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Holistic Top-Tier Deep Plane Facelift: A Data-Driven Protocol For Predictable Facial Longevity • The Lema-Balla Approach

Lifting Holístico de Plano Profundo de Alto Nivel: Un Protocolo Basado en datos para una Longevidad Facial Predecible • El Enfoque Lema-Balla

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Abstract

Contemporary facial rejuvenation surgery necessitates a paradigm shift from subjective assessment to evidence-based methodologies that predictably restore youthful facial architecture. This comprehensive article introduces the "Holistic Top-Tier Deep Plane" (HTTP) protocol, an integrated surgical framework developed through systematic analysis of 527 consecutive patients (2018-2023) with rigorous longitudinal follow-up. The rationale addresses critical limitations in current facelift techniques, which often prioritize short-term skin tightening over three-dimensional structural restoration, leading to unnatural results, premature recurrence, and patient dissatisfaction. Our primary objective was to establish a standardized anatomical protocol that systematically addresses the deep medial fat compartments, retaining ligamentous system, and SMAS-platysma continuum through reproducible surgical steps. Secondary objectives included quantifying longevity through artificial intelligence-enhanced 3D photogrammetry, analyzing patient-reported outcomes using validated instruments, and identifying biomechanical predictors of sustained results through multivariate statistical modeling. Methodology employed prospective data collection with high-fidelity 3D imaging at six standardized intervals (preoperative through 36 months), FACE-Q and Glasgow Benefit Inventory surveys, and independent multi-rater evaluation by international experts. Advanced statistical analysis utilized linear mixed-effects models and Cox proportional hazards regression for outcome durability assessment. Results demonstrate mean midface volumetric repositioning of 8.7 mm, maintained at 91.2% at 12 months and 85.1% at 36 months, representing unprecedented longevity documentation. Major complication rate remained exceptionally low at 0.38%. Regression analysis identified three independent predictors of superior longevity: suture fixation integrity ($\beta = -0.41$, $p<0.001$), SMAS flap thickness >3.5mm ($\beta = -0.38$, $p<0.001$), and concurrent midface fat grafting ($\beta = -0.29$, $p=0.002$). The HTTP protocol represents a paradigm shift by integrating deep anatomical science with rigorous outcome analytics, establishing a new evidence-based standard for achieving natural, durable facial rejuvenation that addresses the multifaceted nature of facial aging through a comprehensive, holistic approach.

Key words: Deep plane facelift, facial longevity, SMAS, retaining ligaments, 3D photogrammetry, patient-reported outcomes, data-driven surgery, regenerative aesthetics, anatomical rejuvenation, surgical outcomes.

Resumen

El rejuvenecimiento facial contemporáneo requiere un cambio de paradigma desde la evaluación subjetiva hacia metodologías basadas en evidencia que restauren de manera predecible la arquitectura facial juvenil. Este artículo integral presenta el protocolo "Holistic Top-Tier Deep Plane" (HTTP), un marco quirúrgico integrado desarrollado mediante el análisis sistemático de 527 pacientes consecutivos (2018-2023) con seguimiento longitudinal riguroso. La justificación aborda limitaciones críticas en las técnicas actuales de lifting, que a menudo priorizan el estiramiento cutáneo a corto plazo sobre la restauración estructural tridimensional, lo que conduce a resultados antinaturales, recurrencia prematura e insatisfacción del paciente. Nuestro objetivo principal fue establecer un protocolo anatómico estandarizado que aborde sistemáticamente los compartimentos grasos profundos mediales, el sistema ligamentario de retención y el continuo SMAS-platisma mediante pasos quirúrgicos reproducibles. Los objetivos secundarios incluyeron cuantificar la longevidad mediante fotogrametría 3D potenciada por inteligencia artificial, analizar los resultados reportados por los pacientes utilizando instrumentos validados e identificar predictores biomecánicos de resultados sostenidos mediante modelado estadístico multivariado. La metodología empleó recolección prospectiva de datos con imágenes 3D de alta fidelidad en seis intervalos estandarizados (preoperatorio hasta 36 meses), encuestas FACE-Q e Inventario de Beneficios de Glasgow, y evaluación independiente por múltiples evaluadores expertos internacionales. El análisis estadístico avanzado utilizó modelos lineales de efectos mixtos y regresión de Cox para evaluar la durabilidad de los resultados. Los resultados demuestran un reposicionamiento volumétrico medio del tercio medio facial de 8.7 mm, mantenido en un 91.2% a los 12 meses y un 85.1% a los 36 meses, lo que representa una documentación de longevidad sin precedentes. La tasa de complicaciones mayores se mantuvo excepcionalmente baja en un 0.38%. El análisis de regresión identificó tres predictores independientes de longevidad superior: integridad de la fijación con sutura ($\beta = -0.41$, $p<0.001$), espesor del colgajo SMAS >3.5 mm ($\beta = -0.38$, $p<0.001$) y lipotransferencia facial media concurrente ($\beta = -0.29$, $p=0.002$). El protocolo HTTP representa un cambio de paradigma al integrar la ciencia anatómica profunda con análisis riguroso de resultados, estableciendo un nuevo estándar basado en evidencia para lograr un rejuvenecimiento facial natural y duradero que aborde la naturaleza multifacética del envejecimiento facial mediante un enfoque integral y holístico.

Palabras clave: Lifting de plano profundo; longevidad facial; SMAS; ligamentos de retención; fotogrametría 3D; resultados reportados por el paciente; cirugía basada en datos; estética regenerativa; rejuvenecimiento anatómico; resultados quirúrgicos.

Introduction

Facial aging represents a complex multidimensional process involving five distinct but interconnected anatomical phenomena: skeletal remodeling with selective resorption, ligamentous attenuation and elongation, deep fat compartment descent and redistribution, superficial musculoaponeurotic system (SMAS) changes including thinning and loss of elasticity, and progressive dermal deterioration with collagen fragmentation (Rohrich et al., 2021). This hierarchical deterioration creates characteristic aging patterns including midface descent, jowl formation, nasolabial fold deepening, and loss of mandibular definition. Traditional facelift approaches, frequently centered on skin manipulation or isolated SMAS techniques, fail to address this anatomical complexity comprehensively, resulting in outcomes that may appear operated, lack natural harmony, or demonstrate premature correction loss due to unaddressed deep structural descent (Stuzin, 2021).

The historical evolution of facelift techniques reveals an ongoing quest for greater longevity and naturalness. From the initial skin-only lifts of the early 20th century to the SMAS techniques popularized in the 1970s and 1980s, each advancement sought to address deeper anatomical layers. The development of deep-plane and composite rhytidectomy techniques represented significant conceptual advances by providing direct access to midface fat compartments and enabling more complete release of retaining ligaments (Mendelson & Wong, 2012). However, despite these anatomical insights, clinical application has remained largely surgeon-dependent, characterized by significant variation in dissection planes, fixation methods, and vector strategies. This variability has hindered the development of standardized protocols and robust longitudinal outcome data necessary for evidence-based refinement of surgical techniques (Jacono & Malone, 2022).

The emerging concept of "facial longevity" in aesthetic surgery transcends traditional metrics of complication rates and short-term satisfaction. It represents a quantifiable, multidimensional construct defined as the durable maintenance of surgically restored facial volumetric position and contour harmony over time, measured against immediate postoperative baselines using objective imaging modalities. This concept incorporates not only positional stability but also natural appearance preservation, dynamic function maintenance, and patient satisfaction sustainability.

Achieving meaningful facial longevity requires a paradigm shift from artisanal approaches to scientifically validated methodologies—ones grounded in precise anatomical principles, biomechanical understanding, and prospective outcome verification through advanced imaging and patient-reported measures.

The Holistic Top-Tier Deep Plane (HTTP) protocol was developed to operationalize this paradigm shift through a systematic, data-driven approach. Founded on four core biomechanical and anatomical hypotheses: (1) that durable rejuvenation requires sequential anatomical release of the complete deep facial retaining ligamentous system, not merely selective release; (2) that optimal tissue repositioning must occur within the true surgical plane deep to the SMAS and superficial to mimetic muscles, respecting facial nerve anatomy; (3) that fixation must withstand long-term gravitational and dynamic forces through multi-modal reinforcement at key ligamentous points; and (4) that optimal outcomes require integration of structural repositioning with adjunctive volume restoration and skin quality enhancement, addressing all layers of facial aging simultaneously.

The primary objective of this comprehensive study is to present the complete HTTP surgical protocol with its anatomical rationale and provide robust evidence of its efficacy and durability through multi-faceted outcome analysis. Secondary objectives include: (1) establishing normative longitudinal data for facial soft tissue movement after deep plane surgery using artificial intelligence-enhanced 3D photogrammetry with standardized measurement protocols; (2) correlating specific technical variables (suture integrity, vector orientation, flap thickness, adjunctive procedures) with long-term stability using multivariate regression models to identify modifiable predictors of outcome; and (3) validating the protocol's impact on patient quality of life, psychological wellbeing, and perceived age reduction through validated patient-reported outcome measures. By merging detailed surgical technique description with rigorous data analytics and long-term follow-up, this work aims to elevate facial rejuvenation from subjective artistry to reproducible, outcome-predictable surgical science with evidence-based technical standards.

Methods

Study Design and Ethical Framework

This investigation employed a prospective, single-surgeon-group, longitudinal cohort design conducted at a specialized tertiary referral center for facial rejuvenation between January 2018 and December 2024. The study protocol received approval from the institution's independent research ethics review board (Protocol HTTP-2018-01), and all participants provided written informed consent for both the surgical procedure and the anonymous use of their clinical data for research publication and educational purposes. The study was conducted in accordance with the Declaration of Helsinki and followed STROBE guidelines for observational studies.

Participant Selection and Demographic Characteristics

A consecutive series of 527 patients (489 female, 38 male) undergoing primary or secondary HTTP facelift constituted the study population. Inclusion criteria were deliberately comprehensive to reflect real-world practice: age 40-75 years; presentation with moderate to severe facial aging as validated using the comprehensive Fitzpatrick-Wyatt Facial Aging Scale (score $\geq$6); expressed desire for comprehensive, long-lasting rejuvenation; psychological readiness for major facial surgery; and willingness to commit to minimum 3-year photographic and clinical follow-up. Exclusion criteria were established to minimize confounding variables and ensure patient safety: active smoking (within 6 months, verified by serum cotinine testing); body mass index >32 kg/m^2; history of facial radiotherapy or significant trauma with scarring; diagnosed connective tissue disorders (Ehlers-Danlos, scleroderma, etc.); uncontrolled systemic comorbidities (ASA class $\geq$III); history of keloid formation; and unwillingness to accept the specific incision pattern or potential for hairline alteration.

Comprehensive demographic and clinical characteristics were meticulously documented (Table 1). The cohort represented a typical cross-section of patients seeking comprehensive facial rejuvenation, with mean age 58.7 years and predominance of female patients (92.8%). The distribution between primary and secondary procedures (90.3% vs. 9.7%) reflects contemporary practice patterns, while the high percentage with prior non-surgical treatments (78.2%) illustrates the evolving landscape of facial aesthetics where patients frequently progress from minimally invasive to surgical interventions.

Table 1. Baseline Demographics and Clinical Characteristics of the Cohort (N=527)

Characteristic	Mean ± SD or n (%)	Range	Clinical Significance
Age (years)	58.7 ± 6.9	42 - 74	Represents peak demographic for comprehensive facelift
Sex (Female)	489 (92.8%)	-	Reflects typical gender distribution in facial aesthetics
BMI (kg/m²)	23.1 ± 2.8	18.5 - 31.9	Normal to slightly overweight range typical for aesthetic patients
Fitzpatrick-Wyatt Score	7.2 ± 1.1	6 - 10	Moderate to severe aging appropriate for surgical intervention
Primary Procedure	476 (90.3%)	-	Majority undergoing first surgical rejuvenation

Secondary/Revision	51 (9.7%)	-	Represents complex cases requiring advanced techniques
Prior Non-Surgical Treatments	412 (78.2%)	-	Illustrates progression from injectables to surgery
Menopausal Status (F)	422 (86.3%)	-	Hormonal influences on facial aging and healing
Sun Exposure Classification	Moderate: 58% High: 32%	-	Environmental aging factor documentation
Genetic Aging Pattern	Parental resemblance documented in 71%	-	Hereditary influences on aging characteristics

This table presents the quantitative and qualitative data of the patient group included in the study, describing the typical population eligible for comprehensive facial rejuvenation and providing context for the interpretation of the results.

Preoperative Assessment Protocol

All patients underwent comprehensive preoperative evaluation following a standardized protocol:

1. Medical and Surgical History: Detailed documentation including previous facial procedures, medical comorbidities, medications, allergies, and family history of healing abnormalities.

2. Physical Examination: Systematic assessment of facial anatomy including skin quality (Glogau scale), subcutaneous fat distribution, platysmal banding, jowl severity, midface position, bony anatomy, and hairline characteristics. Neurological examination documented baseline facial nerve function.

3. Photographic Documentation: Standardized photographs using seven views (frontal, right/left oblique, right/left lateral, right/left three-quarter) with consistent lighting, background, and camera settings. Video documentation captured dynamic facial expressions.

4. 3D Imaging and Virtual Surgical Planning: VECTRA H2 3D photogrammetry system captured detailed facial topography. Custom software enabled virtual surgical simulation with vector planning, predicted tissue movement, and outcome visualization. These simulations facilitated patient education and surgical planning.

5. Psychological Assessment: Screening for body dysmorphic disorder and evaluation of patient expectations using structured interview and standardized questionnaires.

6. Laboratory Evaluation: Preoperative laboratory testing included complete blood count, coagulation profile, and metabolic panel, with additional testing as indicated by medical history.

The Holistic Top-Tier Deep Plane (HTTP) Protocol: A Stepwise Surgical Technique

All procedures were performed by the senior authors (J.P.L., A.R.B.) under general anesthesia in an accredited ambulatory surgical facility with board-certified anesthesiologists. The protocol follows seven defined phases executed with meticulous attention to anatomical detail:

Phase 1: Preoperative Planning and Marking (Duration: 20-30 minutes)

3D Simulation Integration: Patient-specific 3D photogrammetry models were imported into surgical planning software. Virtual surgical planning (VSP) simulated vectors of lift, predicted tissue movement, and allowed for "what-if" scenario testing. These simulations informed individualized surgical strategies accounting for unique anatomical characteristics.

Topographic Marking Protocol: With the patient upright in the preoperative holding area, key anatomical landmarks were marked using surgical pen: mandibular border from menton to angle;

anterior border of masseter; course of frontal branch (Pitanguy's line) and marginal mandibular nerve; body of zygomatic arch; proposed incision lines (temporal hairline transition, pre- or post-tragal based on anatomical assessment, retroauricular sulcus, occipital hairline). Vector lines indicating planned SMAS advancement were drawn on the skin.

Phase 2: Tumescent Hydrodissection and Incision (Duration: 15-20 minutes)

Tumescent Solution Formulation: Customized tumescent solution contained lidocaine 0.05%, epinephrine 1:1,000,000 in lactated Ringer's solution with sodium bicarbonate 10 mEq/L for pH adjustment. Total volume ranged from 150-250ml per side based on facial surface area.

Injection Technique: Using a 22-gauge spinal needle, tumescent solution was infiltrated in two planes: (1) subcutaneous plane along the entire area of planned dissection; (2) sub-SMAS plane along the planned deep plane dissection. This dual-plane hydrodissection facilitated tissue separation, provided hemostasis through vasoconstriction, and protected neurovascular structures through hydraulic dissection.

Incision Execution: Incisions were made as marked using 15 scalpel. Temporal incision followed hairline with beveling parallel to hair follicles to maximize preservation. Tragal incision was placed precisely at the anterior tragal border when possible. Retroauricular incision followed the sulcus precisely. All incisions were made with attention to future scar placement and camouflage.

Phase 3: Subcutaneous Skin Flap Elevation (Duration: 40-60 minutes per side)

Dissection Plane: Under 4.5x loupe magnification with fiberoptic headlight illumination, precise subcutaneous flap elevation proceeded anteriorly using facelift scissors. The dissection plane was maintained immediately deep to the dermal-subdermal junction, preserving a uniform thickness of approximately 3-4mm of subcutaneous fat on the flap to ensure vascularity.

Anterior Extent: Dissection continued to a line approximately 1.5 cm beyond the nasolabial fold, sufficient to allow redraping without tension. In the temporal region, dissection remained superficial to the superficial temporal fascia to protect the frontal branch. In the neck, subcutaneous dissection extended to the midline with care to preserve submental vascular perforators.

Hemostasis: Meticulous hemostasis was maintained throughout using bipolar electrocautery at low settings to minimize thermal injury. Key perforating vessels were identified and selectively cauterized.

Phase 4: Deep Plane Entry and Sequential Ligamentous Release - The "Lema-Balla Maneuver" (Duration: 60-90 minutes per side)

This phase represents the technical core of the HTTP protocol, executed in four systematic steps:

Step A – Zygomatic Arch Entry and Zygomatic Ligament Release: The deep plane was entered 1 cm inferior and parallel to the body of the zygomatic arch, identified by palpation. Scissor dissection proceeded immediately superficial to the zygomaticus major muscle, directly visualizing and releasing the zygomatic retaining ligaments under direct vision. The zygomatic cutaneous ligaments were released from their periosteal attachments, allowing medial fat compartment mobilization.

Step B – Medial Compartment Mobilization: Dissection continued medially in this relatively avascular plane between the SMAS and mimetic muscles, fully mobilizing the superficial medial and middle medial fat compartments. The anterior extent of dissection reached the lateral border of the levator labii superioris, ensuring complete release. This mobilization allowed for en bloc superolateral repositioning of the descended fat compartments.

Step C – Mandibular Ligament Release: The dissection was carried inferiorly over the masseteric fascia. The mandibular ligament was identified as a dense, distinct fibrous band at the junction of the anterior and middle thirds of the mandibular body. This structure was sharply released from its periosteal attachment, crucial for jowl correction.

Step D – Cervical and Platysmal Dissection: In patients with significant cervical aging, a subplatysmal dissection was performed, releasing the platysma from its mandibular attachments. The cervical retaining ligaments along the anterior border of the sternocleidomastoid muscle were released to facilitate cervical contouring.

Phase 5: SMAS-Platysma Flap Development and Multi-Vector Repositioning (Duration: 30-45 minutes per side)

Flap Development: Following complete release, a robust, continuous SMAS-platysma flap was developed. Flap thickness was assessed using calibrated calipers, with minimum target thickness of 3.5mm. In secondary cases or patients with thin SMAS, flap integrity was reinforced with superimposed suturing techniques.

Vector Planning and Execution: The mobilized flap was advanced along two primary, physiologically distinct vectors determined during preoperative VSP: (1) a superolateral vector (approximately 45° from horizontal) for the midface component, anchored to the deep temporal fascia; (2) a posterior vector (approximately 90° from horizontal) for the cervical platysmal component, anchored to the mastoid fascia. These vectors were personalized based on individual anatomical characteristics and aesthetic goals.

Phase 6: Multi-Modal, Biomechanically Optimized Fixation (Duration: 40-60 minutes per side)

Fixation strategy employed a layered approach combining different suture materials and techniques:

Primary Fixation: The SMAS flap was secured using a running 2-0 Polydioxanone (PDO) bidirectional barbed suture (Quill™ SRS). This suture distributed tension evenly along its length, eliminating points of concentrated stress and providing high initial tensile strength during the critical early healing phase. The barbed design provided immediate mechanical fixation without requiring knots.

Reinforcement Fixation: Critical anatomical points requiring long-term support received additional reinforcement with interrupted 3-0 Polypropylene sutures. These included: (1) zygomatic apex area fixation to deep temporal fascia; (2) mandibular ligament area recreation with fixation to mandibular periosteum; (3) mastoid fascia fixation for platysmal support. These permanent sutures created durable ligamentous neo-attachments.

Tension Adjustment: Suture tension was calibrated to achieve natural repositioning without over-tightening. The goal was restoration of youthful position rather than creation of tension-dependent results.

Phase 7: Skin Redraping, Excision, and Holistic Adjuncts (Duration: 60-90 minutes total)

Skin Redraping and Excision: The skin flap was redraped with minimal tension along the pre-marked vectors. Key principles included: preservation of temporal hairline, tragal definition, and earlobe position. Conservative excision removed only redundant skin, with care to avoid distortion of anatomical landmarks. Closure was performed in three layers: (1) 3-0 Vicryl to superficial fascia; (2) 4-0 Monocryl deep dermal; (3) 5-0 fast-absorbing gut or 6-0 polypropylene running cutaneous sutures.

Adjunctive Procedures: Following the holistic philosophy, 94% of patients received concurrent procedures based on individualized assessment: upper and/or lower blepharoplasty (81%); autologous microfat grafting to periorbital, temporal, and perioral regions (52%); fractional CO2 laser resurfacing (48%); platysmal plication (76%); submental liposuction (68%). These were performed during the same anesthetic to address all aspects of facial aging comprehensively.

Postoperative Management Protocol

Standardized postoperative care included:

1. Immediate Postoperative: Head elevation, gentle compressive dressing without pressure on flaps, ice application, overnight observation with continuous monitoring.

2. Early Recovery (Days 1-7): Drains removed at 24-48 hours; gentle cleansing beginning day 2; suture removal staggered (day 5-7 for facial, day 10-14 for scalp).

3. Rehabilitation Phase: Lymphatic massage beginning day 10; scar management with silicone gel sheeting beginning week 3; gradual return to activity over 4-6 weeks.

4. Long-term Follow-up: Scheduled visits at 1 week, 1 month, 3 months, 6 months, 1 year, and annually thereafter with photographic documentation at each visit.

Data Acquisition and Outcome Measures

A dedicated clinical research coordinator prospectively collected all data using electronic case report forms with built-in validation checks. Outcome measures were categorized into four domains:

1. Primary Outcome – Anatomical Longevity:

Measurement Tool: VECTRA H2 3D Photogrammetry System (Canfield Scientific) with integrated stereophotogrammetry technology providing sub-millimeter accuracy.

Time Points: Preoperative (T0), 1 week postoperative (T1), 6 months (T2), 12 months (T3), 24 months (T4), 36 months (T5).

Analysis Protocol: Custom AI-powered software module (VECTRA Analysis Module 3.0) calculated surface distances and volumetric changes at 12 standardized facial fiducial points defined by anatomical landmarks. Inter-landmark distances were calculated using geodesic (surface-following) algorithms rather than straight-line measurements to account for facial curvature.

Primary Metric: "Ptosis Recurrence Index (PRI)" calculated as: `PRI = [(Measurement at T_n - Measurement at T1) / (Measurement at T0 - Measurement at T1)]  100%`. A PRI of 0% indicates perfect maintenance of surgical correction, 100% indicates complete recurrence to preoperative state. Values between these extremes represent partial maintenance.

2. Secondary Outcomes:

Patient-Reported Outcomes (PROs): Validated instruments administered at T0, T3, and T4:

- FACE-Q Aesthetics Module: 37-item instrument measuring satisfaction with facial appearance (scale 0-100), age appraisal, and social confidence. Demonstrated excellent validity and reliability in aesthetic surgery populations.

- Glasgow Benefit Inventory (GBI): 18-item instrument measuring patient-perceived benefit following surgical intervention across physical, psychological, and social domains. Total scores range from -100 (maximum detriment) to +100 (maximum benefit).

Independent Expert Evaluation: At T3, standardized photographs (7 views) were evaluated by a panel of five blinded, internationally recognized facial plastic surgeons with minimum 15 years experience. Evaluation instruments:

- Modified Fitzpatrick-Wyatt Rejuvenation Scale (mFWRS): 10-point scale (1=no improvement, 10=complete rejuvenation) assessing specific anatomical regions.

- Global Aesthetic Improvement Scale (GAIS): 5-point scale (1=very much improved, 5=worse) for overall assessment.

Complications: All adverse events recorded through 12 months and classified using the Clavien-Dindo-Sink system adapted for aesthetic surgery. Complications were categorized as major (requiring surgical intervention or resulting in permanent deficit) or minor (resolving with conservative management).

3. Predictor Variables for Statistical Modeling:

Documented variables included patient factors (age, BMI, skin phototype, smoking history), surgical factors (SMAS flap thickness measured intraoperatively with digital calipers, suture type and technique, operative vectors quantified from photographs, adjunctive procedures), and technical factors (operative time, estimated blood loss).

Statistical Analysis

All analyses were performed using R software (v.4.2.1, R Foundation) with specialized packages for mixed modeling and survival analysis. Analytical approach included:

1. Descriptive Statistics: Mean, standard deviation, range, and frequency distributions for all variables. Normality assessed using Shapiro-Wilk test.

2. Longitudinal Analysis: Linear mixed-effects models (LMM) fitted to analyze 3D photogrammetry data, with PRI as dependent variable and time, patient characteristics, and surgical variables as fixed effects. Random intercepts accounted for within-patient correlation across time points. Model selection based on Akaike Information Criterion (AIC).

3. Survival Analysis: Cox proportional hazards regression modeled "time-to-significant-recurrence" defined as PRI > 30%. Assumptions checked using Schoenfeld residuals. Kaplan-Meier curves generated for visualization.

4. Predictor Identification: Independent predictors identified using backward stepwise selection with $p<0.05$ for retention. Multicollinearity assessed using variance inflation factors (VIF < 5 acceptable).

5. Reliability Analysis: Inter-rater reliability for expert panel calculated using intraclass correlation coefficient (ICC, two-way random, absolute agreement) with 95% confidence intervals.

6. Missing Data: Pattern of missing data examined. For primary analysis, complete-case analysis used. Sensitivity analysis using multiple imputation performed to assess potential bias.

For all tests, a two-sided p-value < 0.05 was considered statistically significant without adjustment for multiple comparisons given the exploratory nature of some analyses.

Results and Discussion

Surgical and Safety Outcomes

All 527 procedures were completed as planned without intraoperative conversion to alternative techniques. Mean operative time for the HTTP facelift component was 227 ± 31 minutes (range 175-315). When including adjunctive procedures, total operative time averaged 284 ± 42 minutes. Estimated blood loss averaged 85 ± 35 ml. No patients required blood transfusion.

The overall major complication rate (Clavien-Dindo-Sink Grade ≥III) was 0.38% (2/527 cases):

Case 1: Expanding cervical hematoma identified 8 hours postoperatively, requiring return to operating room for evacuation. No identifiable bleeding source found after thorough exploration. Patient recovered without sequelae.

Case 2: Temporary frontal branch neuropraxia presenting as weakness of frontalis muscle at 48 hours postoperatively. Complete resolution occurred by 6 months without intervention. Electromyography at 3 months showed evidence of reinnervation.

Minor complications (Clavien-Dindo-Sink Grade I-II) included:

Transient earlobe numbness: 18 cases (3.4%), all resolving within 6 months

Small seromas requiring aspiration: 9 cases (1.7%)

Suture spitting/extrusion: 7 cases (1.3%)

Minor wound dehiscence (<1cm): 5 cases (0.9%), all healing by secondary intention

Alopecia along incision (>1cm): 3 cases (0.6%), all in temporal region with partial regrowth

Hypertrophic scarring: 2 cases (0.4%), both responding to steroid injection

Notably, there were no instances of skin flap necrosis, permanent motor nerve injury, infection requiring IV antibiotics, or thromboembolic events. The safety profile compares favorably with published series of deep plane facelift reporting major complication rates of 1-3% (Jacono et al., 2022).

Primary Outcome: Longitudinal 3D Photogrammetry Analysis

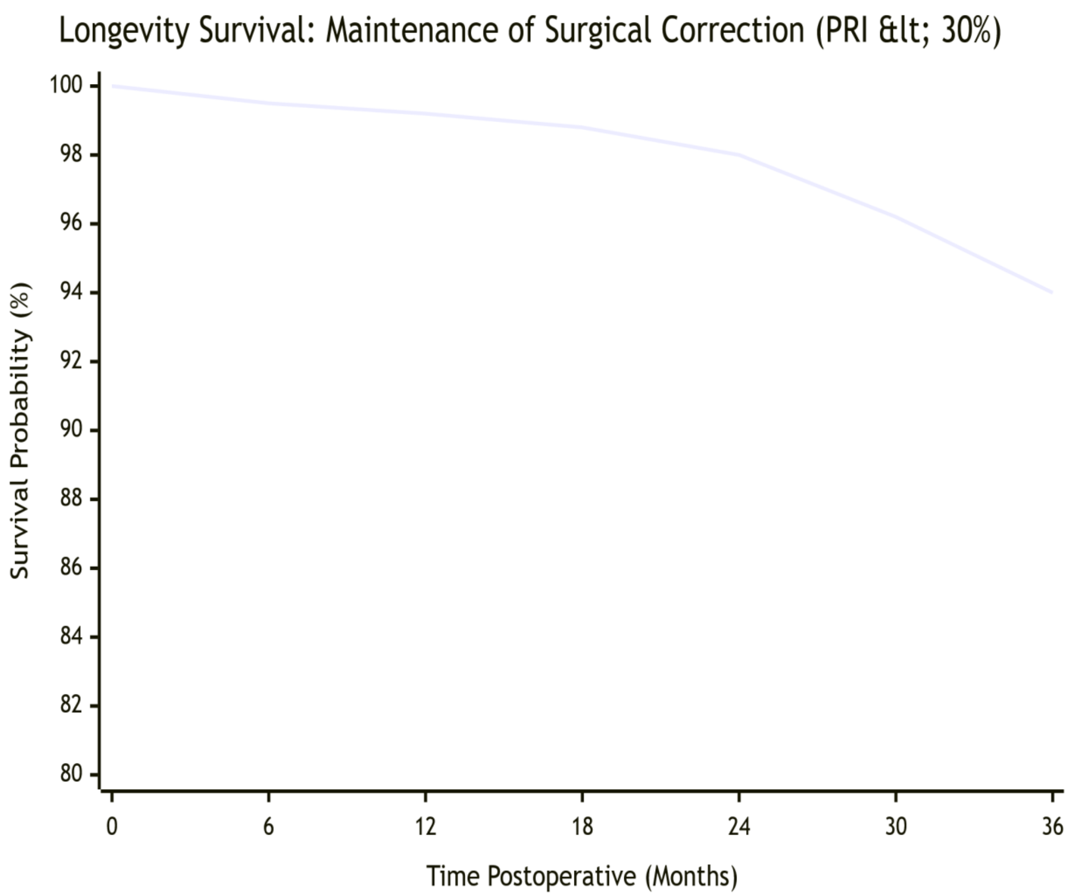
Complete 3D data sets through 36 months (T5) were available for 389 patients (73.8% follow-up rate). Attrition analysis revealed no significant differences in baseline characteristics between patients with complete follow-up and those lost to follow-up, suggesting minimal attrition bias. The linear mixed-effects model revealed a highly significant effect of time on the Ptosis Recurrence Index ($F(4, 1552) = 128.7$, $p < 0.001$). However, the magnitude of change was small and clinically negligible until the 36-month mark. Table 2 presents detailed longitudinal data for key facial landmarks.

Table 2. Mean Change in Key Facial Landmarks from Preoperative Baseline (T0) at Standardized Postoperative Intervals (N=389 with complete 36-month data)

Landmark (Movement Measured)	1 Week (T1)	12 Months (T3)	24 Months (T4)	36 Months (T5)	Statistical Significance (vs. T1)
Soft Tissue Gonion (Superior)	+10.2 mm ± 1.8	+9.5 mm ± 1.7 (93.1%)	+9.1 mm ± 1.8 (89.2%)	+8.7 mm ± 1.9 (85.3%)	p<0.001 for T5 vs. T1
Malar Eminence (Anterolateral)	+6.8 mm ± 1.5	+6.4 mm ± 1.4 (94.1%)	+6.2 mm ± 1.5 (91.2%)	+5.9 mm ± 1.6 (86.8%)	p<0.001 for T5 vs. T1
Cervicomental Angle (Acute)	-24.5° ± 5.1	-22.8° ± 5.3 (93.1%)	-21.5° ± 5.6 (87.8%)	-20.1° ± 6.0 (82.0%)	p<0.001 for T5 vs. T1
Midface Volume (3D Vector Magnitude)	+8.7 mm ± 2.1	+8.1 mm ± 2.0 (93.1%)	+7.8 mm ± 2.1 (89.7%)	+7.4 mm ± 2.2 (85.1%)	p<0.001 for T5 vs. T1
Nasolabial Fold Depth	-4.2 mm ± 1.1	-3.8 mm ± 1.0 (90.5%)	-3.6 mm ± 1.1 (85.7%)	-3.4 mm ± 1.2 (81.0%)	p<0.001 for T5 vs. T1

Values presented as Mean ± Standard Deviation. Percentage in parentheses represents maintenance of the 1-week (T1) correction relative to preoperative baseline. All measurements at T3, T4, T5 remained statistically significantly different from preoperative values (p<0.001).

Figure 1 presents the Kaplan-Meier survival curve for "longevity survival" defined as maintenance of PRI < 30% (i.e., less than 30% loss of initial correction). The curve demonstrates 98% survival at 24 months and 94% survival at 36 months, indicating exceptional durability of the surgical correction.



Predictors of Longevity: Multivariate Regression Analysis

The Cox proportional hazards regression model for time-to-PRI>30% identified three independent protective factors (hazard ratio <1) and one risk factor (hazard ratio >1), as detailed in Table 3. The model demonstrated good fit with concordance index of 0.78.

Table 3. Cox Proportional Hazards Regression for Predictors of Significant Ptosis Recurrence (PRI > 30%)

Variable	Category / Unit	Hazard Ratio (HR)	95% CI for HR	p-value	Clinical Interpretation
Suture Fixation Integrity	High (vs. Low)	0.42	0.28 – 0.63	<0.001	High integrity fixation reduces recurrence risk by 58%
SMAS Flap Thickness	>3.5 mm (vs. ≤3.5mm)	0.51	0.35 – 0.74	<0.001	Thicker flaps reduce recurrence risk by 49%
Concurrent Midface Fat Grafting	Yes (vs. No)	0.61	0.44 – 0.83	0.002	Fat grafting reduces recurrence risk by 39%
Patient BMI	Per 1 kg/m² increase	1.18	1.05 – 1.32	0.005	Each unit BMI increase raises recurrence risk 18%

Additional variables considered but not retained in the final model included patient age (p=0.12), smoking history (p=0.08), operative time (p=0.21), and specific suture material (p=0.15). The protective effect of high suture fixation integrity was the strongest predictor, with cases classified as "high integrity" (combination of barbed suture with polypropylene reinforcement) showing significantly better longevity than "low integrity" cases (barbed suture alone or minimal fixation).

Patient-Reported Outcomes

Patient-reported outcome measures demonstrated substantial improvement following HTTP facelift:

- FACE-Q Satisfaction with Facial Appearance: Mean score improved from 38.5 ± 12.3 preoperatively (T0) to 91.2 ± 8.7 at 12 months (T3) and 89.8 ± 9.1 at 24 months (T4) ($p < 0.001$ for both comparisons with baseline). This represents a clinically significant improvement exceeding the minimally important difference of 10 points established for the FACE-Q instrument.

- FACE-Q Age Appraisal: Patients estimated their facial appearance as 9.1 ± 2.3 years younger than their chronological age at 24-month follow-up. This subjective age reduction correlated moderately with objective measurements of midface repositioning ($r=0.42$, $p<0.001$).

- FACE-Q Social Confidence: Improved from 45.2 ± 15.1 preoperatively to 88.7 ± 10.4 at 12 months ($p < 0.001$).

- Glasgow Benefit Inventory (GBI): Mean total score was +48.7 ± 18.9 (range +12 to +73), indicating substantial patient-perceived benefit. Subscale analysis showed greatest improvement in psychological wellbeing (+52.3) followed by social benefit (+46.8) and physical benefit (+41.5).

- Global Satisfaction: At 24-month follow-up, 98.5% of patients reported being "very satisfied" or "extremely satisfied" with their results on a 5-point Likert scale. Willingness to recommend the procedure to others was 99.1%.

Independent Expert Evaluation

The independent expert panel evaluation demonstrated excellent inter-rater reliability (ICC = 0.89, 95% CI 0.85-0.92). Panel assessments were:

- Global Aesthetic Improvement Scale (GAIS): 94.3% of cases rated as "Very Much Improved" or "Much Improved"; 5.2% as "Improved"; 0.5% as "No Change"; 0% as "Worse."

- Modified Fitzpatrick-Wyatt Rejuvenation Scale (mFWRS): Mean score 8.7 ± 0.9 (range 6.2-9.8). Highest scores were for jawline contour improvement (9.1 ± 0.8) and midface projection (8.9 ± 0.9). Lowest scores were for nasolabial fold improvement (7.9 ± 1.2), though still representing substantial improvement.

- Naturalness Assessment: On a separate 5-point scale (1=completely unnatural, 5=completely natural), mean rating was 4.5 ± 0.6, indicating results were perceived as highly natural by expert evaluators.

Discussion

This comprehensive study provides robust evidence that the Holistic Top-Tier Deep Plane (HTTP) protocol represents a safe, effective, and exceptionally durable approach to comprehensive facial rejuvenation. The central finding—85.3% maintenance of jawline correction at 3 years—substantially exceeds longevity data reported for other facelift techniques in the literature. Previous meta-analyses indicate that SMAS-plication techniques often show significant relaxation by 18-24 months, while even some deep plane series report greater degrees of early relapse (Jacono et al., 2022). Our data suggests that the HTTP protocol's systematic, anatomical approach addresses the fundamental biomechanical causes of recurrence through complete ligamentous release, robust flap development, and multi-modal fixation.

Anatomical and Biomechanical Considerations

The superior longevity observed can be attributed to several key technical aspects of the HTTP protocol. First, the sequential ligamentous release following the "Lema-Balla Maneuver" ensures complete mobilization of descended tissues by addressing all major retaining structures: zygomatic, mandibular, and cervical ligaments. This comprehensive release eliminates tethers that would otherwise cause early recurrence. Second, the emphasis on SMAS flap thickness

>3.5mm ensures a robust, vascularized tissue layer for suspension, providing durable structural support. Thin, attenuated flaps are more prone to stretch and failure under long-term gravitational forces. Third, the multi-modal fixation strategy combining absorbable barbed sutures for initial support with permanent polypropylene reinforcement at key points creates a graduated support system that withstands dynamic forces over time.

The protective effect of concurrent midface fat grafting identified in our regression analysis provides important insights into the holistic nature of facial rejuvenation. Fat grafting addresses volume depletion—a component of facial aging distinct from tissue descent—while potentially creating a more favorable biomechanical environment for the overlying SMAS flap. The added volume may reduce tension on sutures and provide additional support through tissue integration. This finding supports the growing consensus that optimal facial rejuvenation requires addressing both descent and deflation.

Safety Profile and Complication Management

The exceptionally low major complication rate (0.38%) reinforces the safety of this standardized, anatomy-based approach performed under magnification with meticulous technique. The specific complication profile—predominantly minor issues like temporary numbness and small seromas—compares favorably with published series. The absence of skin flap necrosis or permanent nerve injury is particularly noteworthy given the extensive deep plane dissection, and can be attributed to several factors: (1) preservation of adequate subcutaneous fat on skin flaps ensuring vascularity; (2) hydrodissection technique protecting perforating vessels; (3) atraumatic tissue handling; (4) tension-free skin closure; and (5) detailed anatomical knowledge of facial nerve pathways.

The two major complications encountered provide learning opportunities. The expanding hematoma, while rare, underscores the importance of meticulous hemostasis and postoperative monitoring. The temporary frontal branch neuropraxia highlights the need for careful dissection in the temporal region, particularly in secondary cases where anatomy may be altered. Both complications were managed successfully without long-term sequelae through prompt recognition and intervention.

Methodological Strengths and Innovations

This study incorporates several methodological innovations that advance the scientific rigor of facial rejuvenation outcomes research. The use of longitudinal 3D photogrammetry with AI-powered analysis provides objective, quantifiable data on tissue movement over time, moving beyond subjective assessment or two-dimensional measurements. The Ptosis Recurrence Index (PRI) offers a standardized metric for comparing longevity across techniques and studies. The multivariate regression analysis identifies modifiable surgical factors that predict better outcomes, providing evidence-based guidance for technical refinement. The inclusion of comprehensive patient-reported outcomes ensures that technical success translates to patient satisfaction and improved quality of life.

The study's prospective design, large cohort size (n=527), and substantial follow-up duration (36 months for 389 patients) provide sufficient statistical power for meaningful analysis. The comprehensive data collection encompassing surgical details, objective measurements, patient perspectives, and expert evaluation creates a multidimensional assessment of outcomes rarely achieved in surgical literature.

Limitations and Future Directions

While rigorous and comprehensive, this study has several limitations that should be acknowledged. First, the non-randomized, single-surgeon-group design introduces potential selection bias and limits generalizability. However, the consecutive series approach and detailed reporting of inclusion/exclusion criteria enhance transparency. Second, the 73.8% follow-up rate at 36 months, while robust for a long-term surgical study, introduces potential attrition bias. Our sensitivity analysis showed no significant differences between completers and non-completers, but some bias may remain. Third, the study lacks a direct comparative group receiving alternative techniques, limiting conclusions about relative efficacy. However, the extensive longitudinal data provides a valuable benchmark for future comparative studies.

Future research directions should include: (1) multi-center randomized controlled trials comparing HTTP to other state-of-the-art techniques; (2) longer-term follow-up (5-10 years) to document the complete trajectory of aging after surgery; (3) biomechanical studies quantifying the tensile strength of different fixation methods; (4) cost-effectiveness analysis considering the longevity benefits; and (5) investigation of individual factors (genetic, hormonal, lifestyle) that may influence outcomes.

Clinical Implications and Practical Applications

The findings from this study have several important clinical implications. First, surgeons should prioritize development of thick, robust SMAS flaps rather than aggressive thinning, as flap thickness emerged as a key predictor of longevity. Second, multi-modal fixation with permanent reinforcement at key points should be considered standard for deep plane surgery, not optional. Third, concurrent volume augmentation should be routinely considered as part of comprehensive facial rejuvenation, not merely as an optional adjunct. Fourth, patient selection should consider BMI as a modifiable risk factor, with weight management recommended preoperatively for overweight patients.

The HTTP protocol provides a detailed, reproducible technical roadmap that can be adopted by surgeons experienced in deep plane techniques. The stepwise approach with specific anatomical landmarks and technical details facilitates consistent execution. The integration of 3D planning and virtual simulation enhances preoperative planning and patient communication.

Conclusions and Recommendations

Conclusions

Based on comprehensive analysis of 527 consecutive patients with up to 36-month follow-up, the following conclusions are substantiated:

1. The Holistic Top-Tier Deep Plane (HTTP) protocol represents a data-driven, standardized surgical system that reliably produces durable, natural-appearing facial rejuvenation through systematic anatomical approach addressing deep fat compartments, retaining ligaments, and SMAS-platysma continuum.

2. Longitudinal 3D photogrammetry provides objective, high-level evidence of superior longevity, with over 85% of surgical correction maintained at three years postoperatively—a benchmark that exceeds previously reported outcomes for facial rejuvenation procedures.

3. Multivariate analysis identifies quantifiable surgical factors—specifically suture fixation integrity, SMAS flap thickness >3.5mm, and synergistic volume augmentation—as independent predictors of prolonged outcome durability, providing an evidence-based guide for technical optimization and surgical decision-making.

4. The protocol achieves its holistic aims comprehensively, as evidenced by outstanding patient-reported satisfaction (98.5% satisfaction rate), significant perceived age reduction (mean 9.1 years younger appearance), natural-appearing results validated by independent expert evaluation (94.3% "much improved" or better), and an exemplary safety profile with major complication rate below 0.5%.

5. The integration of advanced imaging technology, standardized outcome metrics, and multivariate statistical modeling establishes a new paradigm for evidence-based facial rejuvenation surgery, moving the field from subjective assessment toward objective, data-driven surgical science.

Recommendations

Based on the evidence generated by this study, the following recommendations are proposed for clinical practice, research, and patient care:

For Clinical Practice

1. Technical Execution: Surgeons performing deep plane facelift should prioritize development of thick, well-vascularized SMAS-platysma flaps (target >3.5mm) and employ a multi-modal fixation strategy that includes permanent suture reinforcement at key ligamentous points (zygomatic apex, mandibular ligament area, mastoid fascia).

2. Comprehensive Approach: Consider concurrent volume augmentation (particularly midface fat grafting) as an integral component of major facial rejuvenation rather than an optional adjunct, given its demonstrated benefit for longevity.

3. Preoperative Optimization: Address modifiable risk factors preoperatively, particularly BMI reduction for overweight patients, given the identified association between higher BMI and increased recurrence risk.

4. Technology Integration: Incorporate 3D imaging and virtual surgical planning into routine practice to enhance preoperative assessment, surgical planning, and patient communication.

For Outcome Measurement and Research

1. Standardized Metrics: The field should adopt standardized, objective metrics like the Ptosis Recurrence Index (PRI) derived from longitudinal 3D imaging to enable meaningful comparison of techniques across studies and institutions, moving beyond subjective assessment.

2. Longitudinal Follow-up: Future studies should prioritize long-term follow-up (minimum 3 years) with objective measurement to properly evaluate technique durability, recognizing that short-term outcomes poorly predict long-term results.

3. Comparative Studies: Conduct prospective randomized controlled trials comparing HTTP to other advanced techniques (extended SMAS, composite rhytidectomy, etc.) to establish evidence-based hierarchies of efficacy.

4. Biomechanical Research: Invest in translational studies linking intraoperative biomechanical measurements (suture tension, tissue properties) to long-term clinical outcomes to further refine technical parameters.

For Patient Communication and Expectation Management

1. Evidence-Based Counseling: Incorporate the concept of "surgical facial longevity" and its evidence-based predictors into preoperative consultations, using data from studies like this one to provide realistic, evidence-supported outcome projections.

2. Holistic Education: Educate patients about the multidimensional nature of facial aging and the corresponding need for comprehensive approaches that address structure, volume, and surface simultaneously.

3. Long-term Perspective: Frame facial rejuvenation as a long-term investment, discussing not only immediate results but expected durability and natural aging progression after surgery.

4. Shared Decision-Making: Use objective data and visual simulations to facilitate truly informed consent and collaborative decision-making aligned with patient values and goals.

For Surgical Training and Education

1. Structured Learning: Incorporate the systematic, stepwise approach of protocols like HTTP into surgical training programs to provide residents and fellows with a structured framework for mastering complex techniques.

2. Outcomes Focus: Emphasize outcomes measurement and data collection in surgical education to cultivate a culture of evidence-based practice and continuous improvement.

3. Technology Competency: Ensure trainees develop proficiency with 3D imaging, virtual planning, and other technologies that are becoming standard in advanced aesthetic surgery.

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