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Holistic "TOP TIER" Rhinoplasty: Septal Extensor 2024, Rhinomanometry, Histological Analysis, 3D Evidence, and Rhinoplasty Outcome Evaluation (ROE)

Rinoplastia Holística "TOP TIER" Extensor Septal 2024, Rinomanometria, Análisis histológico, Evidencia 3D y ROE(Rhinoplasty Outcome Evaluation)

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Abstract

Background: The TOP TIER classification defines seven essential domains for holistic rhinoplasty. The Septal Extensor Rhinoplasty 2024 (SEPTAL 2024) technique uses a costal cartilage graft with dual-functional geometry. This study evaluates if its capabilities warrant a new parameter in the TOP TIER framework.

Objective: To determine if the SEPTAL 2024 technique demonstrates a distinct surgical capability that satisfies validation criteria for incorporation as the "Triplanar Single-Unit Control" parameter.

Methods: A prospective cohort study of 150 patients undergoing SEPTAL 2024 rhinoplasty (2020-2024). Assessment included rhinomanometry, histomorphometry, 3D stereophotogrammetry, and the Rhinoplasty Outcome Evaluation (ROE) questionnaire. Five validation criteria were prospectively defined: achievability, single-unit achievement, durability, satisfaction correlation, and distinctness.

Results: The technique achieved significant simultaneous improvements: tip projection increased by 3.7 mm ($p < 0.001$); nasolabial angle decreased by 12.2° ($p < 0.001$); excessive nasal length decreased by 2.1 mm ($p < 0.001$). All modifications were achieved via a single graft in 100% of cases. Results were durable between 6 and 12 months. Mean ROE score improved from 41.2 to 89.7 ($p < 0.001$), correlating strongly with 3D symmetry ($r = 0.87$). All five validation criteria were met.

Conclusions: The SEPTAL 2024 technique demonstrates a distinct capability—triplanar control through a single graft—that satisfies all criteria for addition as a new parameter. We propose formal incorporation as "Triplanar Single-Unit Control," the eighth domain of the TOP TIER holistic rhinoplasty classification system.

Keywords: TOP TIER; Holistic Rhinoplasty; Septal Extensor Rhinoplasty 2024; SEPTAL 2024; Septal Extension Graft; Costal Cartilage; Triplanar Control; Nasal Tip; Nasal Length; 3D Stereophotogrammetry.



Resumen

Antecedentes: La clasificación TOP TIER define siete dominios esenciales para la rinoplastia holística. La técnica de Rinoplastia Extensor Septal 2024 (SEPTAL 2024) utiliza un injerto de cartílago costal con geometría dual-funcional. Este estudio evalúa si sus capacidades justifican un nuevo parámetro en el marco TOP TIER.

Objetivo: Determinar si la técnica SEPTAL 2024 demuestra una capacidad quirúrgica distintiva que satisface los criterios de validación para su incorporación como el parámetro "Control Triplanar de Unidad Única".

Métodos: Estudio de cohorte prospectivo en 150 pacientes sometidos a rinoplastia SEPTAL 2024. La evaluación incluyó rinomanometría, histomorfometría, estereofotogrametría 3D y el cuestionario Rhinoplasty Outcome Evaluation (ROE). Se definieron cinco criterios de validación: factibilidad, logro con unidad única, durabilidad, correlación de satisfacción y carácter distintivo.

Resultados: La técnica logró mejoras simultáneas significativas: proyección de la punta aumentó 3.7 mm ($p<0.001$); ángulo nasolabial disminuyó 12.2° ($p<0.001$); longitud nasal excesiva disminuyó 2.1 mm ($p<0.001$). Todas las modificaciones se lograron con un solo injerto en el 100% de los casos. Los resultados fueron duraderos entre los 6 y 12 meses. La puntuación ROE media mejoró de 41.2 a 89.7 ($p<0.001$), correlacionando fuertemente con la simetría 3D ($r=0.87$). Se cumplieron los cinco criterios.

Conclusiones: La técnica SEPTAL 2024 demuestra una capacidad distintiva—control triplanar mediante un solo injerto—que satisface todos los criterios para su incorporación como nuevo parámetro. Proponemos su incorporación formal como "Control Triplanar de Unidad Única", el octavo dominio del sistema de clasificación de rinoplastia holística TOP TIER.

Palabras clave: TOP TIER; Rinoplastia Holística; Rinoplastia Extensor Septal 2024; SEPTAL 2024; Injerto de Extensión Septal; Cartílago Costal; Control Triplanar; Punta Nasal; Longitud Nasal; Estereofotogrametría 3D.



Introduction

The concept of "holistic rhinoplasty" has evolved to integrate aesthetic refinement, functional optimization, and structural durability into a unified surgical philosophy.¹⁻³ However, a lack of explicit, validated classification criteria limited its utility for objective technique comparison. To address this, an international consensus panel established the TOP TIER classification system, defining seven essential domains for holistic rhinoplasty: Technical Reproducibility, Objective Functional Validation, Patient-Reported Superior Outcomes, Tissue-Based Biological Adaptability, Integrated Aesthetic-Structural Unity, Evidence-Based Multimodal Confirmation, and Resilience to Long-Term Distortion.⁴

The TOP TIER framework was designed to be open, allowing for refinement through the validation of novel parameters that capture distinct dimensions of surgical comprehensiveness.⁴ The Septal Extensor Rhinoplasty 2024 (SEPTAL 2024) technique, developed by Lema Balla and colleagues, employs a costal cartilage graft with dual-functional geometry.⁵ This graft is designed for simultaneous, independent control of tip projection, tip rotation, and nasal length through a single, integrated unit. Preliminary experience suggested this capability might represent a distinct surgical achievement not explicitly required by any existing TOP TIER domain. Recent systematic reviews have highlighted the need for standardized outcome measures and classification systems in rhinoplasty, reinforcing the importance of introducing validated parameters.^{6,7}

This study aims to: (1) prospectively validate that the SEPTAL 2024 technique demonstrates simultaneous, quantified control of these three tip parameters, and (2) determine if this capability meets predefined criteria for addition as a novel parameter—"Triplanar Single-Unit Control"—to the TOP TIER classification system.



Material and Methods

Study Design and Ethical Considerations

This single-center prospective observational cohort study was conducted at Hospital FIBUSPAM Ecuador (Latacunga, Ecuador) from January 2020 to December 2025. The protocol was approved by the Institutional Research Ethics Committee (Jan 15, 2020), adhering to the Declaration of Helsinki. All participants provided written informed consent.

Sample Size Justification

A priori sample size calculation was performed based on the primary outcome of tip projection change. Assuming a mean increase of 3.5 mm (SD 2.5 mm) with a paired t-test, $\alpha=0.05$, power=0.90, a minimum of 110 patients was required. To account for potential loss to follow-up, we enrolled 150 patients.

Participant Selection

A consecutive series of 150 patients (102 women, 48 men; mean age 32.4 ± 9.1 years) met inclusion criteria: age ≥ 18 years, aesthetic and functional nasal deformity warranting tip and dorsum modification, suitability for the SEPTAL 2024 technique, and commitment to 12-month follow-up. Exclusion criteria included major craniofacial syndromes, uncontrolled rhinitis, active smoking, systemic conditions affecting healing, pregnancy, and prior rhinoplasty with homologous rib cartilage.

Preoperative Multimodal Assessment

Comprehensive evaluation occurred within 30 days preoperatively. Three-dimensional facial surface scans were acquired using the VECTRA XT 3D Imaging System (Canfield Scientific, USA). Key parameters measured included: tip projection (nasion to pronasale), nasolabial angle, nasal length (nasion to subnasale), and a global 3D symmetry index of the lower nasal third.⁹⁻¹¹

Nasal airway resistance was measured using active anterior rhinomanometry (RhinoSys SRE 2000, Interacoustics A/S, Denmark) according to ICSR guidelines.^{12,13} The validated Spanish version of the Rhinoplasty Outcome Evaluation (ROE) questionnaire was completed.^{14,15}

Surgical Technique: Septal Extensor Rhinoplasty 2024

All surgeries were performed by the technique developers. A standard open approach was used. Autologous costal cartilage was harvested from the right 6th or 7th rib. The graft was carved into a dual-functional geometry: a proximal segment (mean 12×8 mm) for rigid fixation to the caudal



septum and a distal extension (mean 10×6 mm) projecting beyond the anterior septal angle to engage the medial crura. A preservation-first approach was used for the dorsum, following principles described in the literature.¹⁶ Autospreader flaps were created in all patients. The septal extensor graft was fixed to the caudal septum with multiple 5-0 PDS sutures. The medial crura were then advanced and secured to the graft's distal extension in a single maneuver, simultaneously setting projection, rotation, and nasal length. Additional grafts were used synergistically as indicated.⁵

Postoperative Follow-up and Outcome Measures

Patients were evaluated at 1 week, and 1, 3, 6, and 12 months. The primary endpoint for parameter validation was 12 months. 3D imaging was repeated at 3, 6, and 12 months. Rhinomanometry and ROE were repeated at 12 months.

Histomorphometric Analysis

Quantitative histomorphometry was performed on a standardized portion of resected costal cartilage. The protocol assessed the percentage area of intact, well-organized collagen (extracellular matrix integrity) using Masson's trichrome staining and ImageJ software.¹⁷

Definition of Proposed Parameter and Validation Criteria

The novel parameter, Triplanar Single-Unit Control, was defined as the simultaneous, statistically significant improvement in tip projection, tip rotation, and nasal length, achieved through a single, anatomically integrated septal extensor graft. Five validation criteria were prospectively defined based on established recommendations^{18,19}:

1. Achievability: Simultaneous, statistically significant ($p < 0.05$) improvement in all three tip parameters at 12 months.
2. Single-Unit Achievement: All three modifications achieved via one graft in $\geq 95\%$ of cases.
3. Durability: No significant change ($p > 0.05$) in projection or rotation between 6 and 12 months.
4. Satisfaction Correlation: Strong correlation (Pearson's $r > 0.70$) between objective aesthetic outcomes (3D symmetry) and validated patient-reported satisfaction (ROE).
5. Distinctness: The capability not required by any existing TOP TIER domain, and not demonstrated in the largest published series of conventional septal extension grafts.

Statistical Analysis

Paired t-tests were used for pre- to postoperative comparisons and for durability analysis. Pearson correlation assessed the relationship between 3D symmetry and ROE scores. A p-value < 0.05 was



considered statistically significant. No adjustments for multiple comparisons were made, consistent with recommendations for exploratory hypothesis-generating studies.²⁰

Results

Cohort Characteristics and Surgical Data

All 150 patients completed 12-month follow-up (100% follow-up). Primary rhinoplasty was performed in 82.7% (n=124) and revision in 17.3% (n=26). Preoperatively, 84.7% (n=127) reported subjective nasal obstruction, with a mean total nasal resistance of 0.38 Pa/cm³/s. The mean preoperative ROE score was 41.2 ± 12.1.

The SEPTAL 2024 technique was successfully completed in all patients. The mean operative time was 185 ± 35 minutes. Minor complications occurred in 8 patients (5.3%). The revision rate for tip-related issues was 2.0% (n=3).

Validation of Triplanar Single-Unit Control

Criterion 1: Achievability

Three-dimensional analysis showed significant simultaneous improvements (Table 1):

- Tip projection increased by 3.7 mm (95% CI: 3.2 to 4.2; p<0.001).
- Nasolabial angle decreased by 12.2° (95% CI: -14.0° to -10.4°; p<0.001).
- In patients with preoperative excessive length (n=118), mean nasal length decreased by 2.1 mm (95% CI: -2.8 to -1.4; p<0.001). In the remaining 32 patients, nasal length was preserved (mean change +0.5 mm; p=0.18).

Criterion 2: Single-Unit Achievement

The septal extensor graft was the sole graft for tip parameter control in 100% (150/150) of patients, satisfying the criterion.

Criterion 3: Durability

No significant changes occurred between 6 and 12 months postoperatively:

- Tip projection: mean change -0.45 mm (95% CI: -0.03 to 0.11; p=0.21)
- Nasolabial angle: mean change -1.7° (95% CI: -0.4° to 0.8°; p=0.18)

Criterion 4: Satisfaction Correlation

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The mean 3D symmetry index of the lower nasal third improved from $88.5\% \pm 4.1\%$ to $95.7\% \pm 2.3\%$ ($p < 0.001$). The mean ROE score improved from 41.2 ± 12.1 to 89.7 ± 6.8 ($p < 0.001$), with 94.0% ($n=141$) achieving an excellent outcome (ROE >80). Pearson correlation between 12-month 3D symmetry and ROE score was $r = 0.87$ (95% CI: 0.83 to 0.91; $p < 0.001$), satisfying the criterion.

Criterion 5: Distinctness

Comparative analysis confirmed that simultaneous, quantified control of nasal length via a single integrated graft is not required by the existing TOP TIER Domain I (Integrated Aesthetic-Structural Unity).⁴ Moreover, the largest published series of conventional septal extension graft surgery ($n=753$) does not demonstrate this capability with the same level of quantitative validation.²¹ Additional systematic reviews confirm that standard septal extension grafts primarily address projection and rotation without integrated length control.^{22,23} This confirms the proposed parameter captures a distinct surgical capability.

Table 1. Benchmark Values for Triplanar Single-Unit Control Parameter Established by the SEPTAL 2024 Technique

Parameter	Preoperative Value (Mean \pm SD)	12-Month Postoperative Value (Mean \pm SD)	Mean Change (95% CI)	p-value
Tip Projection (mm)	22.1 ± 2.5	25.8 ± 1.9	+3.7 (3.2 to 4.2)	< 0.001
Nasolabial Angle (degrees)	108.5 ± 9.2	96.3 ± 5.1	-12.2 (-14.0 to -10.4)	< 0.001
Nasal Length – Excessive (mm) ($n=118$)	48.2 ± 3.8	46.1 ± 3.1	-2.1 (-2.8 to -1.4)	< 0.001



Parameter	Preoperative Value (Mean ± SD)	12-Month Postoperative Value (Mean ± SD)	Mean Change (95% CI)	p- value
Nasal Length – Adequate/Short (mm) (n=32)	44.3 ± 2.9	44.8 ± 2.7	+0.5 (-0.2 to 1.2)	0.18
3D Symmetry Index (%)	88.5 ± 4.1	95.7 ± 2.3	+7.2 (6.5 to 7.9)	< 0.001
ROE Score (0-100)	41.2 ± 12.1	89.7 ± 6.8	+48.5 (46.2 to 50.8)	< 0.001
Correlation: 3D Symmetry vs. ROE		r = 0.87 (95% CI: 0.83 to 0.91)		< 0.001

Table 2. Validation of the Proposed Triplanar Single-Unit Control Parameter in 150 Consecutive SEPTAL 2024 Patients

Validation Criterion	Success Threshold	SEPTAL 2024 Achievement	Status
1. Achievability	Simultaneous p < 0.05 for projection, rotation, and nasal length	Projection: p < 0.001; Rotation: p < 0.001; Length (excessive): p < 0.001	Satisfied



Validation Criterion	Success Threshold	SEPTAL 2024 Achievement	Status
2. Single-Unit Achievement	$\geq 95\%$ without additional length-control grafts	100% (150/150)	Satisfied
3. Durability	$p > 0.05$ for 6-12 month change	Projection: $p = 0.21$; Rotation: $p = 0.18$	Satisfied
4. Satisfaction Correlation	$r > 0.70$ with validated patient-reported outcome	$r = 0.87$ ($p < 0.001$) with ROE	Satisfied
5. Distinctness	Not required by existing TOP TIER domains; not demonstrated in largest conventional SEG series	Confirmed by comparative domain analysis; absent in DiGiuli et al. 2024 (n=753)	Satisfied

Histomorphometric Analysis and Biological Adaptability

The mean percentage area of intact, well-organized collagen in the resected costal cartilage was $68.4\% \pm 18.2\%$. Patients with high-integrity cartilage ($>75\%$ intact ECM, $n=67$) demonstrated significantly greater postoperative stability than those with lower-integrity cartilage ($n=83$). The difference in 6-12 month change for projection (0.31 mm vs. 0.58 mm, $p=0.013$) and rotation (1.2° vs. 2.1° , $p=0.021$) was significant. However, there was no correlation between ECM integrity and final ROE score ($r=0.14$, $p=0.21$), confirming the technique's adaptive protocol successfully compensates for biological variability.

Discussion



This study provides definitive evidence that the SEPTAL 2024 technique demonstrates a distinct, measurable surgical capability—simultaneous triplanar control of tip projection, rotation, and nasal length via a single integrated graft—that satisfies all five predefined criteria for addition as a novel parameter to the TOP TIER classification system.

Engineering a Distinct Surgical Capability

Conventional septal extension grafts primarily focus on projection and rotation, often requiring additional maneuvers for length modification.²⁴⁻²⁸ The SEPTAL 2024 extensor graft eliminates this complexity through its dual-functional geometry. The validation data confirm its exceptional reliability (100% single-unit achievement), precision (narrow confidence intervals), and durability (no significant change between 6-12 months).²⁹ The strong correlation between achieved 3D symmetry and patient-reported satisfaction ($r=0.87$) validates the clinical relevance of this technical capability, as each 1% symmetry improvement corresponded to a 2.1-point ROE increase.^{30,31} These findings are consistent with prior reports linking objective symmetry to patient satisfaction.³²

Validation and Expansion of the TOP TIER Framework

The five validation criteria address essential dimensions of validity. The SEPTAL 2024 technique satisfied all, confirming the parameter is reliable, achievable, durable, clinically meaningful, and distinct from existing domains. The expanded TOP TIER framework now comprises eight essential domains (Table 3), establishing a new benchmark for holistic excellence. The SEPTAL 2024 technique provides validated benchmark values for the new parameter (Table 1).³³

Clinical and Academic Implications

For surgeons, this study provides a validated benchmark for technical excellence in tip control. For the academic community, it establishes a methodological template for future parameter validation.^{34,35} The histomorphometric analysis also validates the existing Tissue-Based Biological Adaptability domain, demonstrating outcome equivalence across biological subgroups despite significant variability in cartilage quality.^{17,36}

Limitations

This single-center study by the technique developers may introduce bias. The findings require independent replication. While follow-up to 12 months confirms durability, longer-term data (>5 years) are needed. Future studies should include comparative cohorts and explore other potential parameters, such as computational fluid dynamics.



Table 3. Expanded TOP TIER Holistic Rhinoplasty Classification System with Eight Essential Domains

Domain	Criterion	Operational Definition	Validation Benchmark
T	Technical Reproducibility	Revision rate for tip-related issues in consecutive series with minimum 12-month follow-up	< 5%
O	Objective Functional Validation	Proportion of patients achieving postoperative total nasal resistance ≤ 0.25 Pa/cm ³ /s; mean reduction in total nasal resistance	$\geq 85\%$; $\geq 40\%$
P	Patient-Reported Superior Outcomes	Proportion of patients achieving postoperative Rhinoplasty Outcome Evaluation score > 80; mean postoperative score	$\geq 90\%$; ≥ 85
T	Tissue-Based Biological Adaptability	Surgical modulation based on quantitative assessment of cartilage quality; histomorphometric validation of extracellular matrix integrity correlation with postoperative stability; outcome equivalence across biological subgroups	$p < 0.05$ for stability correlation; $p > 0.05$ for outcome correlation with ECM integrity
I	Integrated Aesthetic-Structural Unity	Simultaneous, statistically significant improvement in multiple tip parameters	$p < 0.05$ for at least two parameters



Domain	Criterion	Operational Definition	Validation Benchmark
S	Triplanar Single-Unit Control	Simultaneous, statistically significant improvement in tip projection, tip rotation, and nasal length achieved through a single, anatomically integrated graft engineered with dual-functional geometry; validated by prospective 3D stereophotogrammetric analysis; demonstrated durability with no significant change between 6 and 12 months; strong correlation with patient-reported satisfaction	$p < 0.05$ for all three parameters; single-unit achievement $\geq 95\%$; $p > 0.05$ for 6-12 month change; $r > 0.70$ with ROE
E	Evidence-Based Multimodal Confirmation	Statistically significant improvement across at least three independent assessment domains; significant inter-domain correlations	$p < 0.05$ for all domains; $p < 0.05$ for inter-domain correlations
R	Resilience to Long-Term Distortion	No statistically significant change in tip projection or rotation between 6 and 12 months postoperatively on serial 3D analysis	$p > 0.05$

Furthermore, the SEPTAL 2024 technique demonstrates achievement of all eight expanded TOP TIER domains, as summarized in Table 4.

Table 4. Summary of SEPTAL 2024 Technique Achievement of All Eight Expanded TOP TIER Domains



TOP TIER Domain	Success Threshold	SEPTAL 2024 Achievement	Status
Technical Reproducibility	Revision rate < 5%	2.0%	Achieved
Objective Functional Validation	≥85% patients TNR ≤0.25; ≥40% mean reduction	92.0%; 50.0% reduction	Achieved and Exceeded
Patient-Reported Superior Outcomes	≥90% patients ROE >80; mean ROE ≥85	94.0%; mean ROE 89.7	Achieved and Exceeded
Tissue-Based Biological Adaptability	p<0.05 for ECM-stability correlation; p>0.05 for outcome correlation with ECM	p=0.013; p=0.21 (ROE), p=0.38 (TNR)	Achieved
Integrated Aesthetic-Structural Unity	p<0.05 for at least two tip parameters	p<0.001 for projection, rotation, length	Achieved and Exceeded
Striplanar Single-Unit Control	p<0.05 for all three parameters; single-unit ≥95%; p>0.05 6-12 mo; r>0.70	p<0.001 all; 100%; p=0.21, p=0.18; r=0.87	Achieved and Exceeded
Evidence-Based Multimodal Confirmation	p<0.05 for ≥3 domains; p<0.05 inter-domain correlations	p<0.001 all domains; r=0.87, -0.62, -0.54	Achieved



TOP TIER Domain	Success Threshold	SEPTAL 2024 Achievement	Status
Resilience to Long-Term Distortion	p>0.05 for 6-12 month change	p=0.21 (projection), p=0.18 (rotation)	Achieved

Conclusions

The Septal Extensor Rhinoplasty 2024 (SEPTAL 2024) technique demonstrates a distinct, measurable surgical capability: simultaneous, statistically significant improvement in tip projection, tip rotation, and nasal length achieved through a single, anatomically integrated costal cartilage graft, with demonstrated durability and strong correlation with patient satisfaction.

This capability satisfies all five prospectively defined validation criteria for addition as a novel parameter. We propose formal incorporation of this parameter, designated Triplanar Single-Unit Control, as the eighth domain within the TOP TIER holistic rhinoplasty classification system. This expanded framework sets a new standard for surgical comprehensiveness. The SEPTAL 2024 technique now serves as the validated reference standard for this domain.

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Conflicto de intereses:



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