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REVIEW ARTICLE

ADVANCES IN FACELIFT SURGERY: A SCOPING REVIEW OF SURGICAL TECHNIQUES, CLINICAL OUTCOMES, COMPLICATIONS, AND FUTURE PERSPECTIVES

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Abstract

Background: Facial aging is a multifactorial process characterized by skin laxity, soft tissue descent, volume loss, and weakening of the superficial musculoaponeurotic system (SMAS). Rhytidectomy (facelift surgery) remains the gold standard for the correction of moderate-to-severe facial aging. Over the past two decades, advances in surgical techniques—particularly SMAS-based procedures—have significantly improved aesthetic outcomes while maintaining facial harmony and reducing complications. Despite the growing number of published studies, a comprehensive synthesis of current evidence regarding facelift techniques, clinical outcomes, and postoperative complications is warranted.

Objective: This scoping review aimed to summarize and map the current evidence on facelift surgery, including surgical approaches, indications, contraindications, perioperative management, clinical outcomes, complications, and future directions in facial rejuvenation.

Methods:A scoping review methodology was designed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines. Electronic databases including PubMed/MEDLINE, Scopus, Web of Science, and Embase were searched for English-language publications. Original clinical studies, systematic reviews, meta-analyses, and consensus statements evaluating facelift procedures were considered eligible. Data regarding patient characteristics, operative techniques, postoperative outcomes, complications, and long-term effectiveness were extracted and synthesized narratively.

Results: Current evidence indicates that SMAS-based facelift techniques provide superior and longer-lasting aesthetic outcomes compared with skin-only facelift procedures. Deep-plane and composite facelift approaches demonstrate enhanced correction of midface ptosis and nasolabial folds while preserving natural facial contours. Endoscopic techniques offer shorter recovery periods and reduced postoperative morbidity in carefully selected patients. The most frequently reported complications include hematoma, seroma, transient facial nerve dysfunction, infection, skin flap necrosis, hypertrophic scarring, and prolonged edema, whereas permanent functional deficits remain uncommon when surgery is performed by experienced surgeons. Long-term patient satisfaction is consistently high, with rejuvenation effects commonly maintained for 8–12 years.

Conclusions: Modern facelift surgery has evolved into a safe and highly effective procedure for facial rejuvenation through the restoration of both superficial and deep facial support structures. SMAS-based techniques currently represent the standard of care because they provide durable, natural-appearing outcomes with acceptable complication rates. Future research should focus on standardized outcome reporting, patient-reported quality-of-life measures, and the integration of regenerative medicine and minimally invasive technologies to further optimize surgical results.

Keywords: facelift; rhytidectomy; SMAS facelift; facial rejuvenation; deep-plane facelift; facial aging; plastic surgery; aesthetic surgery

1. INTRODUCTION

Facial aging is a complex and progressive biological process that involves structural, functional, and aesthetic changes affecting multiple anatomical layers of the face. Traditionally, facial aging was considered primarily a consequence of skin laxity; however, contemporary anatomical studies have demonstrated that aging involves progressive alterations of the skin, superficial musculoaponeurotic system (SMAS), retaining ligaments, facial fat compartments, muscles, and underlying skeletal structures. These combined changes contribute to soft tissue descent, loss of facial volume, deepening of facial folds, development of jowls, and deterioration of the cervicomental contour [1–4].

Understanding the multidimensional nature of facial aging has fundamentally changed the principles of surgical facial rejuvenation, shifting the focus from simple skin tightening toward restoration of facial anatomy and preservation of natural appearance. Rhytidectomy, commonly known as facelift surgery, remains the most effective surgical procedure for correcting moderate-to-severe age-related changes of the face and neck. Since the early descriptions of facelift techniques, surgical approaches have continuously evolved in response to improved anatomical knowledge and increasing patient expectations for natural and long-lasting outcomes. Early facelift procedures relied predominantly on skin excision and elevation, which could provide temporary improvement but were associated with increased skin tension, recurrence of laxity, and occasionally unnatural facial appearance. The introduction of deeper tissue manipulation represented a major advancement in facial rejuvenation surgery [5, 6].

A significant milestone in the evolution of facelift surgery was the anatomical recognition of the superficial musculoaponeurotic system (SMAS) as a key structural component of facial soft tissues. Improved understanding of facial layers and supporting structures demonstrated that deeper tissues could be safely mobilized and repositioned during surgery. The development of SMAS-based facelift techniques allowed redistribution of tension from the skin to deeper anatomical structures, contributing to improved durability and more harmonious aesthetic outcomes. Since then, multiple refinements, including SMAS plication, SMASectomy, extended SMAS facelift, high-SMAS approaches, and deep-plane facelift techniques, have been developed to address different patterns of facial aging and soft tissue descent [3–6].

The deep-plane facelift further advanced the concept of anatomical repositioning by allowing mobilization of deeper facial tissues as a composite skin–SMAS unit and by incorporating controlled release of retaining ligaments. This approach improved correction of midface descent, nasolabial fold prominence, and lower facial laxity while reducing reliance on skin tension. Subsequent refinements of deep-plane and extended SMAS techniques have focused on achieving predictable rejuvenation, maintaining facial dynamics, and avoiding an overcorrected or operated appearance. Current evidence suggests that these advanced techniques can provide substantial improvement in appropriately selected patients; however, surgical planning should be individualized according to facial anatomy, degree of soft tissue ptosis, skin characteristics, and surgeon experience [4–6].

Modern facelift surgery is increasingly based on the concept of comprehensive facial rejuvenation rather than isolated lifting. Aging-related volume loss and changes in facial fat compartments have encouraged the incorporation of adjunctive procedures, including autologous fat grafting, neck contouring, platysmaplasty, eyelid surgery, brow lifting, and skin resurfacing techniques. These combined approaches aim to restore youthful facial proportions while preserving individual characteristics and avoiding excessive correction [7–9]. The contemporary objective of facelift surgery is therefore not simply to tighten tissues but to recreate balanced anatomical relationships between facial structures.

Despite major improvements in surgical techniques, facelift surgery remains one of the most technically demanding procedures in aesthetic surgery. Successful outcomes require detailed knowledge of facial anatomy, careful patient selection, appropriate surgical planning, and meticulous postoperative management. Potential complications include hematoma, seroma, infection, skin flap necrosis, temporary or permanent facial nerve dysfunction, alopecia at incision sites, hypertrophic scarring, prolonged edema, and asymmetry[10-12]. Although serious complications are uncommon in experienced hands, they remain clinically important because they may negatively affect patient satisfaction and quality of life.

Patient expectations have also changed significantly in recent years. Individuals seeking facial rejuvenation increasingly desire subtle, natural-looking improvements rather than dramatic changes. This shift has encouraged surgeons to develop techniques that preserve facial identity, minimize visible signs of surgery, and provide long-term but natural results. Patient-reported outcome measures and quality-of-life assessments have become increasingly important tools for evaluating the effectiveness of facelift procedures beyond traditional surgeon-based aesthetic assessment [13–16].

Although numerous studies have investigated individual facelift techniques, variability remains regarding surgical terminology, outcome assessment methods, follow-up duration, and reporting of complications. The absence of standardized evaluation criteria makes direct comparison between different facelift approaches challenging. Therefore, a comprehensive mapping of current evidence is necessary to clarify the advantages, limitations, and clinical applications of modern facelift techniques [17].

The objective of this scoping review is to systematically map the available literature on contemporary facelift surgery, including surgical approaches, anatomical principles, clinical indications, outcomes, complications, and future perspectives. By summarizing current evidence, this review aims to provide an updated overview of the evolution of facelift surgery and identify areas requiring further investigation to improve safety, reproducibility, and patient satisfaction.

2. MATERIALS AND METHODS

2.1. Study Design and Methodological Framework

This scoping review was conducted to map the existing evidence regarding contemporary facelift surgery techniques, anatomical principles, clinical outcomes, complications, and future perspectives in facial rejuvenation. The methodology was developed based on the framework originally proposed by Arksey and O'Malley and further enhanced by Levac et al. for conducting scoping reviews. The review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines to ensure methodological transparency, reproducibility, and standardized reporting [18,19].

A scoping review approach was selected because the available literature on facelift surgery includes a broad range of study designs, including anatomical investigations, technical reports, retrospective clinical studies, prospective studies, systematic reviews, and expert consensus articles. Unlike systematic reviews focused on narrowly defined clinical questions, scoping reviews are particularly suitable for exploring heterogeneous evidence, identifying knowledge gaps, and describing the evolution of surgical techniques and concepts.

2.2. Review Question and Objectives

The primary research question was formulated as follows:

What is the current evidence regarding surgical techniques, clinical outcomes, complications, and future directions in modern facelift surgery?

The specific objectives were:

1. To identify and categorize contemporary facelift techniques, including SMAS facelift, extended SMAS facelift, deep-plane facelift, composite facelift, and minimally invasive approaches.
2. To evaluate reported clinical outcomes and long-term effectiveness of different surgical techniques.
3. To summarize commonly reported postoperative complications and safety considerations.
4. To identify current limitations in facelift research and areas requiring further investigation.

2.3. Search Strategy

A comprehensive literature search was conducted in PubMed/MEDLINE, Scopus, Web of Science Core Collection, and Embase databases to identify studies evaluating contemporary facelift surgery techniques and clinical outcomes.

The search strategy combined Medical Subject Headings (MeSH) terms and free-text keywords related to facelift surgery. The following key terms were used individually and in combination: "facelift," "rhytidectomy," "face lift," "SMAS facelift," "deep plane facelift," "extended SMAS," "facial rejuvenation," "facelift outcomes," and "facelift complications." Boolean operators (AND/OR) were applied to optimize retrieval of relevant publications. Only studies published in English and involving adult human participants were included. Reference lists of relevant articles and previous reviews were additionally screened to identify studies not captured through electronic database searches.

2.4. Eligibility Criteria

Studies were considered eligible according to predefined inclusion and exclusion criteria.

Inclusion criteria:

- Original research articles evaluating facelift or rhytidectomy procedures;
- Anatomical studies related to facelift surgery;
- Clinical studies reporting surgical outcomes, patient satisfaction, or complications;
- Systematic reviews, narrative reviews, and expert consensus publications;
- Studies published in the English language;
- Publications involving adult human participants.

Exclusion criteria:

- Studies unrelated to surgical facial rejuvenation;
- Non-human studies;
- Conference abstracts without full-text availability;
- Publications without sufficient methodological information;
- Articles focusing exclusively on nonsurgical facial rejuvenation techniques, injectables, or cosmetic products.

2.5. Study Selection Process

After removal of duplicate records, titles and abstracts were screened independently for relevance according to the predefined eligibility criteria. Potentially relevant articles were subsequently assessed through full-text review.

The study selection process followed the PRISMA-ScR framework, documenting the number of identified, screened, included, and excluded studies. Disagreements regarding study eligibility were resolved through discussion and consensus.

2.6. Data Extraction and Charting

A standardized data extraction form was developed to collect relevant information from included studies. The following data were extracted:

- publication characteristics (author, year, country, study design);
- patient demographics and sample size;
- facelift technique performed;
- anatomical level of intervention;
- surgical indications;
- follow-up duration;
- reported aesthetic outcomes;
- patient satisfaction measures;
- postoperative complications;
- limitations and recommendations for future research.

Data extraction was performed in a structured manner to allow comparison between different surgical approaches and identify trends in modern facelift practice.

2.7. Data Synthesis

Due to the expected heterogeneity of included studies, a quantitative meta-analysis was not planned. Instead, extracted data were synthesized using a narrative approach.

The findings were organized into major thematic categories:

1. Evolution of facelift techniques;
2. Anatomical principles of SMAS-based procedures;
3. Clinical effectiveness and durability of outcomes;
4. Safety profile and complications;
5. Emerging technologies and future directions.

This approach allowed comprehensive mapping of current evidence while highlighting areas where further high-quality research is required.

2.8. Ethical Considerations

As this study involved analysis of previously published literature and did not include direct involvement of human participants or identifiable patient data, ethical approval was not required.

3.1. Literature Search Results

The systematic search process identified a total of 198 records from electronic databases and additional reference screening. Database searching retrieved 186 publications, including 62 records from PubMed/MEDLINE, 54 from Scopus, 41 from Web of Science, and 29 from Embase. An additional 12 records were identified through manual screening of reference lists from relevant reviews and key publications. After removal of duplicate records, 142 unique publications remained for title and abstract screening.

During the screening phase, 67 records were excluded because they did not address surgical facelift procedures, involved non-human studies, were not published in English, represented conference abstracts only, or lacked sufficient clinical information.

A total of 75 full-text articles were assessed for eligibility. Thirty articles were excluded after full-text evaluation because they did not specifically investigate facelift techniques, focused exclusively on nonsurgical facial rejuvenation, lacked clinical outcome data, or represented overlapping patient cohorts. Finally, 45 studies met the predefined inclusion criteria and were included in the qualitative synthesis of this scoping review. The included evidence consisted of anatomical investigations, technical descriptions, clinical outcome studies, systematic reviews, and expert consensus publications. The selected studies provided comprehensive information regarding the evolution of facelift techniques, anatomical principles, surgical approaches, clinical outcomes, and postoperative complications. The complete study identification, screening, eligibility assessment, and inclusion process is presented in the PRISMA-ScR flow diagram (Figure 1).

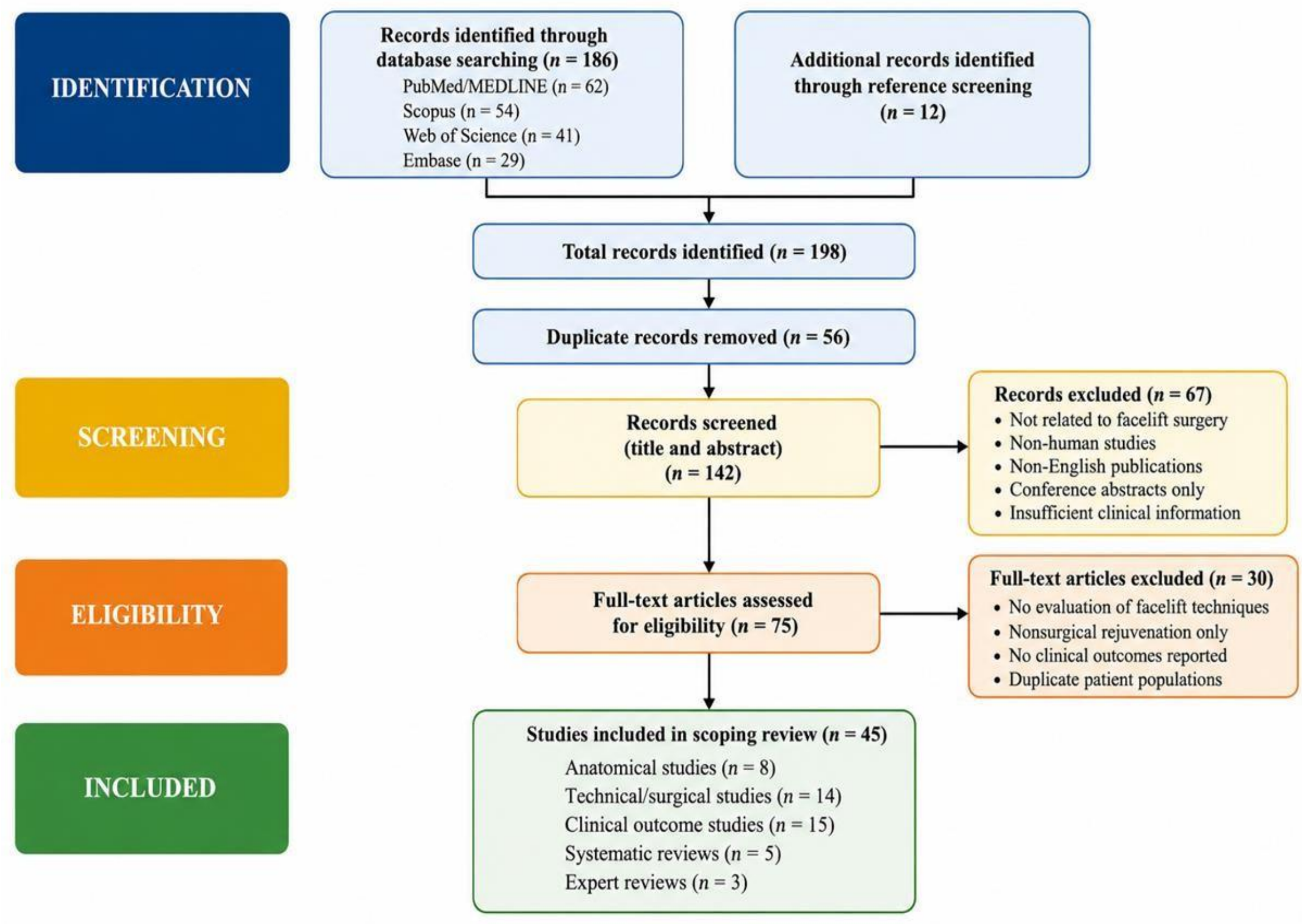

Figure 1. PRISMA-ScR flow diagram illustrating the study identification, screening, eligibility assessment, and inclusion process of studies included in the scoping review.

3.2. Evolution of Facelift Techniques

Facelift surgery has undergone remarkable evolution over the past century, progressing from procedures aimed solely at correcting superficial skin laxity to sophisticated operations that restore the three-dimensional architecture of the aging face. Each successive generation of facelift techniques has been developed to overcome the limitations of previous approaches, resulting in improved aesthetic outcomes, greater longevity, and more natural facial rejuvenation [5].

The earliest facelift procedures, performed during the first half of the twentieth century, were based almost exclusively

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on subcutaneous skin undermining followed by excision of redundant skin. These operations successfully reduced visible wrinkles and skin redundancy but failed to correct age-related descent of the deeper facial soft tissues. Because tissue support depended primarily on skin closure, excessive wound tension frequently resulted in widened scars, distortion of the hairline and earlobe, prolonged postoperative edema, and relatively short-lived aesthetic improvement. These limitations stimulated the development of techniques capable of addressing the structural causes of facial aging rather than merely its superficial manifestations [20–22].

The major milestones in the evolution of facelift techniques, from early skin-only procedures to contemporary multimodal approaches, are summarized in Table 1.

Table 1. Milestones in the Evolution of Facelift Techniques

Technique	Period of Introduction	Key Innovation	Principal Clinical Benefit	Main Limitation
Skin-only facelift	Early 20th century	Skin excision and redraping	Improved correction of superficial skin laxity	High skin tension and limited longevity
Subcutaneous facelift	Mid-20th century	Wider skin undermining and redraping	Improved facial contour correction	Limited correction of deep tissue descent
SMAS facelift	Late 1970s	Repositioning of the superficial musculoaponeurotic system	More natural facial contour and reduced tension on skin closure	Increased technical complexity
SMAS modifications (plication/SMASectomy)	1980s–1990s	Different methods of SMAS manipulation and reinforcement	Greater adaptability according to patient anatomy	Variable long-term outcomes depending on technique
Extended SMAS facelift	1990s	Wider mobilization of SMAS and facial soft tissues	Enhanced correction of lower facial and cervical aging	Longer operative time and greater technical demands
Deep-plane facelift	1990s–present	Composite mobilization of skin and deeper facial tissues	Improved midface rejuvenation, jawline definition, and durable outcomes	Technically demanding procedure requiring advanced anatomical expertise
Contemporary multimodal facelift	2000s–present	Combination of lifting procedures with volume restoration and regenerative approaches	Comprehensive and individualized facial rejuvenation	Requires careful patient selection and advanced surgical expertise

A major turning point occurred following the description of the superficial musculoaponeurotic system (SMAS), which fundamentally changed the philosophy of facial rejuvenation. Instead of relying solely on skin tightening, surgeons increasingly focused on repositioning the deeper soft tissues responsible for facial contour and structural support. This conceptual shift enabled more effective correction of facial ptosis while reducing tension on skin closure, thereby improving scar quality and producing more natural postoperative results. SMAS surgery rapidly became the foundation of modern rhytidectomy and remains one of the most influential innovations in aesthetic facial surgery [3,6].

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Subsequent refinements led to the development of several SMAS-based techniques designed to balance surgical effectiveness with procedural complexity. SMAS plication provided a relatively conservative approach by reinforcing the fascial layer without extensive dissection, whereas SMASectomy involved partial excision of the SMAS to achieve stronger tissue repositioning. Extended SMAS procedures further increased the degree of tissue mobilization, allowing improved correction of lower facial and cervical aging. These modifications expanded the surgical armamentarium and enabled procedure selection according to the severity of aging changes and individual patient characteristics [3,20,23].

The introduction of deep-plane facelift techniques represented another important stage in the evolution of facial rejuvenation surgery. Unlike conventional SMAS procedures, deep-plane surgery allows simultaneous mobilization of the skin and underlying soft tissues as a unified flap, facilitating more effective repositioning of descended facial structures. Clinical experience has demonstrated improved restoration of midfacial contour, enhanced definition of the jawline, and durable rejuvenation in appropriately selected patients. As surgical expertise and anatomical knowledge have advanced, deep-plane facelift has become increasingly recognized as an important approach for comprehensive facial rejuvenation [4,6,23].

Contemporary facelift surgery has moved beyond reliance on a single standardized technique. Current practice emphasizes individualized treatment planning based on patient-specific aging patterns and frequently combines traditional lifting procedures with complementary interventions such as structural fat grafting, neck contouring, laser resurfacing, and regenerative therapies. These multimodal strategies aim not only to reposition descended tissues but also to restore facial volume, improve skin quality, and optimize long-term aesthetic outcomes. Consequently, modern facelift surgery has evolved into a personalized reconstructive and aesthetic procedure that integrates multiple techniques to achieve harmonious, natural-looking facial rejuvenation [4,7–9].

3.3. Surgical Approaches and Anatomical Considerations

Successful facelift surgery requires a detailed understanding of facial anatomy and age-related structural changes. Modern facelift techniques are no longer limited to skin tightening alone; they are based on the correction of multiple anatomical layers, including the skin, superficial musculoaponeurotic system (SMAS), retaining ligaments, facial fat compartments, and deeper soft tissues. Selection of the appropriate surgical approach depends on the patient's anatomical characteristics, degree of tissue descent, skin condition, and aesthetic goals.

3.3.1. The Superficial Musculoaponeurotic System (SMAS)

The superficial musculoaponeurotic system (SMAS) is a fibromuscular layer located between the superficial facial fat and the underlying facial muscles. Anatomically, it represents a continuous connective tissue network that connects the facial muscles of expression with the overlying dermis through numerous fibrous attachments. This anatomical relationship explains why changes in the SMAS directly influence facial contour and soft tissue position [3,6]. Functionally, the SMAS plays an important role in facial movement by transmitting muscular contractions to the skin. With aging, progressive weakening, stretching, and downward displacement of the SMAS contribute to soft tissue descent, loss of facial definition, development of jowls, and accentuation of nasolabial and marionette folds [3].

The recognition of the SMAS as a key anatomical structure significantly changed facelift surgery. Traditional skin-only facelifts provided limited durability because excessive tension was transferred to the skin. Modern SMAS-based techniques aim to reposition and stabilize deeper facial tissues, allowing more harmonious and durable rejuvenation. Different SMAS approaches, including SMAS plication, SMASectomy, SMAS flap elevation, extended SMAS procedures, and deep-plane techniques, are selected according to individual anatomical characteristics and the degree of soft tissue descent [6,23].

3.3.2. Facial Retaining Ligaments

Facial retaining ligaments are specialized fibrous structures that connect the superficial soft tissues of the face with deeper anatomical structures, including the periosteum, deep fascia, and underlying muscles. These ligamentous structures provide essential support by maintaining facial contour and stabilizing the position of soft tissues. With aging, progressive changes in ligamentous support, soft tissue volume, and surrounding anatomical compartments contribute

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to downward displacement of facial tissues, loss of facial definition, and the development of characteristic signs of facial aging such as midface descent, jowling, and cervical laxity [2,3]. The zygomatic retaining ligament is an important midface support structure located near the zygomatic eminence.

It stabilizes the malar soft tissues and contributes to maintenance of cheek projection. Age-related descent of tissues supported by this ligament may result in flattening of the midface, accentuation of the nasolabial fold, and formation of tear trough deformity. A detailed understanding of the zygomatic ligament anatomy is essential during facelift surgery because controlled release can improve mobilization and repositioning of descended tissues [3,4].

The masseteric retaining ligament represents a major lateral facial fixation structure associated with the anterior border of the masseter muscle. It connects superficial facial tissues with deeper structures and may restrict tissue mobility during facelift procedures. Selective release of this ligament during deep-plane and extended deep-plane techniques allows greater advancement of the facial flap and improves correction of lower facial aging changes [4].

The mandibular retaining ligament contributes to the anatomical transition between the cheek and mandibular regions. Age-related weakening and descent of tissues in this area are associated with the development of jowls and loss of mandibular contour. Proper management of this region is therefore important for achieving improved jawline definition during lower facelift procedures [1,4].

Cervical retaining structures provide support for the soft tissues of the neck and influence the appearance of the cervicomental angle. Their management, together with platysma modification and neck contouring techniques, plays an important role in restoring harmony between the lower face and neck during comprehensive facelift procedures [4,6]. Release of retaining ligaments has become an important principle of advanced facelift techniques. Because these structures act as anatomical fixation points, controlled ligament release permits greater tissue mobilization, facilitates anatomical repositioning, and reduces excessive tension on the skin envelope. This concept represents a fundamental component of deep-plane and extended deep-plane facelift approaches aimed at restoring natural facial relationships rather than simply tightening superficial tissues [4,6].

3.3.3. Facial Fat Compartments

Facial fat is not a single continuous layer but is organized into distinct superficial and deep compartments with specific anatomical and functional roles. Understanding the distribution and age-related changes of these fat compartments is essential for achieving balanced and natural facial rejuvenation [2].

Superficial fat compartments

Superficial fat compartments are located between the skin and the SMAS and contribute to facial softness, contour, and surface smoothness. During aging, these compartments may undergo volume reduction, redistribution, and gravitational descent, leading to irregularities of the facial contour, loss of youthful fullness, and accentuation of facial folds [1,2].

Deep fat compartments

Deep facial fat compartments are located beneath the SMAS and serve as important structural components supporting midfacial volume and projection. Age-related changes in these compartments, including deflation and descent, contribute to flattening of the malar region, deepening of nasolabial folds, and alteration of facial proportions. Modern facelift techniques increasingly consider restoration and repositioning of deep facial volume as an essential component of rejuvenation [2,3].

Malar fat pad

The malar fat pad represents a key midface structure responsible for cheek projection and youthful facial contour. Inferior displacement of the malar fat pad is one of the characteristic manifestations of facial aging and contributes to the development of nasolabial folds, midface flattening, and tear trough deformity. Surgical correction requires careful consideration of the relationship between fat compartments, retaining ligaments, and the SMAS layer [2,3].

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Aging changes in facial fat

Facial aging involves complex alterations in adipose tissue, including both volume loss and redistribution. Current anatomical concepts indicate that aging is not explained by simple global fat atrophy; rather, different compartments may demonstrate variable patterns of deflation, hypertrophy, and downward displacement. Consequently, modern facelift procedures frequently incorporate both repositioning of descended tissues and selective volume restoration using techniques such as structural fat grafting to achieve harmonious and natural outcomes [7–9].

3.3.4. Facial Nerve and Vascular Considerations

Preservation of neural and vascular structures represents one of the fundamental principles of safe facelift surgery. Because modern facelift techniques involve manipulation of multiple anatomical planes, detailed knowledge of facial nerve pathways, vascular networks, and tissue planes is essential for minimizing complications while achieving effective rejuvenation [3,10].

Temporal branch of the facial nerve

The temporal branch of the facial nerve is particularly vulnerable during surgical dissection in the temporal region and near the zygomatic arch. Injury to this branch may result in weakness of the frontal muscle, impaired eyebrow elevation, and facial asymmetry. Safe dissection requires careful identification of anatomical planes and avoidance of unnecessary trauma in high-risk areas during SMAS and deep-plane procedures [3,4,12].

Marginal mandibular branch of the facial nerve

The marginal mandibular branch innervates muscles responsible for lower lip depression and movement. Due to its anatomical course near the inferior border of the mandible, this nerve may be exposed to injury during lower facelift and cervical dissection. Preservation of this structure is essential to maintain lower facial symmetry and avoid functional impairment [10,12].

Great auricular nerve

The great auricular nerve provides sensory innervation to the lower ear and adjacent periauricular skin. It is susceptible to injury during dissection along the sternocleidomastoid region, particularly during neck rejuvenation procedures. Damage may lead to postoperative numbness, altered sensation, or discomfort in the auricular area [10].

Vascular preservation

Adequate vascular preservation is critical for maintaining skin flap viability and reducing the risk of complications such as ischemia, delayed healing, and skin necrosis. Modern facelift techniques emphasize preservation of vascular connections and careful handling of tissue planes to maintain blood supply during flap elevation and repositioning. Appropriate surgical planning and meticulous technique remain essential factors in reducing vascular complications [10,11].

3.3.5. Selection of the Surgical Plane

The selection of the appropriate surgical plane is one of the most important steps in facelift planning because each anatomical approach provides different advantages regarding tissue mobilization, correction of aging changes, technical complexity, and potential risks. Modern facelift surgery is based on individualized selection of the surgical plane according to the patient's facial anatomy, degree of soft tissue descent, skin quality, and aesthetic objectives rather than the application of a single universal technique [5,6].

Subcutaneous Facelift

The subcutaneous facelift involves elevation of the skin flap above the SMAS layer. Historically, this approach represented the foundation of early facelift procedures and remains technically less complex compared with deeper

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techniques. It may provide satisfactory improvement in patients with limited skin laxity; however, because deeper supporting structures are not directly addressed, correction of significant soft tissue descent is limited. In addition, excessive dependence on skin tension may reduce long-term durability and increase the risk of unnatural tightening effects [5].

SMAS Facelift

SMAS-based facelift procedures represent a major advancement in facial rejuvenation by addressing the deeper fascial support system. Manipulation of the SMAS allows redistribution of tension away from the skin and enables more stable repositioning of facial tissues. Different modifications, including SMAS plication, SMASectomy, and SMAS flap techniques, provide improved correction of lower facial laxity and mandibular contour changes while maintaining natural facial expression [6,20,23].

Sub-SMAS Facelift

Sub-SMAS dissection involves surgical manipulation beneath the SMAS layer, allowing greater access to deeper facial structures and increased tissue mobilization. Although this approach provides enhanced correction of advanced aging changes, it requires extensive knowledge of facial anatomy because of the closer relationship with important facial nerve branches. Careful identification of anatomical planes is essential to reduce the risk of nerve injury 6.

Deep-Plane Facelift

The deep-plane facelift represents an evolution of anatomical facelift surgery in which the skin, SMAS, and deeper soft tissues are mobilized as a composite unit. Controlled release of retaining ligaments allows greater repositioning of descended midface and lower facial tissues with reduced reliance on skin tension. This approach may provide improved correction of midface ptosis, nasolabial folds, jawline definition, and cervical aging changes in appropriately selected patients [4,6].

Composite-Plane Facelift

The composite-plane facelift preserves the anatomical continuity between the skin, SMAS, and underlying soft tissues by elevating them as a unified flap. This concept allows simultaneous repositioning of multiple facial layers and may be particularly beneficial for patients requiring comprehensive correction of midface, lower face, and neck aging. The technique emphasizes restoration of facial harmony rather than isolated tissue elevation [4].

Anatomical Indications for Plane Selection

The ideal surgical plane should be selected according to individual anatomical characteristics, including the severity of soft tissue ptosis, midface volume deficiency, skin elasticity, facial morphology, previous facelift procedures, and patient expectations. Contemporary practice increasingly favors a personalized approach in which the surgical plane is adapted to the specific pattern of facial aging rather than applying the same technique to all patients [4–6].

The key anatomical structures involved in facelift surgery and their functional relevance for surgical plane selection are summarized in Table 2.

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Table 2. Key Anatomical Structures and Their Role in Modern Facelift Surgery

Anatomical Structure	Main Function	Age-related Changes	Importance in Facelift Surgery
Superficial Musculoaponeurotic System (SMAS)	Provides connection between facial muscles and overlying skin; transmits facial movements	Weakening, elongation, and downward displacement leading to facial laxity	Main target layer for deep tissue repositioning and long-lasting facial rejuvenation
Zygomatic Retaining Ligament	Supports midface soft tissues and malar region	Inferior migration of cheek tissues and loss of midface projection	Release allows effective elevation of descended midface structures
Masseteric Retaining Ligament	Stabilizes lateral cheek tissues over the masseter muscle	Contributes to limitation of tissue mobility during aging	Controlled release improves lower face mobilization
Mandibular Retaining Ligament	Defines transition between cheek and mandibular region	Formation of jowls and loss of mandibular contour	Important for correction of lower facial aging
Cervical Retaining Ligaments	Support cervical soft tissues	Neck laxity and reduced cervicomental definition	Important during neck lift and cervicofacial rejuvenation
Superficial Fat Compartments	Provide facial contour and smooth skin transition	Volume loss and redistribution	Require repositioning or volume restoration
Deep Facial Fat Compartments	Maintain midface volume and structural support	Atrophy and descent	Targeted correction improves midface rejuvenation
Facial Nerve Branches	Control facial expression muscles	Vulnerability during surgical dissection	Anatomical preservation prevents functional complications
Great Auricular Nerve	Provides sensation to ear and lateral neck	Risk during cervical dissection	Preservation reduces postoperative sensory disturbance
Facial Vasculature	Maintains tissue perfusion	Reduced vascular reserve with aging	Essential for flap survival and complication prevention

3.3.6. Patient-specific Anatomical Considerations

Facelift surgery requires individualized anatomical assessment because facial aging does not occur according to a uniform pattern. Variations in soft tissue descent, skin characteristics, facial proportions, skeletal structure, and previous procedures significantly influence both surgical planning and expected outcomes. Modern facelift surgery therefore emphasizes patient-specific strategies rather than applying a standardized technique to all individuals [1,3,4].

Age

Age is an important factor affecting the extent and distribution of facial aging changes. Younger patients may primarily demonstrate early skin laxity or limited soft tissue descent and may benefit from less extensive procedures. In contrast, older patients frequently present with combined changes involving the skin, SMAS, retaining ligaments, facial fat compartments, and skeletal support, requiring correction of multiple anatomical layers [1,3].

Skin Quality

Skin thickness, elasticity, collagen content, degree of photodamage, and regenerative capacity influence postoperative healing and aesthetic outcomes. Patients with better skin quality generally demonstrate more predictable results, whereas severe elastosis or significant sun damage may limit the degree of improvement achievable through surgical lifting alone. Appropriate evaluation of skin characteristics is therefore essential during preoperative planning [1,5].

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Facial Morphology

Facial morphology plays a central role in selecting the appropriate facelift strategy. Skeletal structure, cheek projection, mandibular contour, facial width, and distribution of soft tissues determine the pattern of aging and the required degree of correction. The primary objective of modern facelift surgery is restoration of balanced facial relationships while preserving individual identity and avoiding an artificial appearance [3,4].

Body Mass Index (BMI)

Body mass index and changes in body weight may influence facial volume distribution, skin behavior, and long-term stability of surgical results. Significant weight loss after facelift surgery may lead to recurrent volume deficiency and altered facial contour, whereas increased adiposity may affect tissue thickness and surgical planning. Stable body weight is therefore considered an important factor for maintaining long-term outcomes [7,8].

Degree of Ptosis

The severity and anatomical location of soft tissue descent are critical determinants in selecting the surgical approach. Assessment should include midface descent, jowl formation, mandibular contour changes, and cervical laxity. Patients with limited ptosis may benefit from less extensive procedures, whereas advanced aging changes often require SMAS-based, deep-plane, or combined approaches to achieve adequate correction [4,6].

Previous Surgery

Previous facelift procedures, filler treatments, thread lifting, or other facial interventions may significantly alter normal anatomical planes and increase surgical complexity. Revision facelift surgery requires careful evaluation of scar tissue, previous dissection planes, remaining tissue support, and vascular conditions to achieve safe and predictable results [4,10]. A comprehensive understanding of patient-specific anatomical characteristics allows surgeons to select the most appropriate surgical plane, optimize aesthetic outcomes, reduce complications, and achieve natural, durable facial rejuvenation. Increasing emphasis on individualized planning and patient-reported outcome assessment reflects the modern shift toward personalized facial aesthetic surgery [13–16].

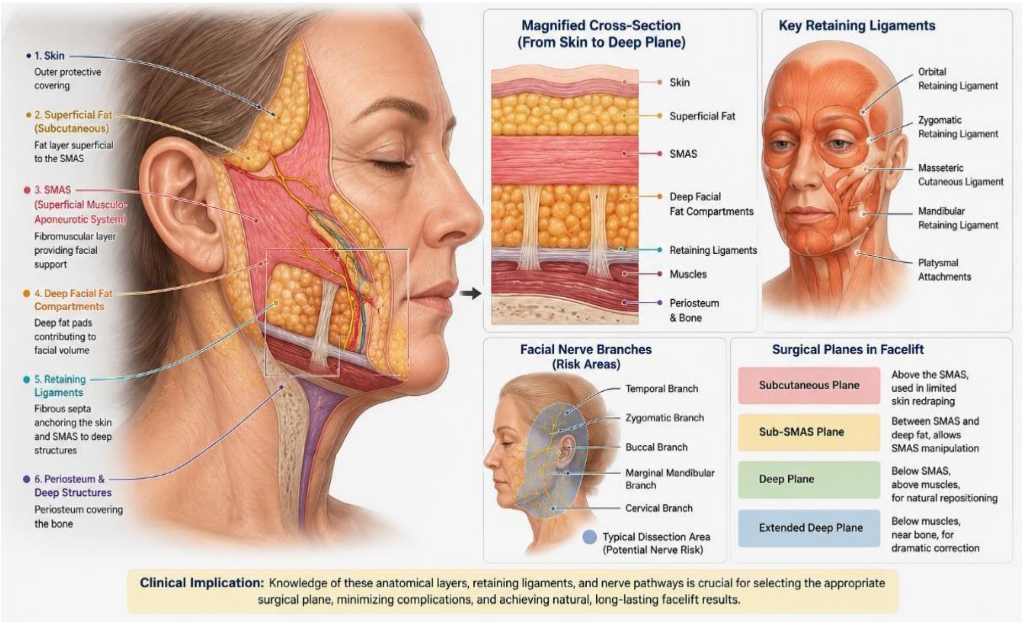

Figure 2. Anatomical layers and surgical planes involved in modern facelift procedures.

The illustration demonstrates the relationship between the skin, superficial fat, SMAS, deep facial fat compartments, retaining ligaments, and facial nerve structures, highlighting the anatomical basis of different facelift approaches.

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3.4. Clinical Outcomes and Durability

The clinical success of facelift surgery should not be evaluated solely by the amount of tissue elevation achieved during surgery. Contemporary assessment focuses on restoration of harmonious facial proportions, preservation of natural facial expression, improvement of age-related deformities, and long-term patient satisfaction. Modern facelift procedures aim to correct multiple manifestations of facial aging, including skin laxity, soft tissue descent, volume redistribution, and loss of facial contour [4–6].

Published evidence demonstrates that facelift surgery provides consistent improvement in lower facial contour, jowl formation, midface descent, cervical definition, and overall facial rejuvenation. However, the magnitude and durability of improvement depend on several factors, including the selected surgical plane, patient anatomy, severity of aging changes, skin characteristics, and surgeon experience. Techniques that address deeper anatomical structures generally provide more comprehensive correction compared with procedures limited to skin excision and tightening [5,6].

Traditional Subcutaneous Facelift

Traditional skin-only facelift techniques primarily address excess skin and superficial laxity. Although these procedures can produce visible short-term improvement, they do not directly correct descent of deeper facial structures. As a result, reliance on skin tension alone may limit long-term stability and may contribute to recurrent laxity or an unnatural appearance in some patients [5].

SMAS-based Facelift

SMAS-based techniques represent a major advancement in facial rejuvenation by addressing the deeper fascial support system. Redistribution of tension from the skin to the SMAS allows more stable repositioning of facial tissues and improves correction of lower facial aging, mandibular contour changes, and soft tissue laxity. These approaches have become a fundamental component of modern facelift surgery because they provide improved durability while maintaining natural facial movement [6,23].

Deep-plane and Composite-plane Facelift

Deep-plane and composite-plane approaches further expand anatomical correction by allowing mobilization of the SMAS, facial fat compartments, and deeper soft tissues as a unified structure. Controlled release of retaining ligaments enables greater repositioning of descended midface and lower facial tissues with reduced skin tension. These techniques may provide enhanced correction of midface ptosis, nasolabial folds, jawline definition, and cervical aging changes in appropriately selected patients [4].

Role of Volume Restoration in Clinical Outcomes

Current concepts of facial rejuvenation recognize that aging involves both tissue descent and volume deficiency. Therefore, many facelift procedures are combined with structural fat grafting to restore facial fullness, improve contour transitions, and achieve more balanced results. Evidence suggests that combining lifting procedures with volume restoration may enhance overall aesthetic outcomes when performed according to individual anatomical requirements [7–9]. The principal clinical outcomes, advantages, limitations, and expected durability of the major facelift techniques are summarized in Table 3.

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Table 3. Clinical Outcomes and Durability of Different Facelift Approaches

Surgical approach	Main anatomical target	Advantages	Limitations	Expected durability
Subcutaneous facelift	Skin and superficial laxity	Simpler technique, shorter operative time, suitable for mild aging changes	Limited correction of deep tissue descent; greater dependence on skin tension	Short- to medium-term
SMAS facelift	SMAS layer and lower facial soft tissues	Improved contour restoration, reduced skin tension, more natural facial appearance	Requires anatomical expertise and greater technical complexity	Long-term
Extended SMAS facelift	Extended SMAS and midface structures	Enhanced correction of midface and lower facial aging	More extensive dissection and longer operative time	Long-term
Deep-plane facelift	SMAS, retaining ligaments, deep facial tissues	Comprehensive rejuvenation, improved midface rejuvenation, jawline definition, and durable tissue repositioning	Technically demanding; requires advanced anatomical knowledge	Long-term
Composite-plane facelift	Skin–SMAS–deep tissue composite flap	Simultaneous repositioning of multiple tissue layers while preserving anatomical continuity	Increased operative complexity and prolonged learning curve	Long-term

Patient-reported Outcomes and Durability

Long-term success of facelift surgery is increasingly evaluated using validated patient-reported outcome measures rather than surgeon assessment alone. FACE-Q studies have demonstrated high levels of satisfaction following facelift procedures, particularly when outcomes are evaluated in terms of appearance, psychological well-being, and quality of life improvement [13–16].

The durability of facelift results varies among individuals and is influenced by age at surgery, genetic factors, lifestyle, sun exposure, smoking status, postoperative skincare, and continued facial aging. Although surgery does not stop the aging process, modern anatomical techniques can provide long-lasting rejuvenation while preserving facial identity and natural expression [4–6].

Patient Satisfaction and Functional Outcomes

Evaluation of facelift outcomes has progressively shifted from surgeon-based aesthetic assessment toward patient-reported measures that reflect personal satisfaction, confidence, and quality-of-life improvement. Contemporary evidence indicates that successful facelift surgery is associated not only with visible facial rejuvenation but also with improved psychological perception of facial appearance and overall well-being [13–16].

An important objective of modern facelift surgery is the preservation of facial identity and natural expression. Excessive skin tension, overcorrection, or inappropriate tissue repositioning may result in an unnatural appearance and reduced patient satisfaction. Therefore, optimal outcomes depend on achieving balanced restoration of facial anatomy while maintaining individual characteristics [4,6].

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Durability of Facelift Results

The longevity of facelift outcomes varies according to patient-related and procedure-related factors. Although surgery cannot prevent the biological aging process, anatomical repositioning of deeper facial structures may provide durable improvement compared with techniques limited to superficial skin tightening [4–6].

Long-term changes after facelift surgery continue to occur because of progressive skin aging, collagen degradation, alterations in facial volume, and gradual soft tissue descent. Factors influencing durability include patient age at surgery, genetic characteristics, skin quality, smoking status, sun exposure, postoperative care, weight stability, and surgical technique [1,4,5].

Long-term evaluation of facelift outcomes requires a multidimensional assessment that integrates anatomical correction, facial harmony, preservation of expression, complication profile, and patient-reported satisfaction. The most successful procedures are those that achieve durable rejuvenation while maintaining natural facial characteristics and avoiding an overcorrected appearance. Therefore, modern facelift surgery should be considered successful not simply when tissues are elevated, but when balanced restoration of facial anatomy is achieved with stable and patient-perceived improvement over time [4–6,13–16].

3.5. Complications and Safety Profile

Although facelift surgery has undergone substantial refinement through improved anatomical understanding, advanced surgical planes, and modern perioperative protocols, postoperative complications remain an important aspect of clinical decision-making. The safety profile of facelift procedures depends on multiple variables, including patient characteristics, surgical technique, extent of tissue dissection, preservation of vascular and neural structures, and surgeon experience. Large clinical analyses have emphasized that appropriate patient selection, risk assessment, and standardized perioperative management are essential components of improving facelift safety and reducing adverse outcomes [4,10,24]. Modern facelift surgery aims not only to achieve effective facial rejuvenation but also to minimize complications through careful anatomical planning, individualized selection of the surgical plane, meticulous hemostasis, and preservation of critical neurovascular structures. Contemporary safety strategies focus on balancing adequate tissue mobilization with preservation of vascular supply and functional anatomy [4,10,24].

Early Postoperative Complications

Hematoma

Hematoma remains one of the most frequent and clinically significant early complications after facelift surgery. It usually develops during the immediate postoperative period and may present with progressive swelling, pain, increased flap tension, ecchymosis, or facial asymmetry. Because increased tissue pressure can compromise microcirculation, significant hematoma formation may threaten skin flap viability and increase the risk of delayed healing, skin necrosis, or need for surgical evacuation [10,11].

Risk factors associated with hematoma formation include uncontrolled hypertension, inadequate intraoperative hemostasis, anticoagulant or antiplatelet medication use, smoking, and excessive physical activity during the early postoperative period. Prevention requires meticulous surgical technique, careful coagulation of bleeding vessels, appropriate perioperative blood pressure control, appropriate patient selection, and close postoperative monitoring. Recent evidence highlights the importance of systematic risk reduction protocols to decrease hematoma incidence and improve overall patient safety following rhytidectomy [10,11,24].

3.3.3. Facial Fat Compartments

Facial fat is not organized as a single continuous layer but rather as a complex system of superficial and deep compartments that contribute to facial contour, volume distribution, and soft tissue support. The recognition of these anatomical units has significantly changed modern facelift surgery by demonstrating that facial aging involves selective volume loss, redistribution, and descent of specific fat compartments rather than uniform tissue atrophy [1,2].

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Superficial fat compartments

Superficial facial fat is located between the skin and the superficial musculoaponeurotic system (SMAS) and plays an important role in facial smoothness and contour. Age-related changes within these compartments include volume reduction, thinning, and inferior displacement, which may contribute to irregular facial contours, loss of cheek fullness, and accentuation of facial folds. Understanding superficial fat behavior is essential during facelift surgery because excessive removal may result in an aged or hollow appearance, whereas preservation or selective repositioning can improve facial harmony [2,8].

Deep fat compartments

Deep facial fat compartments are located beneath the SMAS and provide structural support for the midface. These compartments include the deep medial cheek fat, deep lateral cheek fat, and other supporting fat structures associated with midfacial projection. With aging, deep fat compartments undergo volume reduction and inferior migration, contributing to flattening of the malar region, increased nasolabial fold depth, and changes in facial proportions [1,3].

Malar fat pad

The malar fat pad represents one of the most clinically important midface structures because it contributes significantly to cheek projection and youthful facial appearance. Descent of the malar fat compartment during aging contributes to midface ptosis, tear trough formation, and accentuation of the nasolabial fold. Modern facelift techniques, particularly SMAS-based and deep-plane approaches, aim not only to elevate soft tissues but also to restore the anatomical position of descended fat compartments [3,4].

Aging changes in facial fat

Contemporary understanding of facial aging indicates that fat changes are characterized by both volume loss and redistribution. Different compartments may demonstrate simultaneous deflation, hypertrophy, and downward displacement. Therefore, modern rejuvenation strategies frequently combine anatomical repositioning of descended tissues with selective volume restoration using techniques such as structural fat grafting. This combined approach allows restoration of facial proportions while maintaining a natural appearance [7–9].

Nerve-Related Complications

Facial Nerve Injury

Facial nerve injury represents one of the most concerning complications following facelift surgery because it may lead to temporary or permanent functional impairment, facial asymmetry, and reduced patient satisfaction. The risk of nerve dysfunction depends mainly on the surgical plane, extent of dissection, and anatomical location of tissue manipulation. The temporal branch of the facial nerve is particularly vulnerable during temporal dissection, whereas the marginal mandibular branch requires careful protection during lower facial and cervical procedures. Most postoperative nerve disturbances are transient and are usually related to traction, edema, or neuropraxia. Permanent facial nerve dysfunction remains uncommon when surgery is performed with detailed anatomical knowledge and meticulous dissection techniques [12,25].

Recent evidence indicates that nerve injuries after facelift surgery are rare, with most cases demonstrating spontaneous recovery during follow-up. However, prevention remains the primary goal, emphasizing the importance of anatomical plane selection and avoidance of unnecessary nerve manipulation [25].

Sensory Disturbances

Temporary sensory changes are frequently observed after facelift surgery due to manipulation of superficial sensory nerves. The great auricular nerve is especially important during cervical dissection because injury may result in numbness, altered sensation, or hypersensitivity around the earlobe and lateral neck. In most patients, sensory

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disturbances gradually improve over several months as nerve regeneration and adaptation occur. Careful preservation of sensory nerve pathways remains essential for reducing postoperative discomfort [12,25].

Skin and Scar-Related Complications

Skin Flap Necrosis

Skin flap necrosis is an uncommon but serious complication caused by insufficient vascular perfusion of elevated facial tissues. Risk factors include excessive skin tension, aggressive flap thinning, smoking, vascular disease, previous surgery, and extensive undermining. Modern facelift techniques that preserve vascularity, reduce tension on the skin flap, and rely more on deeper tissue repositioning have contributed to improved safety profiles and reduced rates of flap compromise [10,24].

Hypertrophic Scarring and Poor Scar Quality

Although facelift incisions are designed within natural skin folds and hair-bearing areas, scar quality remains an important factor influencing aesthetic satisfaction. Hypertrophic scarring, widened scars, or unfavorable scar appearance may occur due to individual healing characteristics, infection, increased wound tension, or inadequate postoperative care. Careful incision planning, reduction of skin tension, and appropriate postoperative scar management are important components of achieving optimal long-term results [10,26].

Patient-related Risk Factors and Prevention Strategies

The occurrence and severity of facelift-related complications are influenced not only by surgical technique but also by individual patient characteristics and perioperative factors. Comprehensive preoperative evaluation is essential to identify conditions that may increase the risk of impaired wound healing, bleeding, infection, or suboptimal aesthetic outcomes. Important patient-related risk factors include active smoking, uncontrolled hypertension, diabetes mellitus, anticoagulant or antiplatelet therapy, significant fluctuations in body weight, previous facial surgery, and reduced skin quality associated with aging or environmental damage [10,24,26,28].

Smoking remains one of the most significant modifiable risk factors because nicotine-induced vasoconstriction and impaired microcirculation may compromise skin flap viability and increase the risk of wound complications. Similarly, uncontrolled hypertension has been strongly associated with postoperative hematoma formation, emphasizing the importance of adequate perioperative blood pressure management [11,26,28].

Previous facial procedures, including prior facelift surgery, filler injections, or energy-based treatments, may alter normal anatomical planes and increase surgical complexity. Therefore, detailed assessment of previous interventions and individualized surgical planning are necessary to minimize complications and optimize outcomes. Modern evidence-based approaches emphasize careful patient selection, optimization of medical conditions, meticulous surgical technique, and structured postoperative follow-up as essential components of facelift safety [27,29].

The principal complications associated with facelift surgery, together with their typical timing, clinical significance, major risk factors, and recommended prevention strategies, are summarized in Table 4.

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Table 4. Complications Associated with Facelift Surgery: Incidence, Clinical Significance, and Prevention

Complication	Typical Timing	Clinical Significance	Main Risk Factors	Prevention Strategies
Hematoma	Early (first 24–48 hours)	Most important early complication; may compromise flap survival	Hypertension, anticoagulants, inadequate hemostasis, smoking	Careful hemostasis, blood pressure control, close monitoring
Edema and ecchymosis	Early postoperative period	Temporary swelling and bruising affecting recovery	Extensive dissection, individual healing response	Gentle tissue handling, postoperative care
Seroma	Early/intermediate	Fluid accumulation causing delayed healing	Lymphatic disruption, large dissection spaces	Preservation of lymphatics; aspiration when required
Infection	Early/intermediate	May impair wound healing and increase morbidity	Smoking, poor wound care, prolonged surgery	Sterile technique, early diagnosis, and appropriate treatment
Facial nerve injury	Early	Functional impairment and facial asymmetry	Incorrect dissection plane, excessive traction	Detailed anatomical knowledge and careful nerve preservation
Sensory nerve disturbance	Early/intermediate	Numbness or altered sensation	Great auricular nerve manipulation	Anatomical preservation and patient counseling
Skin flap necrosis	Early	Serious wound-healing complication	Smoking, excessive flap tension, vascular compromise	Preservation of blood supply and reduction of flap tension
Hypertrophic scarring	Late	Aesthetic dissatisfaction	Genetic predisposition, wound tension, infection	Optimal incision design and appropriate scar management
Facial asymmetry	Late	Compromised aesthetic outcome	Unequal tissue repositioning, healing variability	Accurate preoperative planning and individualized surgical technique

3.6. Emerging Trends in Facelift Surgery

Recent advances in facial rejuvenation have shifted the philosophy of facelift surgery from isolated tissue tightening toward a more comprehensive, anatomy-based approach. Modern concepts recognize facial aging as a multidimensional process involving progressive changes in skin quality, soft tissue descent, ligamentous laxity, fat redistribution, muscular alterations, and skeletal remodeling. Consequently, contemporary facelift procedures increasingly emphasize individualized treatment planning based on patient-specific anatomical characteristics rather than the application of a standardized surgical technique [1,4,21].

The current evolution of facelift surgery is characterized by integration of structural correction, volume restoration, and complementary rejuvenation procedures. These approaches aim to achieve balanced facial rejuvenation while preserving facial identity, natural expression, and long-term aesthetic stability [7,9,27].

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Integration of Volume Restoration and the "Lift-and-Fill" Concept

One of the most important developments in modern facial rejuvenation is the recognition that facial aging involves not only gravitational descent of soft tissues but also progressive changes in facial volume distribution. Loss of fullness, particularly in the midface, temporal region, and periorbital area, contributes significantly to an aged appearance and cannot be completely corrected by lifting procedures alone [1,2].

The "lift-and-fill" concept combines anatomical repositioning of descended tissues with restoration of age-related volume deficiency. Autologous fat grafting has become an important adjunctive technique because it allows correction of contour irregularities, restoration of soft tissue fullness, and improvement of facial harmony using a biologically compatible material [7,8].

Compared with isolated lifting procedures, combined tissue repositioning and volume restoration strategies provide a more comprehensive approach by addressing both structural ptosis and facial deflation. Current evidence supports the integration of fat grafting with facelift surgery in selected patients to improve aesthetic balance and optimize rejuvenation outcomes [9,27].

Combined Surgical and Minimally Invasive Approaches

Modern facial rejuvenation increasingly incorporates combined surgical and minimally invasive procedures to achieve comprehensive and harmonious aesthetic outcomes. Facelift surgery is frequently combined with complementary procedures such as cervical contouring, blepharoplasty, brow rejuvenation, laser resurfacing, and volume-enhancing treatments. These multimodal strategies allow simultaneous correction of different manifestations of facial aging, including tissue descent, volume depletion, and skin quality deterioration, while maintaining facial balance and natural appearance [7,27].

Minimally invasive procedures, including neuromodulators, dermal fillers, energy-based skin tightening technologies, and biostimulatory treatments, are increasingly used as adjunctive methods for optimizing and maintaining facelift outcomes. Rather than replacing surgical rejuvenation, these techniques serve as complementary approaches that address superficial aging changes and contribute to long-term aesthetic maintenance [9,27].

Regenerative and Biological Approaches

Regenerative medicine represents one of the emerging directions in contemporary facial rejuvenation. Current interest has shifted toward biological approaches aimed not only at restoring facial volume but also at improving tissue quality, vascularity, and dermal remodeling. Adipose-derived products, platelet-rich plasma (PRP), platelet-rich fibrin (PRF), and other biologically active materials have been investigated for their potential effects on collagen synthesis, angiogenesis, wound healing, and skin regeneration. These approaches may provide additional benefits when combined with surgical rejuvenation procedures by improving tissue quality and enhancing postoperative recovery [31,32].

However, despite promising preliminary findings, the clinical application of regenerative techniques remains heterogeneous, with variations in preparation protocols, treatment parameters, and outcome assessment methods. Further well-designed clinical studies are required to establish standardized protocols and determine their long-term effectiveness in facial rejuvenation [27,31].

Three-Dimensional Facial Analysis and Personalized Planning

Technological advances have introduced objective methods for facial assessment and surgical planning in modern facial rejuvenation. Three-dimensional (3D) imaging technologies allow quantitative evaluation of facial morphology, asymmetry, soft tissue distribution, and postoperative changes. Compared with conventional two-dimensional photography, 3D facial analysis provides more comprehensive information regarding volumetric changes and spatial relationships, improving patient consultation, surgical simulation, and individualized treatment planning. These technologies may enhance communication between surgeons and patients by providing a more precise representation of expected aesthetic outcomes [33].

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Artificial Intelligence and Data-driven Facial Assessment

Artificial intelligence (AI) and machine-learning technologies are emerging as promising tools in aesthetic and reconstructive surgery. AI-based systems may assist in automated facial analysis, recognition of aging patterns, evaluation of facial symmetry, and objective assessment of postoperative results. Although clinical applications remain at an early stage, these technologies may contribute to more standardized assessment methods, improved surgical planning, and personalized decision-making in future facelift surgery [34,35].

Personalized and Anatomy-Based Facelift Surgery

The future direction of facelift surgery is moving toward precision-based, anatomy-driven rejuvenation. Rather than selecting procedures solely according to chronological age, contemporary approaches increasingly consider individual anatomical characteristics, facial morphology, skin quality, volume distribution, skeletal structure, and patient expectations. Personalized surgical planning aims to achieve harmonious rejuvenation while preserving facial identity and avoiding excessive correction. The integration of objective facial analysis with anatomical principles may further improve predictability and long-term aesthetic outcomes [21,33]. Current emerging technologies and personalized strategies that are expected to shape the future of facelift surgery are summarized in Table 5.

Table 5. Emerging Trends and Future Directions in Facelift Surgery

Emerging Approach	Main Principle	Clinical Application	Potential Advantages	Current Limitations
Lift-and-fill facelift	Combination of tissue repositioning and volume restoration	Facelift combined with autologous fat grafting or volume correction	More balanced and natural facial rejuvenation	Long-term volume stability may vary
Autologous fat grafting	Restoration of lost facial volume using patient-derived adipose tissue	Midface, temples, periorbital region, and facial contour correction	Natural volume replacement and improved tissue quality	Variable graft survival
Combined facial rejuvenation procedures	Simultaneous treatment of multiple aging components	Facelift combined with neck lift, blepharoplasty, resurfacing, or injectables	Comprehensive aesthetic improvement	Increased procedural complexity
Minimally invasive maintenance strategies	Nonsurgical enhancement following facelift surgery	Dermal fillers, neuromodulators, and energy-based devices	Prolongation of aesthetic results with reduced downtime	Temporary effects requiring repeated treatments
Regenerative medicine approaches	Enhancement of tissue quality and healing capacity	PRP, PRF, and adipose-derived regenerative products	Potential improvement in skin quality and tissue regeneration	Limited standardization and variable level of clinical evidence
Three-dimensional facial analysis	Objective evaluation of facial morphology and aging changes	Preoperative planning and postoperative outcome assessment	Improved personalization and objective outcome measurement	Additional cost and technical requirements
Artificial intelligence-based assessment	Automated analysis of facial features and aging patterns	Surgical planning, decision support, and outcome evaluation	Increased objectivity, reproducibility, and personalized planning	Requires further validation and clinical integration
Personalized facelift planning	Anatomy-driven selection of surgical technique	Individualized treatment based on patient-specific anatomy	Preserves facial identity and improves patient satisfaction	Requires comprehensive preoperative assessment and advanced surgical expertise

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4. DISCUSSION

The evolution of facelift surgery reflects a fundamental transformation in the understanding of facial aging. Earlier procedures were primarily based on removal of excess skin and superficial tightening; however, contemporary concepts recognize facial aging as a complex three-dimensional process involving skeletal remodeling, redistribution of facial fat compartments, soft tissue descent, ligamentous changes, and alterations in skin quality [1,2,21]. Therefore, successful facial rejuvenation is no longer defined only by the amount of tissue elevation achieved, but rather by the ability to restore anatomical relationships, maintain facial identity, and achieve natural long-term outcomes.

Comparative Interpretation of Facelift Techniques

The available evidence demonstrates that facelift techniques have progressively evolved from skin-focused procedures toward anatomy-based approaches. Traditional skin-only facelifts may provide acceptable improvement in patients with mild skin laxity; however, their ability to correct deeper structural changes associated with facial aging remains limited [5,20,21]. The recognition of the superficial musculoaponeurotic system (SMAS) as a major supporting structure represented an important advancement because it allowed redistribution of tension away from the skin and improved correction of lower facial aging changes [6,23].

SMAS-based procedures remain among the most widely used approaches because they provide reliable improvement of facial contour while maintaining favorable safety characteristics. Extended SMAS techniques further expanded this concept by allowing deeper mobilization and correction of midface descent through anatomical release of retaining structures [22,23]. Deep-plane and composite-plane techniques represent a continuation of this structural philosophy by treating multiple facial layers as an integrated unit, enabling more comprehensive repositioning of descended tissues [4,6]. However, current evidence does not support the concept that one facelift technique is universally superior. The choice of procedure should be based on individual anatomical characteristics, degree of tissue descent, skin quality, facial proportions, and patient expectations rather than chronological age alone [21,43,44].

Modern facelift surgery therefore represents a personalized approach rather than a standardized operation.

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Durability of Results and Factors Affecting Long-Term Outcomes

Long-term success after facelift surgery depends on both surgical correction and biological factors influencing facial aging. Procedures that address deeper anatomical structures generally demonstrate greater stability because they restore structural support rather than relying primarily on skin tension [6,23,38]. Nevertheless, facelift surgery does not interrupt the aging process, and progressive changes in skin elasticity, collagen metabolism, fat distribution, and skeletal morphology continue after surgery [1,2].

The durability of facelift outcomes is influenced by multiple variables, including genetic predisposition, lifestyle factors, environmental exposure, smoking status, postoperative care, and maintenance treatments [10,27]. Therefore, the concept of a permanent facelift result should be replaced by the understanding of long-term rejuvenation through restoration of anatomical balance. The incorporation of adjunctive procedures, particularly volume restoration with autologous fat grafting, has further modified the concept of facial rejuvenation. Aging is associated not only with descent of tissues but also with progressive deflation and redistribution of facial fat compartments [2,8]. The combination of lifting and volume restoration may improve facial harmony by addressing both positional and volumetric changes [7,9,27].

Patient Satisfaction and Individualized Treatment Planning

Modern evaluation of facelift outcomes increasingly emphasizes patient-reported measures rather than surgeon assessment alone. Instruments such as FACE-Q have demonstrated that successful facelift surgery is associated with improvements in satisfaction with facial appearance, psychological well-being, and quality of life [13–16].

An important principle emerging from contemporary literature is that aesthetic success should not be measured only by visible tightening but by the preservation of facial expression and individual characteristics. Excessive correction may result in an unnatural appearance, whereas anatomical restoration aims to create a refreshed but recognizable facial appearance [21,43].

Personalized planning has therefore become central to modern facelift practice. Patients with similar chronological ages may demonstrate substantially different patterns of volume loss, ligamentous laxity, skin changes, and skeletal remodeling. Individualized assessment allows selection of the most appropriate surgical strategy and reduces the risk of overcorrection [21,44].

Safety Considerations and Current Limitations of Evidence

Although advances in surgical anatomy and perioperative management have improved the safety profile of facelift surgery, complications remain an important consideration. Hematoma, nerve injury, wound healing problems, infection, and scar-related complications continue to influence postoperative outcomes [10,11,24,26,29].

The available evidence indicates that complication rates are closely associated with patient selection, surgical technique, vascular preservation, and perioperative management. Smoking cessation, blood pressure control, optimization of medical conditions, and careful anatomical dissection remain essential strategies for reducing adverse events [11,26,28].

Despite extensive clinical experience, several limitations exist within the current evidence base. Many studies are retrospective, include heterogeneous patient populations, and use different outcome assessment methods, making direct comparison between facelift techniques difficult [10,17,36,45]. Furthermore, objective measurement of aesthetic improvement remains challenging because traditional photography and subjective evaluation may not fully capture three-dimensional changes.

Future investigations should prioritize prospective multicenter studies, standardized outcome measures, longer follow-up periods, and objective assessment technologies to better define the comparative effectiveness of different facelift approaches [36,45].

Future Directions in Facelift Surgery

The future development of facelift surgery is expected to focus on precision, personalization, and integration of advanced technologies. Three-dimensional facial imaging has already demonstrated value in objective assessment of facial morphology, volume changes, surgical planning, and postoperative evaluation [33,39,42]. Compared with conventional two-dimensional photography, three-dimensional systems provide more comprehensive information regarding spatial relationships and soft tissue changes.

Artificial intelligence and machine-learning technologies represent another emerging direction. AI-based systems may assist in facial analysis, prediction of aging patterns, evaluation of symmetry, and development of individualized treatment plans [34,35,40,41]. However, these technologies require further validation before routine clinical implementation.

Regenerative strategies, including adipose-derived products, platelet-based therapies, and biological approaches, may further influence the future of facial rejuvenation by targeting tissue quality, healing, and regeneration rather than only structural correction [30–32]. Nevertheless, variations in preparation methods and treatment protocols highlight the need for high-quality clinical studies before widespread adoption.

Overall, the next generation of facelift surgery will likely combine advanced anatomical understanding, personalized surgical planning, digital assessment technologies, and regenerative concepts. The ultimate goal will remain achieving durable rejuvenation while preserving facial identity, natural movement, and patient satisfaction.

DECLARATIONS

Ethical Approval
Not applicable.
Competing Interests
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