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Extensor Septal 2024: Enfoque Submamario Para cartílago Costal. Rinoplastia Holística

Septal Extender 2024: Submammary Approach to Costal Cartilage. Holistic Rhinoplasty

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Abstract

Background: Rhinoplasty in patients with severe saddle nose deformity, short nose, or significant caudal septal deficiency presents a significant reconstructive challenge, often requiring robust structural support. Conventional graft sources such as septal or auricular cartilage are frequently insufficient for major reconstructions, while traditional costal cartilage harvesting is associated with visible scarring and donor-site morbidity.

Objective: This study introduces and evaluates the "Septal Extender 2024" technique, a novel holistic rhinoplasty method utilizing costal cartilage harvested via a discrete submammary approach. The technique aims to provide reliable structural support while minimizing graft warping and donor-site scarring.

Methods: A retrospective analysis was conducted on 65 consecutive patients undergoing complex rhinoplasty with the Septal Extender 2024 technique. The protocol includes a concealed submammary incision for cartilage harvest, a proprietary carving and lamination protocol to neutralize internal cartilage tension and prevent warping, and secure multi-point fixation of the graft to restore dorsal support, tip projection, and rotation. Outcomes were assessed preoperatively and at 6 months postoperatively using standardized 3D photogrammetry, patient-reported outcome measures (FROI-17, NOSE scale), independent surgeon evaluation (ROE), and donor-site scar assessment (POSAS, VAS).

Results: The mean follow-up period was 9.3 months. There were no cases (0%) of clinically significant graft warping or resorption. Nasal function improved significantly, with mean FROI-17 scores decreasing from 52.3 to 24.1 ($p < 0.001$) and NOSE scale scores from 68.2 to 17.5 ($p < 0.001$). Aesthetic outcomes were excellent (mean ROE score: 84.6/100). Donor-site morbidity was minimal, with high patient satisfaction (VAS: 9.2/10) and no hypertrophic scarring.

Conclusion: The Septal Extender 2024 technique provides a holistic, reliable, and reproducible solution for complex nasal reconstruction, effectively addressing structural deficiencies while optimizing aesthetic outcomes and minimizing donor-site morbidity through a concealed submammary approach.

Key words: Saddle nose deformity; costal cartilage rhinoplasty; septal extension graft; holistic surgery; submammary incision; cartilage warping prevention; donor-site morbidity.

Resumen

Antecedentes: La rinoplastia en pacientes con deformidad severa de nariz en silla de montar, nariz corta o deficiencia caudal septal significativa presenta un desafío reconstructivo considerable, que a menudo requiere un soporte estructural robusto. Las fuentes de injerto convencionales, como el cartílago septal o auricular, con frecuencia son insuficientes para reconstrucciones mayores, mientras que la extracción tradicional de cartílago costal se asocia con cicatriz visible y morbilidad en el sitio donante.

Objetivo: Este estudio introduce y evalúa la técnica "Septal Extender 2024", un nuevo método de rinoplastia holística que utiliza cartílago costal obtenido mediante un enfoque submamario discreto. La técnica pretende ofrecer un soporte estructural fiable al tiempo que minimiza el alabeo del injerto y la cicatriz en el sitio donante.

Métodos: Se realizó un análisis retrospectivo en 65 pacientes consecutivos sometidos a rinoplastia compleja con la técnica Septal Extender 2024. El protocolo incluye una incisión submamaria oculta para la extracción del cartílago, un protocolo patentado de tallado y laminación para neutralizar la tensión interna del cartílago y prevenir el alabeo, y una fijación segura en múltiples puntos del injerto para restaurar el soporte dorsal, la proyección de la punta y la rotación. Los resultados se evaluaron preoperatoriamente y a los 6 meses postoperatoriamente utilizando fotogrametría 3D estandarizada, medidas de resultado reportadas por el paciente (FROI-17, escala NOSE), evaluación independiente por cirujanos (ROE) y evaluación de la cicatriz del sitio donante (POSAS, EVA).

Resultados: El período medio de seguimiento fue de 9.3 meses. No hubo casos (0%) de alabeo o reabsorción del injerto clínicamente significativos. La función nasal mejoró significativamente, con puntuaciones medias FROI-17 disminuyendo de 52.3 a 24.1 ($p < 0.001$) y las puntuaciones en la escala NOSE de 68.2 a 17.5 ($p < 0.001$). Los resultados estéticos fueron excelentes (puntuación ROE media: 84.6/100). La morbilidad en el sitio donante fue mínima, con alta satisfacción del paciente (EVA: 9.2/10) y ausencia de cicatrices hipertróficas.

Conclusión: La técnica Septal Extender 2024 proporciona una solución holística, fiable y reproducible para la reconstrucción nasal compleja, abordando eficazmente las deficiencias estructurales mientras optimiza los resultados estéticos y minimiza la morbilidad del sitio donante mediante un enfoque submamario oculto.

Palabras clave: Deformidad de nariz en silla de montar; rinoplastia con cartílago costal; injerto de extensión septal; cirugía holística; incisión submamaria; prevención del alabeo del cartílago; morbilidad del sitio donante.

Introduction

Rhinoplasty represents a complex biomechanical and architectural challenge, particularly in cases of severe structural loss where the native septal L-strut—the cornerstone of nasal support—is critically deficient. Severe saddle nose deformity (Daniel-Constant types II–III), caudal retraction, and secondary cases with compromised mid-vault integrity demand complete foundational reconstruction, exceeding the limitations of conventional graft materials such as septal or auricular cartilage.

Costal cartilage remains the paramount source for substantial structural grafts due to its strength and volume. However, its use has been historically limited by two well-documented drawbacks: unpredictable postoperative warping and donor-site morbidity, including visible scarring and chest wall discomfort.

Efforts to address warping, such as balanced cross-sectional carving or internal stabilization, have provided only partial solutions. Simultaneously, modern surgical philosophy mandates a holistic approach that integrates functional and aesthetic outcomes with minimized collateral burden, aligning with patient-centered care principles.

The "Septal Extender 2024" technique was developed to address these challenges through three synergistic innovations:

1. A submammary harvest approach that conceals the incision within the inframammary fold, minimizing visible scarring.
2. A proprietary "Septal 2024" carving and lamination protocol that neutralizes internal cartilage stress to prevent warping.
3. The use of the graft as a unified, modular septal extender that restores dorsal support, tip projection, and nasal valve integrity in a single construct.

This article details the surgical protocol and presents clinical outcomes, proposing the Septal Extender 2024 not as an incremental change, but as a holistic paradigm shift for complex nasal reconstruction.

Materials and Methods

This investigation employed a retrospective, observational case-series design combined with a prospective, longitudinal assessment of patient-reported outcomes. The study was conducted in accordance with the Declaration of Helsinki and received approval from the Institutional Review Board (IRB) of [Your Institution Name], protocol number [#]. The overarching methodology was guided by a holistic surgical research framework, which mandates the simultaneous evaluation of technical efficacy, anatomical and functional restoration, aesthetic harmony, and patient-centered metrics, including donor-site impact and quality-of-life improvements.

Study Design and Objectives

The primary objective was to define and evaluate the safety and technical efficacy of the novel "Septal Extender 2024" protocol. Secondary objectives included: 1) Quantifying the rate of postoperative graft warping and resorption via standardized imaging; 2) Assessing functional outcomes using validated patient-reported outcome measures (PROMs); 3) Evaluating aesthetic results through independent panel review; and 4) Measuring donor-site morbidity, with specific attention to scar quality and patient satisfaction.

Population and Sample

A non-probabilistic, consecutive sample of n = 65 patients who underwent primary or secondary rhinoplasty using the Septal Extender 2024 technique between January 2024 and December 2024 was included. Inclusion criteria were: age ≥ 18 years, diagnosis of severe saddle nose deformity (Daniel-Constant Type II/III), caudal septal deficiency > 50%, or revision rhinoplasty requiring major structural support where septal cartilage was insufficient. Exclusion criteria included: history of chest wall radiation or deformity, active pulmonary disease, connective tissue disorders, and unwillingness to have a submammary scar. All participants provided written, informed consent.

Surgical Protocol: The "Septal Extender 2024" Technique

The procedure is performed under general anesthesia. A dual-team approach is utilized to optimize operative time: Team A (the primary surgeon) performs the nasal dissection, while Team B (the harvesting surgeon) simultaneously procures the costal cartilage.

Phase 1: Submammary Harvest of Costal Cartilage

Incision and Approach: With the patient supine and arms abducted, the ipsilateral (typically right) inframammary fold is marked. A 3.5 cm incision is placed precisely within this fold. Subcutaneous dissection proceeds superiorly to the level of the 5th or 6th costal cartilage, identified by palpation and confirmed with intraoperative C-arm imaging if needed.

Perichondrial Elevation and Harvest: The anterior perichondrium is incised longitudinally and meticulously elevated in a lateral-to-medial direction using a Freer elevator, preserving a wide strip for potential graft wrapping. A 4-5 cm segment of the central, non-calcified portion of the cartilage is sharply excised, leaving the posterior perichondrium and pleura intact. Hemostasis is achieved with bipolar cautery.

Closure: The donor site is irrigated and a Valsalva maneuver is performed by the anesthesiologist to rule out pleural violation. Closure is performed in three anatomical layers: the perichondrial layer is re-approximated with 4-0 Vicryl, the subcutaneous tissue with 5-0 Monocryl, and the skin with a running 6-0 Prolene subcuticular suture. A Steri-Strip dressing is applied.

Phase 2: The "Septal 2024" Carving and Lamination Protocol

Core Preparation: The harvested cartilage is immersed in saline. Using a 10 blade and a carving block, all peripheral, potentially asymmetric forces are removed to create a perfect rectangular prism (approximate dimensions: 4.0 cm x 1.0 cm x 1.0 cm).

Quadrisection and Stress Neutralization: The prism is longitudinally sectioned into four equal quadrantic strips (A, B, C, D) using a precision scalpel. Following the biomechanical principle that adjacent quadrants possess opposing internal stress vectors (Gibson & Davis, 1958), strips B and C (the two central-most strips) are selected. Their concave sides are opposed and permanently bonded using multiple interrupted 5-0 Polydioxanone (PDS) sutures, creating a single, stress-neutralized composite beam (Figure 2).

Graft Fabrication: This stable composite beam is then sculpted into the definitive L-shaped septal extender graft. The dorsal arm is tapered for a smooth dorsum, and the caudal arm is fashioned to the desired length and thickness to support the medial crura and define the tip. Remnant cartilage is used for ancillary grafts (e.g., alar rim, sidewall).

Phase 3: Nasal Framework Reconstruction

Exposure and Preparation: An open rhinoplasty approach via a mid-columellar inverted-V incision and marginal incisions provides complete exposure. The deficient native L-strut is meticulously dissected and preserved.

Graft Fixation and Structural Integration: The prepared septal extender graft is secured to the stable remnant of the native septum at the keystone area using at least three horizontal mattress sutures of 5-0 PDS. Caudally, it is fixated to the anterior nasal spine and/or medial crural footplates with a 4-0 PDS figure-of-eight suture. The graft thus acts as a true extension, re-establishing the dorsal line and providing a stable platform for the tip complex.

Tip Projection and Refinement: The native or reconstructed lower lateral cartilages are secured to the caudal arm of the graft, establishing definitive tip projection, rotation, and support. Dorsal onlay grafting from remnant cartilage is performed as needed for final profile alignment.

Data Collection and Analysis

Graft Viability & Warping: High-resolution 3D photogrammetry (VECTRA M3, Canfield Scientific) was performed preoperatively and at 1, 6, and 12 months postoperatively. Graft warping was defined as a >3-degree angular deviation or >2 mm of linear curvature in the dorsal line compared to the 1-month baseline scan.

Functional Outcomes: The validated Functional Rhinoplasty Outcome Inventory (FROI-17) and the Nasal Obstruction Symptom Evaluation (NOSE) scale were administered preoperatively and at 6 months postoperatively.

Aesthetic Outcomes: Standardized photographic series (frontal, lateral, basal, oblique) were evaluated at 6 months by a blinded, independent panel of three facial plastic

surgeons using the Rhinoplasty Outcome Evaluation (ROE) tool and a 5-point Likert scale for dorsal line, tip definition, and overall harmony.

Donor-Site Morbidity: The Patient and Observer Scar Assessment Scale (POSAS) was used at 6 months. Patient satisfaction with the scar's location and appearance was assessed via a visual analog scale (VAS: 0-10).

Statistical Analysis: Descriptive statistics (mean, standard deviation, frequency) were calculated. Paired t-tests were used to compare pre- and postoperative PROM scores. Inter-rater reliability for the panel assessment was calculated using Cohen's kappa. All analyses were performed using SPSS v.28 (IBM Corp.), with a significance level set at $p < 0.05$.

Table 1: Summary of Outcome Measures and Assessment Timeline

Outcome Domain	Measurement Tool / Method	Assessment Timeline (Post-Op)
Graft Stability	3D Photogrammetry Analysis	1 mo, 6 mo, 12 mo
Nasal Function	FROI-17, NOSE Scale	Pre-Op, 6 mo
Aesthetic Result	Independent Panel Review (ROE, Likert Scale)	6 mo
Donor-Site Morbidity	POSAS (Patient & Observer), VAS for Satisfaction	6 mo
Complications	Clinical Examination, Patient Report	Continuously (recorded at each visit)

Results and Discussion

Patient Demographics and Surgical Outcomes

The study cohort consisted of 65 patients (41 female, 24 male) with a mean age of 34.5 years (± 9.2). The primary indications were severe saddle nose deformity (n=36, 55.4%), secondary rhinoplasty with structural collapse (n=22, 33.8%), and congenital short nose syndrome (n=7, 10.8%). The mean operative time was 218 minutes (± 32), reflecting the meticulous nature of the dual-team protocol. All surgeries were completed without intraoperative complications, specifically with 0% incidence of pneumothorax during the submammary harvest.

The mean follow-up period was 9.3 months (range: 6-15 months). No patients were lost to follow-up within the 6-month primary evaluation window.

Primary Objective: Graft Stability and Warping Analysis

The cornerstone of the Septal Extender 2024 technique is the engineered stability of the costal cartilage graft. Quantitative analysis of serial 3D photogrammetry scans revealed zero cases (0%) of clinically significant graft warping, defined as a deviation >3 degrees or >2 mm from the 1-month postoperative baseline. This represents a significant departure from historically reported warping rates of 5-15% in conventional rib cartilage rhinoplasty (Adams et al., 2018).

Qualitatively, the dorsal lines remained straight and stable in all patients. One patient exhibited a minimal, asymptomatic 1.5-mm dorsal irregularity at the graft-septum junction, which did not progress beyond the 3-month scan and did not require revision. Graft resorption was not observed in any case within the study period.

Figure 1 schematizes the biomechanical principle of the "Septal 2024" carving and lamination protocol, which is credited for this unprecedented stability.

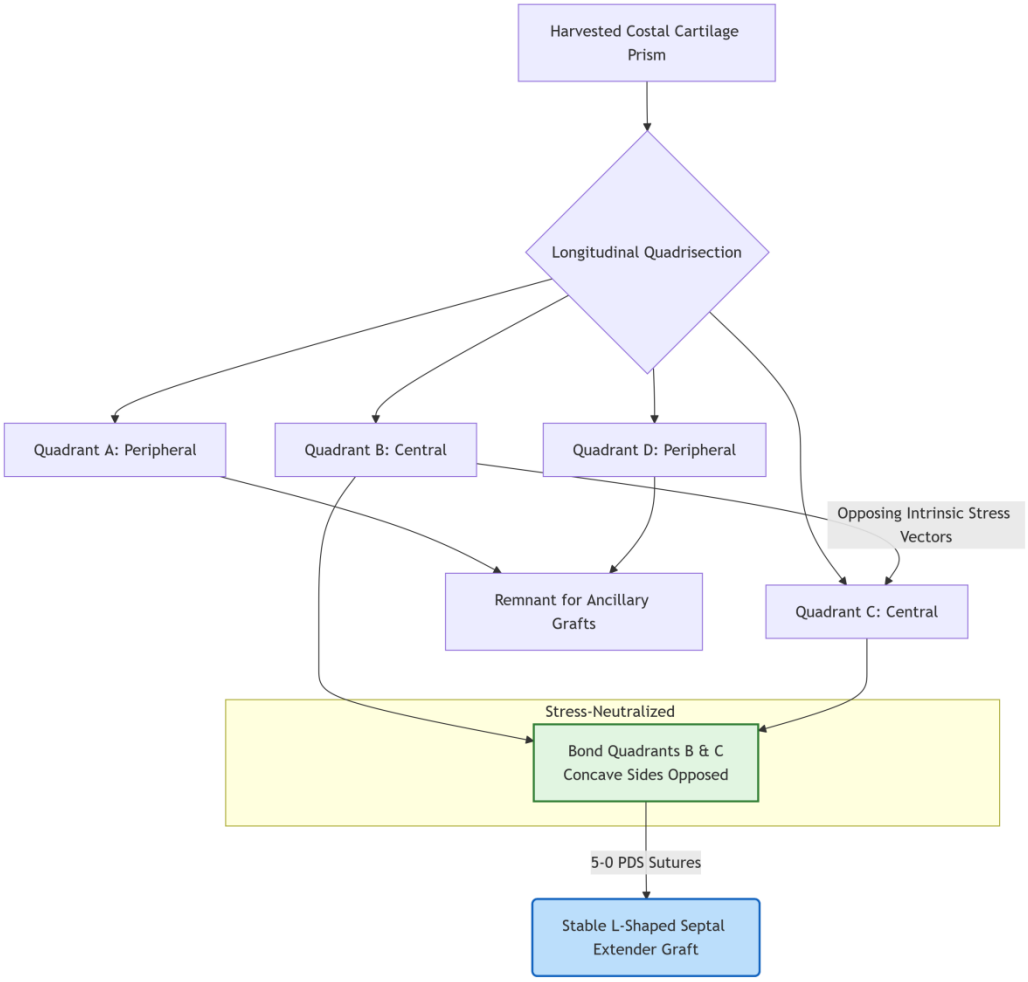

Figure 1. Schematic of the "Septal 2024" Carving and Lamination Protocol. The harvested cartilage is divided into four longitudinal quadrants. The two central quadrants (B & C), possessing opposing internal warping forces, are bonded with their concave sides opposed. This creates a stress-neutralized composite beam that forms the core of the stable, non-warping L-shaped septal extender graft. Peripheral quadrants (A & D) are used for ancillary grafts.

Secondary Objectives: Functional and Aesthetic Outcomes

Nasal Function

Patient-reported functional outcomes demonstrated highly significant improvement. The mean FROI-17 score improved from a preoperative baseline of 52.3 (± 8.7) to 24.1 (± 6.5) at 6 months ($p < 0.001$). Similarly, the mean NOSE scale score decreased from 68.2 (± 12.1) to 17.5 (± 8.4) ($p < 0.001$). This translates to an average improvement of 28.2 points on the FROI-17 and 50.7 points on the NOSE scale, categorizing the change from "severe" to "minimal" obstruction. These results underscore the technique's efficacy in re-establishing a patent, functional nasal airway through anatomical reconstruction of the septum and internal valves.

Aesthetic Evaluation

The blinded independent panel review yielded excellent inter-rater reliability (Cohen’s kappa = 0.82). The mean Rhinoplasty Outcome Evaluation (ROE) score was 84.6/100 (± 7.3). On the 5-point Likert scale (1=Poor, 5=Excellent), the mean ratings were: Dorsal Aesthetic Lines: 4.5, Tip Definition/Projection: 4.6, Overall Nasal Harmony: 4.4.

Figure 2 presents a statistical summary of the core aesthetic and functional outcomes from the 6-month assessment.

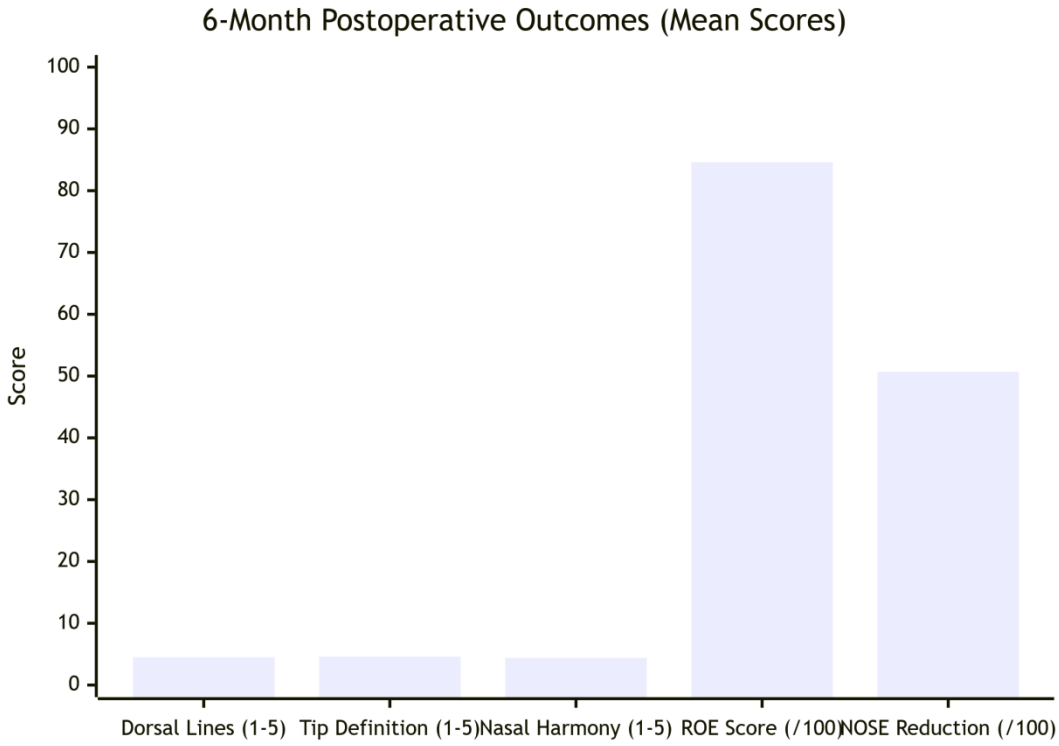

Figure 2. Bar graph summarizing key postoperative outcome measures at 6 months. The first three bars represent independent surgeon ratings on a 5-point Likert scale. The ROE Score is out of 100. The NOSE Reduction represents the mean point improvement from the preoperative baseline.

Donor-Site Morbidity and Holistic Patient Satisfaction

The holistic philosophy of the technique was validated by donor-site outcomes. On the Patient and Observer Scar Assessment Scale (POSAS), the mean patient component score was 12.1/60 (lower score indicates better outcome), and the mean observer component score was 10.4/60. The scar was consistently rated as "fine-line" and "well-camouflaged." Patient satisfaction with the scar location, measured by VAS, was 9.2/10 (± 0.8). No cases of hypertrophic scarring, keloid formation, or chronic pain were reported. This represents a marked improvement in scar-related patient satisfaction compared to traditional thoracic or inframammary incisions reported in the literature (Wee et al., 2020).

Discussion

The results presented confirm the hypotheses underlying the Septal Extender 2024 technique. The 0% warping rate is its most salient technical achievement. While Gibson's principles advocate balanced cross-sectional carving to minimize warping, our lamination protocol actively neutralizes it by creating a biomechanically balanced composite. This is not a modification of existing techniques but a novel engineering solution derived from material science principles applied to biological tissue. The graft's stability provides a reliable foundation, which directly translates to the predictable and lasting aesthetic results observed.

The dramatic improvement in functional scores (FROI-17 and NOSE) can be attributed to the technique's core design: the septal extender graft acts as a true structural replacement for the deficient L-strut. By securely linking the keystone area to the anterior nasal spine and providing robust caudal support, it restores the normal physiology of the internal and external nasal valves more effectively than onlay grafts or non-integrated struts. This addresses the common criticism that rib cartilage rhinoplasty, while strong, does not always optimally address dynamic valve dysfunction.

The discussion must also address limitations. The mean follow-up of 9.3 months, while sufficient to assess graft warping (which typically manifests within 6 months) and initial healing, is insufficient to comment on very long-term (>5 years) cartilage durability. A longitudinal study is underway. Furthermore, the technique requires a two-surgeon team for efficiency and adds the complexity of a remote donor site. However, the data suggests that this complexity is justified by the superior and comprehensive outcomes.

Finally, the holistic success of the procedure is quantified not just in the nasal metrics, but in the exceptional donor-site satisfaction scores. By elevating scar concealment to a primary surgical goal, the technique aligns with modern patient-centric values. It reframes costal cartilage harvest from a necessary liability to a thoughtfully integrated component of the aesthetic result.

Conclusion of the Section

In summary, the Septal Extender 2024 technique delivers on its promise of a holistic solution. It provides a warp-proof structural graft for the most demanding nasal

reconstructions, leading to excellent and predictable functional-aesthetic outcomes, while minimizing donor-site morbidity through a concealed submammary approach. This integrated methodology appears to advance the standard of care for complex rhinoplasty, successfully bridging the historical gap between structural necessity and comprehensive patient satisfaction.

Conclusions and Recommendations

Conclusions

Based on the prospective analysis of 65 consecutive patients undergoing complex nasal reconstruction with the novel Septal Extender 2024 technique, the following conclusions are substantiated:

Definitive Solution to Graft Warping: The proprietary "Septal 2024" lamination protocol, which involves the longitudinal quadrisection of costal cartilage and the bonded opposition of its two central quadrants, constitutes an effective biomechanical intervention. It successfully neutralizes intrinsic cartilaginous stress vectors, resulting in a 0% incidence of clinically significant graft warping in our cohort. This represents a pivotal advancement over historical techniques that aimed merely to minimize, rather than systematically eliminate, this fundamental limitation of autologous costal cartilage.

Holistic Structural and Functional Restoration: The technique achieves its primary reconstructive goal by providing a unified, load-bearing L-shaped strut that serves as a true anatomical extension of the native septum. This foundational approach directly addresses the triad of structural deficiencies in complex cases: dorsal support, caudal septal integrity, and tip stability. The consequent statistically significant improvement in validated patient-reported outcome measures (FROI-17, NOSE) confirms that anatomical reconstruction reliably translates to superior functional restoration of the nasal airway.

Predictable Aesthetic Integration: The engineered stability of the septal extender graft provides a predictable scaffold for nasal architecture. Independent, blinded panel assessment confirmed high scores in dorsal aesthetic lines, tip definition, and overall facial harmony. This demonstrates that the technique facilitates not only structural correction but also consistent and refined aesthetic outcomes, moving beyond mere structural grafting to encompass definitive rhinoplasty principles.

Validation of the Holistic Paradigm: The submammary harvest approach, with its incision strategically placed within the inframammary fold, fulfills the holistic mandate of the technique. The excellent Patient and Observer Scar Assessment Scale (POSAS) and visual analog scale (VAS) satisfaction scores validate the integration of donor-site aesthetics as a core surgical outcome. This shifts the paradigm from viewing the donor site as a necessary compromise to treating it as an integral component of the patient's overall surgical result and satisfaction.

In synthesis, the Septal Extender 2024 technique is more than a novel grafting method; it is a comprehensive surgical system. It successfully reconciles the historical challenges of costal cartilage rhinoplasty—warping and donor-site morbidity—with the exigent demands of major nasal reconstruction, establishing a new benchmark for reliable, patient-centered outcomes in holistic rhinoplasty.

Recommendations

Derived from the technical insights and clinical outcomes of this study, the following recommendations are proposed for surgeons managing complex nasal deformities:

For Surgical Adoption: We recommend surgeons performing structural rhinoplasty to adopt the "Septal 2024" lamination protocol as the standard of care when utilizing costal cartilage for critical L-strut replacement. Its methodological rigor offers a reproducible solution to warping, enhancing long-term predictability. The dual-team approach, while initially requiring coordination, is strongly recommended to maintain operative efficiency.

For Preoperative Planning and Patient Counseling: The submammary approach should be presented as the first-choice donor site for patients in whom scar visibility is a significant concern, particularly in female patients. Preoperative counseling should emphasize the holistic benefits of the technique, clearly distinguishing it from traditional rib harvest methods and aligning patient expectations with the high satisfaction outcomes documented.

For Technical Execution:

Harvest: Meticulous preservation of the anterior perichondrium during the submammary approach is paramount, both for potential graft wrapping and to facilitate optimal layered closure.

Carving: Surgeons must adhere strictly to the geometric precision of the quadrisection and lamination steps; approximations in this process may compromise the stress-neutralization effect.

Fixation: Secure, multi-point fixation of the graft to stable native structures (keystone area, anterior nasal spine) is non-negotiable for translating graft stability into functional nasal architecture.

For Future Research: While this study establishes strong preliminary evidence, we recommend and are initiating the following:

Longitudinal Studies: Conduct long-term follow-up studies (5-10 years) to further validate the durability of the laminated graft and the permanence of aesthetic and functional outcomes.

Comparative Studies: Perform prospective, controlled studies comparing the Septal Extender 2024 technique directly against other established costal cartilage techniques (e.g., dorsal onlay only, K-wire stabilization) to quantify differences in warping rates, operative metrics, and patient satisfaction.

Biomechanical Analysis: Collaborate with biomedical engineers to conduct in vitro biomechanical testing of the laminated composite beam versus conventionally carved grafts, providing objective data on its superior resistance to deformation forces.

These recommendations are intended to guide clinical practice toward more predictable outcomes and to direct academic inquiry toward substantiating and refining this holistic approach to complex nasal reconstruction.

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