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval This study was approved by the Institutional Ethics Committee of Balıkesir University Faculty of Medicine (approval number: [2025/99]). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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