The Review Of
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STUDIES
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Multidisciplinary Clinical Approaches To Facial Implant Procedures: Nursing, Radiology, Pharmacy, Dental Perspectives, Physiotherapists, And Health Security Professionals In Emergency Cases-An Updated Review

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Abstract:

Background: Facial implants are widely utilized in reconstructive and aesthetic surgery to correct skeletal deficiencies, restore facial symmetry, and address age-related volume loss. Their use has increased significantly over the past two decades, with malar and chin implants demonstrating relatively low complication rates and predictable outcomes.
Aim: This review highlights updated multidisciplinary perspectives—nursing, radiology, pharmacy, dentistry, physiotherapists, and emergency health security—on facial implant procedures, emphasizing anatomy, indications, contraindications, surgical technique, equipment, complications, and clinical significance.
Methods: A comprehensive narrative analysis was conducted using contemporary literature summarized within the full article. Topics include implant materials, imaging modalities, surgical approaches, postoperative care, and complication management.
Results: Modern facial implant surgery is supported by advanced imaging, software-assisted planning, and refined surgical techniques. Three-dimensional imaging significantly improves preoperative planning accuracy. Titanium, silicone, and high-density polyethylene remain the principal implant materials, each offering distinct advantages in stability, biocompatibility, and tissue integration. Complications range from hematoma, seroma, and infection to nerve injury and implant malposition, with infection reported in 2–5% of cases. Despite these risks, implants offer shorter recovery times than osteotomies and provide precise, customizable augmentation of the chin, malar region, and mandibular angles.

Conclusion: Facial implant surgery represents a safe and effective solution for aesthetic enhancement and facial reconstruction when grounded in proper patient selection, meticulous anatomical assessment, imaging-guided planning, and disciplined surgical technique. The multidisciplinary model enhances patient safety and optimizes outcomes.

Keywords: Facial implants, malar augmentation, chin implant, mandibular implant, 3D imaging, surgical planning, complications, anatomy, reconstruction, aesthetics.

Introduction:

Facial implants serve a dual role in both reconstructive and aesthetic surgery, addressing deficiencies due to congenital anomalies, trauma, or age-related changes in facial contours. They are commonly employed to augment regions such as the chin, zygomas, and mandibular angles, providing structural enhancement and symmetry restoration. According to a 2020 survey conducted by the American Society of Plastic Surgeons, malar implants were identified as the most frequently performed facial implant procedure, ranking third among all cosmetic surgical interventions, highlighting their prominence in contemporary facial aesthetic practices [1]. The utilization of facial implants has demonstrated a notable increase over the past two decades. Specifically, malar implant procedures have surged by 938% since 2000, whereas chin augmentation has shown a more modest increase of 63% within the same period. Although procedures involving other bony surfaces such as the nasal dorsum, glabella, and temporal regions are less commonly undertaken, they remain integral to comprehensive facial reconstruction and augmentation strategies [1]. Recent systematic reviews conducted in 2024 and 2025 report pooled complication rates ranging from 4% to 11%, with malar and chin implants exhibiting lower complication frequencies compared to implants placed in paranasal and other less conventional regions [2]. These findings underscore the relative safety of malar and chin augmentations while emphasizing the need for careful planning in anatomically complex or less frequently augmented areas.

The selection of implant materials is guided by requirements for chemical inertness, biocompatibility, and surgical manipulability. Despite these properties, all implants inherently constitute foreign bodies and carry associated risks. Facial implants are categorized into organic and synthetic types. In the United States, synthetic materials such as high-density polyethylene (HDPE), silicone, and titanium remain predominant due to their reliability and predictability, whereas the use of autogenous grafts has declined owing to long-term variability in outcomes and challenges in achieving consistent results [3]. Material choice is therefore a critical determinant of both short-term surgical success and long-term aesthetic stability. Complications associated with facial implants range from minor aesthetic concerns to severe surgical challenges. Poor cosmetic outcomes, frequently resulting from asymmetry or malpositioning, are among the most common complications. More serious issues, including infection and localized bone erosion, can necessitate implant removal. The removal process is technically demanding, particularly for porous implants that permit soft tissue ingrowth, whereas solid implants encapsulated by fibrous tissue are comparatively easier to extract [4][5]. These complications highlight the importance of precise surgical technique, careful patient selection, and thorough preoperative planning.

Technological advancements have facilitated enhanced evaluation and surgical planning through software-assisted facial analysis. The incorporation of three-dimensional (3D) imaging has revolutionized treatment planning by providing detailed spatial representations of facial structures. Although two-dimensional (2D) imaging continues to offer valuable insights into bony relationships and their correlation with soft tissue contours, its limitations are evident in complex midface assessments. Lateral cephalograms remain the standard for evaluating chin deficiencies and planning genioplasty procedures, but midface and malar analyses benefit significantly from 3D modalities, indicating the ongoing need for research and refinement in imaging techniques. The integration of objective clinical criteria with patient-centered aesthetic considerations guides implant selection and surgical decision-making. While societal and cultural trends influence aesthetic preferences, achieving optimal outcomes requires a combination of accurate diagnosis, comprehensive facial analysis, careful selection of implant type and size, and precise surgical execution. The synergy of these factors is critical to balancing functional restoration with aesthetic enhancement, ensuring both patient satisfaction and procedural success.

Anatomy and Physiology

Successful facial implant placement requires a comprehensive understanding of the underlying anatomical and physiological structures to minimize the risk of injury and optimize both functional and aesthetic outcomes. Key structures of concern include sensory and motor nerves, vascular networks, and the musculature of the face, each of which must be carefully preserved during surgical intervention. The trigeminal nerve, or cranial nerve V (CN V), provides both sensory innervation to the facial region and motor control to specific muscles of mastication. CN V is divided into three main branches—ophthalmic (V1), maxillary (V2), and mandibular (V3)—each exiting the skull through distinct foramina and extending terminal branches to target soft tissues on the facial surface [6]. The ophthalmic division (V1) exits via the superior orbital fissure and subdivides into the frontal, lacrimal, and nasociliary nerves. The frontal branch traverses the orbit and emerges as the supraorbital and supratrochlear nerves, innervating the upper eyelid, conjunctiva, and anterior scalp. The lacrimal nerve, though the smallest branch of V1, communicates with the zygomatic nerve and supplies the lateral upper eyelid and lacrimal gland. The nasociliary nerve further divides within the orbit, giving rise to terminal branches such as the infratrochlear and external nasal nerves, which supply the medial upper eyelid and dorsum of the nose. These branches are particularly susceptible to injury at points of exit and during subperiosteal dissection associated with implant placement.

The maxillary division (V2) exits the skull through the foramen rotundum and gives rise to the infraorbital and zygomatic nerves. The infraorbital nerve emerges from the infraorbital foramen, providing sensory input to the soft tissues from the lower eyelid to the upper lip. The zygomatic nerve courses along the lateral orbit and divides into zygomaticotemporal and zygomaticofacial branches, which supply the temple and malar regions. These nerves are at elevated risk during zygomatic implant procedures due to their proximity to common dissection planes. The mandibular division (V3) exits via the foramen ovale and contains multiple branches, including pterygoid, masseteric, deep temporal, buccal, auriculotemporal, lingual, and inferior alveolar nerves. While V3 provides motor innervation to muscles of mastication, most fibers are shielded from subperiosteal dissection planes, though the inferior alveolar nerve and its terminal branch, the mental nerve, are frequently encountered during chin implant procedures [7][8]. The mental nerve exits the mental foramen, located approximately 1.5 cm superior to the inferior mandibular border, and supplies sensory innervation to the lower lip, chin, and associated gingival tissues, necessitating careful surgical planning during genioplasty. The facial nerve (cranial nerve VII, CN VII) provides motor innervation to the muscles of facial expression. CN VII exits the skull through the stylomastoid foramen and divides within the parotid gland into five primary branches: temporal, zygomatic, buccal, mandibular, and cervical. While these branches are not directly encountered during implant dissection, they remain vulnerable to stretching or compression, particularly during zygomatic or midface augmentation. The temporal branch innervates the frontalis and superior orbicularis oculi, the zygomatic branch supplies the inferior orbicularis oculi and nasal musculature, and the buccal branch controls the upper lip and cheek. The marginal mandibular branch courses along the mandibular border, supplying the mentalis and depressor anguli oris, while the cervical branch innervates the platysma [9]. Injury to these branches can compromise functional facial expressions and esthetic outcomes.

Facial vasculature arises primarily from branches of the external carotid artery. Major vessels are most vulnerable during initial incision and subperiosteal dissection, particularly when accompanying neurovascular bundles emerge from cranial foramina. For instance, the infraorbital and mental arteries and veins accompany their respective nerves and require careful management to avoid hemorrhagic complications. Facial musculature includes both muscles of expression and muscles of mastication. Muscles of facial expression are positioned subcutaneously across the scalp, face, and neck, attaching to bone or fascia to produce dynamic movements of the overlying skin. All receive motor innervation from CN VII, and precise knowledge of their position is essential to avoid inadvertent damage. Muscles of mastication, including those attached near the chin and malar regions, are critical for functional activities such as chewing and speech, and contribute to facial contour. They are innervated by CN V3, and improper implant placement can lead to pain, impaired function, or compromised esthetic outcomes. Recognition of anatomical landmarks, nerve courses, and muscular attachments is therefore fundamental to safe and effective facial implant surgery [6][7][8][9].

Indications

Facial implants are indicated for a variety of functional and aesthetic purposes, providing structural support, correcting asymmetry, and restoring facial volume lost through aging, trauma, or congenital anomalies. These interventions address both soft tissue and skeletal deficiencies, offering solutions where non-surgical measures are insufficient. Among the primary functional indications are loss of soft tissue support, progressive volume loss, and skeletal or soft tissue asymmetry secondary to growth discrepancies, trauma, or congenital syndromes [10]. Bony resorption of the viscerocranium typically becomes clinically evident during the third and fourth decades of life, contributing to age-related changes in facial contour. Skeletal atrophy is often uneven, with regions such as the infraorbital and pyriform maxillary areas demonstrating more pronounced deficiency, leading to midfacial volume loss and the appearance of facial hollowing. The support of the overlying soft tissue is largely dependent on osseocutaneous ligaments, including the zygomatic and mandibular ligaments, which attach to the periosteum and skin. Additionally, the masseteric ligaments extend from the musculature to the dermis. As these ligamentous structures weaken with age and lose elasticity, soft tissue ptosis occurs under gravitational forces, resulting in a downward displacement of malar fat pads and contributing to jowl formation [10].

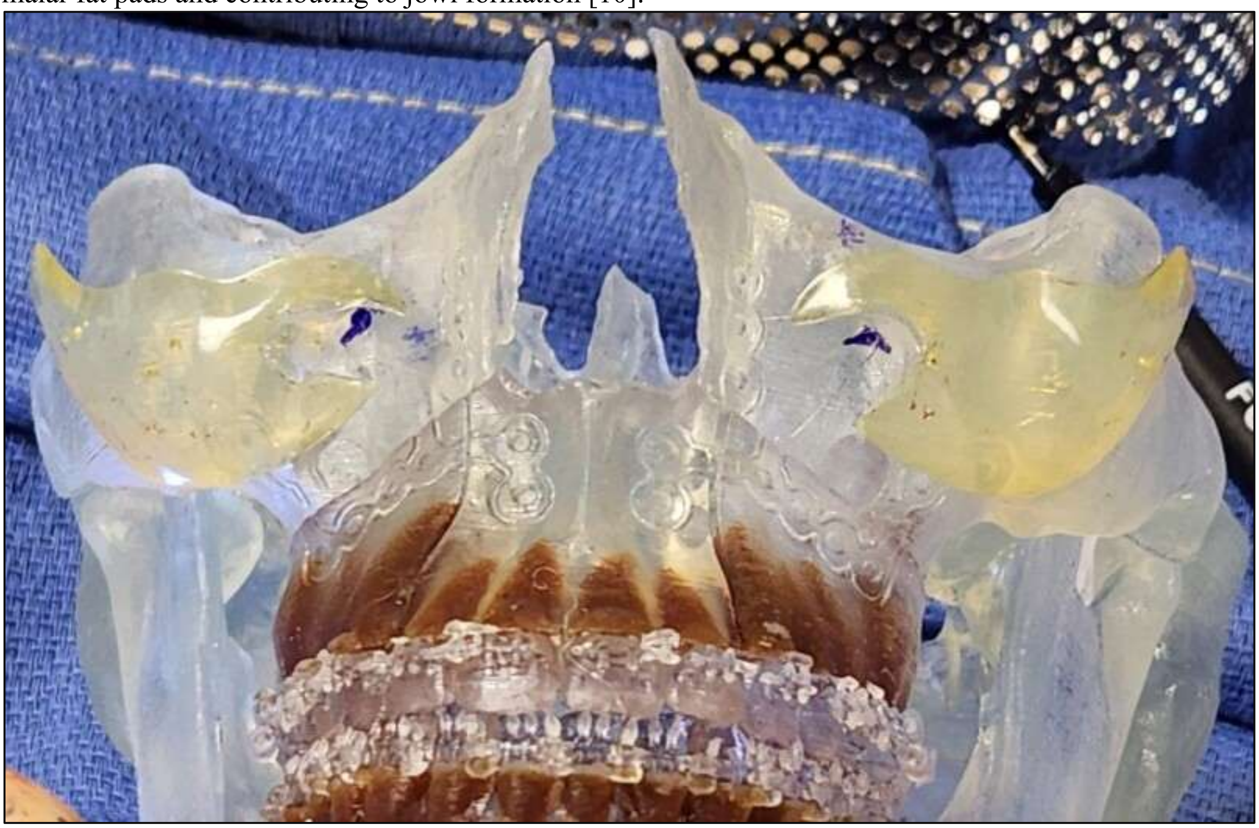

Fig. 1: Silicone Malar Implants.

Facial fat compartments, distributed in both superficial and deep layers and separated by fascial septa, undergo progressive atrophy over time. In the malar region, for example, superficial and deep fat pads are delineated by the superficial muscular aponeurotic system (SMAS). Loss of volume in these compartments, coupled with ligamentous laxity and skin sagging, contributes to the characteristic signs of facial aging. The prejowl sulcus, a depression along the anterior mandibular border, cannot be corrected solely through genioplasty. In fact, osteotomies performed during genioplasty may exacerbate this sulcus. Prejowl implant placement, therefore, represents the preferred intervention to correct such defects, with augmentation possible in the chin, prejowl region, or both, depending on the extent of skeletal deficiency [11]. Facial asymmetry may also arise from deviations in craniofacial growth patterns. Human skull development occurs along multiple planes—transverse, sagittal, and vertical—resulting in complex interactions between skeletal components. The maxilla typically grows anteriorly, inferiorly, and laterally, whereas the mandibular condyles exhibit superoposterior growth that displaces the mandible in an anteroinferior direction. The chin generally completes growth before the remainder of the mandible, which continues to develop transversely and vertically during adolescence. Disruptions in these growth trajectories can lead to malocclusion, mandibular rotation, and abnormal facial proportions. Individuals may present with a dolichocephalic phenotype, characterized by a long, retrognathic vertical profile, or a brachycephalic phenotype, defined by a short, prognathic, and horizontally oriented mandibular morphology [12][13].

In cases of hypoplastic mandibles or residual skeletal deficiencies, orthodontic treatment can address associated dental malocclusions; however, this intervention alone is often insufficient to restore facial contour. Orthognathic surgery and implant-based augmentation serve as complementary strategies for achieving functional occlusion and aesthetic harmony. The choice between osteotomy, implant placement, or combined approaches depends on the severity of the skeletal discrepancy, patient-specific anatomical factors, and desired aesthetic outcomes [14]. Congenital syndromes affecting the first and second branchial arches frequently result in craniofacial anomalies that may benefit from implant-based interventions. Craniofacial microsomia, for instance, commonly involves hypoplasia of the maxilla, mandible, and orbits, representing the second most prevalent congenital craniofacial deformity after cleft lip and palate. Clinical severity varies considerably, necessitating individualized treatment planning. In mild forms of the disorder, facial implants can provide predictable aesthetic enhancement and structural support. They may also be employed in patients who have undergone previous corrective procedures, including orthognathic surgery, to refine facial symmetry and restore lost volume [15].

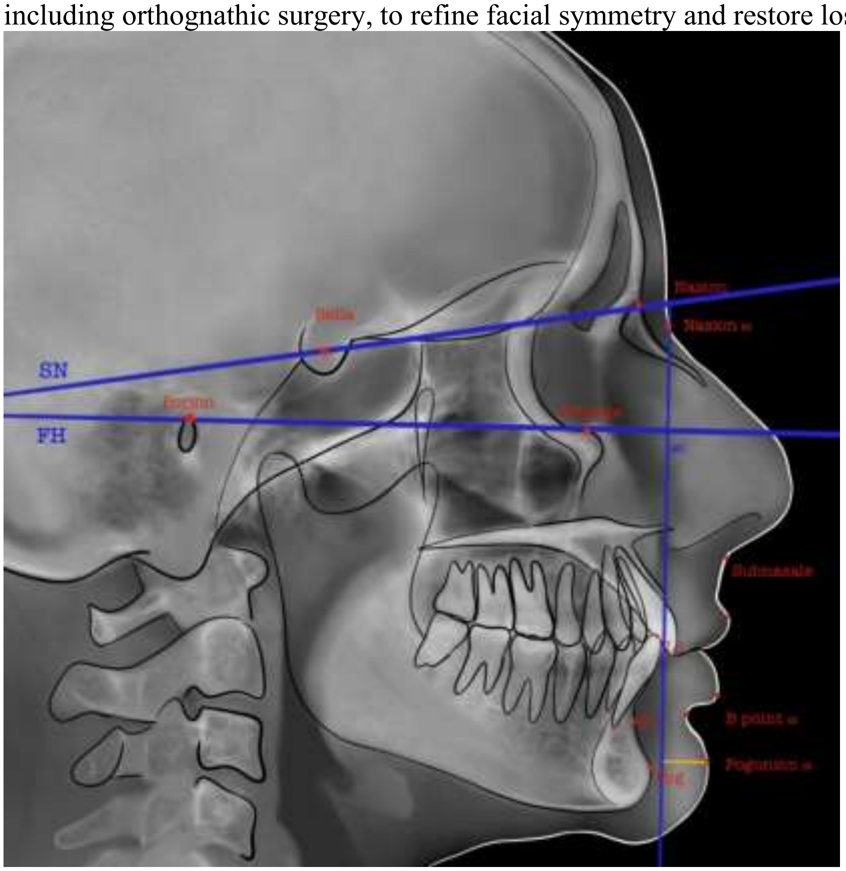

Fig. 2: Zero Degree Meridian.

Similarly, patients with cleft lip and palate frequently present with midfacial deficiencies, particularly malar hypoplasia, which may persist despite prior surgical interventions such as Le Fort I osteotomies. While osteotomies can improve the nasolabial angle and upper lip projection, their capacity to correct malar deficiencies is limited. In these cases, facial implants offer a reliable method for augmenting deficient regions, complementing surgical reconstruction and optimizing aesthetic outcomes [16]. Implant placement in these patients requires careful assessment of skeletal architecture, soft tissue thickness, and prior surgical modifications to ensure proper positioning and long-term stability. Overall, indications for facial implants encompass both the restoration of facial aesthetics and the correction of functional deficits. They address age-related skeletal and soft tissue changes, asymmetries resulting from atypical craniofacial growth, congenital deformities, and post-traumatic or post-surgical deficiencies. Success in these procedures relies on a comprehensive understanding of craniofacial anatomy, soft tissue biomechanics, and individualized patient assessment. Proper patient selection, meticulous surgical planning, and consideration of both functional and aesthetic goals are critical for achieving optimal outcomes, ensuring that implants provide durable support, restore facial harmony, and maintain natural appearance across dynamic facial movements. The integration of implants with adjunctive treatments, such as orthognathic surgery or soft tissue augmentation, allows for tailored interventions that address complex anatomical deficiencies. Emerging technologies, including three-dimensional imaging and computer-assisted surgical planning, further refine the ability to predict postoperative outcomes and enhance precision in implant placement. Collectively, these approaches underscore the critical role of facial implants in modern craniofacial surgery, highlighting their utility in both aesthetic and reconstructive contexts [10][11][12][13][14][15][16].

Contraindications

Facial implant surgery carries specific contraindications that must be carefully evaluated to ensure patient safety and optimal outcomes. One primary consideration is incomplete craniofacial growth, as premature implant placement can interfere with natural skeletal development and result in asymmetry over time. Female individuals generally reach skeletal maturity earlier than males, with most craniofacial growth completing between ages 14 and 16, whereas males may continue to experience growth until ages 16 to 18 [17]. Accurate assessment of growth cessation is therefore critical before planning implant procedures. The Craniofacial Growth Consortium Study defines growth cessation using precise quantitative criteria, including annual linear growth of less than 0.1 mm or growth rates below 10% of peak velocity. Serial cephalometric imaging is commonly employed to monitor these parameters, allowing clinicians to make informed decisions regarding surgical timing [18]. Large-volume facial deficits may represent another contraindication, as implants have limitations in terms of the amount of augmentation they can provide. Extensive deficiencies are often more appropriately addressed with orthognathic surgery, autologous grafting, or combination procedures. Implant-based augmentation may be insufficient in these cases, particularly when skeletal reconstruction is required to restore functional occlusion or facial harmony. Active infection at the proposed surgical site represents an absolute contraindication, as introducing a foreign body into an infected field significantly increases the risk of complications, including implant rejection, soft tissue necrosis, and systemic spread of infection.

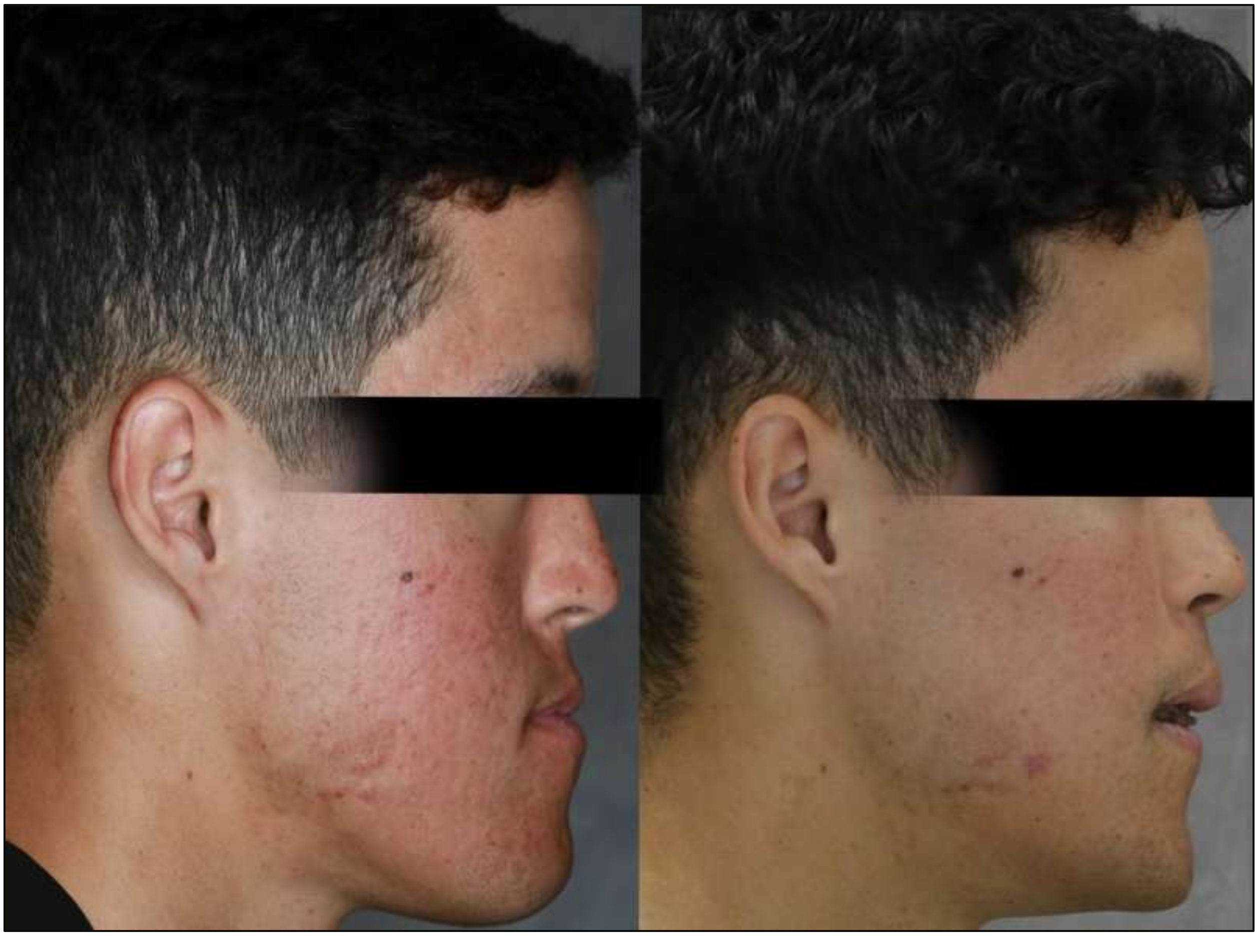

Fig. 3: Zygomatic Malar Implants.

Inadequate bony or soft tissue support also limits implant suitability. Thin, soft tissue coverage increases the likelihood of implant visibility, palpability, and postoperative contour irregularities. Conversely, sufficient soft tissue thickness and bone volume are necessary to provide stable support for the implant and ensure predictable aesthetic results. Patients with skeletal discrepancies complicated by dental malocclusion are typically better candidates for orthognathic surgery, as osteotomies allow for more comprehensive correction. Nevertheless, patient preference may favor implant-based solutions, provided that the anatomical limitations are thoroughly evaluated and expectations are managed realistically. Comprehensive preoperative assessment, including imaging studies, growth analysis, and evaluation of soft tissue characteristics, is therefore essential to identify contraindications and guide treatment planning. Recognizing these limitations helps prevent suboptimal outcomes, reduces complication risks, and ensures that facial implant surgery is performed safely and effectively, aligning with both functional and aesthetic objectives [10][17][18].

Equipment

Facial implant procedures rely on specialized equipment and implant materials that are designed to achieve both functional and aesthetic outcomes. The choice of implant material is dictated by the site of augmentation, desired rigidity, tissue integration potential, and surgeon preference. Titanium remains one of the most widely used alloplastic materials for facial skeletal augmentation. Chemically inert, nonresorbable, and rigid, titanium implants are particularly suited for mandibular angle reconstruction and augmentation of both length and width. Fenestrated mesh designs facilitate soft tissue and periosteal ingrowth, enhancing primary stability and reducing the risk of implant migration over time [19]. Titanium's biocompatibility and mechanical strength make it a reliable choice for areas requiring structural support or load-bearing capacity. High-density polyethylene (HDPE) implants represent another major class of alloplastic materials. These implants are rigid and thermoplastic, available in a range of pore sizes and densities, typically from 80 to 400 µm [20]. The porosity of HDPE implants determines the type and extent of tissue integration. Studies indicate that pore diameters between 100 and 250 µm support bony ingrowth, while smaller pores generally favor fibrous tissue integration [21]. Due to their porous nature, HDPE implants require secure fixation during surgery to avoid disruption of neovascularization and to maintain long-term stability. The thermoplastic characteristics of HDPE allow intraoperative modification, which is achieved by heating the implant to approximately 180 °F and sculpting it with appropriate instruments [22]. These properties make HDPE versatile for contouring complex facial surfaces, including malar and submalar regions.

Silicone implants differ from HDPE and titanium in that they are nonporous and do not support tissue ingrowth. Solid silicone or dimethylsiloxane subunit implants become encapsulated within surrounding tissues, necessitating fixation to the underlying bone to minimize mobility and reduce the formation of dead space, which can predispose to seroma formation, implant migration, and aesthetic compromise [23]. Current literature debates the optimal fixation method, with both screws and sutures being employed. A 2023 narrative review concluded that complication rates, including displacement, bone resorption, and infection, were statistically similar for fixated and nonfixated implants, although certain anatomical sites may benefit from screw fixation to enhance stability [24]. These findings underscore the importance of precise pocket creation, proper implant design, and meticulous surgical technique in achieving long-term outcomes, sometimes exceeding the influence of fixation hardware alone. Autogenous implants, harvested from the patient, are less frequently used in cosmetic augmentation due to unpredictable resorption patterns and increased procedural complexity. Bone grafts require mechanical stress to maintain density, consistent with Wolff's law, which dictates that bone remodels in response to functional loading [25]. Sites subjected to minimal mechanical stress experience accelerated resorption, compromising implant longevity. Additionally, autografts carry risks of donor site morbidity and prolong operative time [26].

Advances in technology have introduced patient-specific implants, which are increasingly utilized for complex or asymmetrical facial defects. These implants, fabricated from titanium, polyetheretherketone (PEEK), or HDPE composites, are designed from patient-specific imaging data obtained via CT or cone-beam CT scans. Patient-specific implants provide precise conformity to the underlying anatomy, reducing the need for intraoperative modification and improving overall implant fit. Emerging evidence suggests that these customized implants may lower complication rates, including soft tissue irritation, displacement, and infection, compared with stock preformed implants [27]. Anesthesia is an essential component of facial implant procedures. Deep intravenous or general anesthesia is typically induced, followed by local infiltration using lidocaine combined with longer-acting agents such as bupivacaine. Administration is performed with a dental syringe and a fine-gauge needle, usually 27-gauge, to achieve precise tissue analgesia. Surgical incisions are created using either a #15 scalpel blade or bovie electrocautery, based on the surgeon's preference and the anatomical site involved. The surgical armamentarium remains consistent across different implant materials and facial regions, emphasizing meticulous handling, precise placement, and proper fixation to optimize both aesthetic and functional outcomes. Overall, the combination of advanced implant materials, patient-specific designs, and standardized surgical instrumentation provides surgeons with the necessary tools to achieve predictable and durable facial augmentation outcomes. The integration of technological advances, careful material selection, and refined surgical technique continues to enhance the safety and effectiveness of facial implant procedures.

Personnel

Facial implant procedures require a coordinated surgical team, with the primary composition typically including the lead surgeon and a surgical assistant. In many cases, a cosurgeon is also involved to facilitate complex dissections, enhance precision, and reduce operative time. The surgical team's composition is complemented by a secondary team responsible for anesthesia management, which includes an anesthesiologist and, when indicated, a nurse anesthetist. This team ensures the patient maintains an appropriate depth of anesthesia, whether general or deep intravenous, and provides intraoperative support, including hemodynamic monitoring and airway management. Operating room nurses and surgical technicians play essential roles in facilitating the procedure. Their responsibilities range from instrument preparation and maintenance of a sterile field to assisting with tissue retraction and handling of implants. Although oral and maxillofacial surgeons are trained to administer deep anesthesia, the standard of care favors the presence of a dedicated anesthesia provider to maximize patient safety and optimize perioperative monitoring. Intraoperative nerve monitoring is generally not required due to the subperiosteal dissection plane, which allows for safe tissue reflection while avoiding critical neural structures. Key nerves, such as the mental and infraorbital nerves, are directly visualized and meticulously protected throughout the procedure, minimizing the risk of iatrogenic injury. The coordinated efforts of the surgical and anesthesia teams, alongside vigilant intraoperative management, are crucial for ensuring patient safety, implant stability, and optimal surgical outcomes [27][28].

Preparation

Comprehensive facial implant planning relies on detailed anatomical evaluation, which has advanced considerably with the integration of three-dimensional (3D) imaging technologies. Clinicians routinely combine two-dimensional (2D) photography with both 2D and 3D radiographic assessments to obtain an accurate understanding of the patient's facial morphology. Traditional 2D cephalometric analyses remain foundational in assessing facial proportions; however, their application is limited when interpreting complex 3D structures. Innovations such as stereophotogrammetry, cone-beam computed tomography, and digital surface scanning now allow for volumetric analysis of hard and soft tissues, enhancing the precision of preoperative planning and facilitating objective measurements of facial symmetry, curvature, and contour [28]. 3D anthropometric evaluations provide more accurate representations of facial geometry than linear or angular 2D analyses, including measurements like the Holdaway and labiomental angles. Integration of artificial intelligence-assisted cephalometric software and virtual surgical planning enables simulation of postoperative outcomes, optimization of implant positioning, and individualized implant design. Digital overlays and virtual surgical simulations support objective assessment of midface projection, chin prominence, and mandibular width, ensuring patient-specific surgical strategies and more predictable results. Standardized photographic documentation is obtained with the patient in frontal, oblique (45°), and lateral orientations to capture volumetric data from multiple perspectives. Lateral cephalograms remain critical for evaluating skeletal relationships and soft tissue contours essential to surgical planning.

Chin evaluation involves several cephalometric parameters. The Holdaway ratio compares the bony chin position relative to the lower incisor tips using key landmarks: pogonion, lower incisor tip, nasion, and B point. Deviations greater than 4 mm indicate a need for surgical correction. The 0° meridian line, perpendicular to the Frankfort horizontal plane at the nasion, provides an additional metric, with ideal chin positioning measuring 0 mm in females and up to 2 mm in males. The true vertical line, intersecting the subnasale, assesses mandibular retrusion and protrusion, with deviations up to 4 mm retrusion or 2 mm protrusion generally undetectable to untrained observers [29]. The labiomental angle, which reflects soft tissue convexity between the lower lip and chin, informs implant sizing. Chin morphology influences augmentation requirements: vertical chins typically need approximately 8 mm of augmentation, posteriorly angled chins may require 12 mm or more, and convex labiomental angles demand caution to avoid overcorrection. Transverse mandibular assessment is also essential. Bigonial width, defined as the distance between the most lateral posterior points of the mandible, is evaluated relative to bizygomatic width to guide posterior implant placement. In Caucasian individuals, males exhibit a bigonial width approximately 34 mm narrower than the bizygomatic width, whereas females demonstrate a 36 mm difference. Midfacial deficiencies are evaluated using multiple reference points, including the malar eminence, which ideally aligns with the Frankfort horizontal plane 2 to 2.5 cm lateral to the lateral canthus. Alternative assessments relate the malar eminence to the cornea, with normative positioning ranging 4 to 8 mm anterior to the corneal plane [31]. The Hinderer point represents the most prominent aspect of the malar region, situated 15–20 mm inferior and 10 mm lateral to the lateral canthus [32].

Binder's classification system categorizes midfacial deficiencies into three types, informing implant selection and positioning strategies. Type 1 deficiencies involve skeletal hypoplasia with malar projection loss and are addressed with malar shell implants to increase lateral and anterior projection. Type 2 deficiencies, the most common, reflect submalar soft tissue volume loss and are corrected using submalar implants positioned inferior to the zygoma along the anterior maxilla. Type 3 deficiencies combine skeletal and soft tissue volume deficits, often requiring larger or combined implants to restore both structural and aesthetic harmony. Tailored implant design based on precise preoperative imaging and cephalometric analysis is essential for optimizing functional and cosmetic outcomes, minimizing complications, and ensuring long-term patient satisfaction. This preparation phase underscores the importance of integrating advanced imaging modalities, cephalometric evaluation, and individualized planning in modern facial implant surgery. By applying objective measurements alongside virtual surgical simulations, clinicians can achieve precise restoration of facial symmetry, proportion, and volume, addressing both congenital and acquired deficiencies while reducing intraoperative uncertainty and improving postoperative predictability [29][30][31].

Technique or Treatment

Facial implant procedures require meticulous planning and execution, with a strong emphasis on minimizing infection risk and ensuring accurate implant positioning. Antibiotic prophylaxis is fundamental for the success of these procedures. Broad-spectrum antibiotics are administered preoperatively, intraoperatively, and postoperatively. For extraoral incisions, cefazolin is commonly used to cover skin flora, including Staphylococcus species. In contrast, intraoral approaches necessitate coverage for oral gram-positive aerobes and anaerobes, often achieved with amoxicillin or third-generation penicillins. Alternative intraoperative options include ampicillin-sulbactam or cefazolin. Postoperative antibiotic use remains a topic of debate, with no clear consensus regarding optimal duration or timing [33][34][35]. Surgical site preparation involves antiseptic cleansing, usually with iodine, followed by administration of local anesthesia. The depth of anesthesia depends on the complexity of the procedure and the approach used. Most implants are placed under intravenous sedation or general anesthesia, with certain procedures, such as malar implant placement via transconjunctival access, occasionally requiring neuromuscular blockade. Factors influencing anesthetic choice include procedural duration, cost, and the anesthesiologist's expertise.

Malar implants are predominantly placed using an intraoral approach. A mucosal incision is made 0.5 to 1.0 cm above the gingival margin posterior to the canine fossa. Subperiosteal dissection is performed bluntly along the anterior maxilla with a periosteal elevator, extending superiorly toward the infraorbital rim while carefully protecting the infraorbital neurovascular bundle. For more extensive type 2 or 3 midfacial defects, dissection extends laterally to the masseteric tendon to accommodate the implant. Implant sizers, often provided by the manufacturer or obtained separately, verify pocket adequacy and implant dimensions, while 3D stereolithographic models may assist in preoperative visualization and intraoperative trimming. Implants and sizers are soaked in antibiotics, and the dissection pocket is irrigated prior to insertion. Proper seating is critical to avoid folding, asymmetry, or soft tissue compromise. Fixation is achieved with nonresorbable sutures or titanium screws, followed by layered closure and application of compressive dressings to minimize dead space and postoperative edema. Elastic head wraps are typically worn continuously for the first seven days and then during sleep for additional lymphatic support [36]. Chin implants may be inserted via intraoral or submental incisions. Intraoral placement involves an anterior vestibular incision extending from canine to canine, with visualization of the mentalis muscle. A cuff of muscle is preserved to maintain function, while the subperiosteal pocket is created laterally along the inferior border and superiorly beyond the planned implant dimensions. Special care is taken to identify and protect the mental nerve. Implant sizers confirm adequate pocket dimensions, and Aufricht retractors may enhance nerve protection during lateral dissection. Fixation is achieved with nonresorbable sutures or titanium screws, and layered closure follows, reapproximating the mentalis muscle before mucosal closure using resorbable sutures [37].

Posterior mandibular implants involve subperiosteal dissection along the ramus to the sigmoid notch. Releasing the pterygomasseteric sling allows for placement of titanium mesh implants along the inferior and posterior borders. Fixation with monocortical screws ensures stability and minimizes dead space. Intraoral or extraoral incisions may be used depending on implant size and malleability. For larger or rigid implants, a transcutaneous lateral incision can facilitate screw placement and enhance fixation. Throughout the procedure, identification and protection of the mandibular nerve are critical to prevent neuropraxia or sensory deficits. Layered closure using resorbable sutures reduces infection risk and scarring, while postoperative monitoring ensures early detection of complications. Postoperative care is essential for maintaining functional and aesthetic outcomes. Patients are advised to follow a soft-food diet to minimize stress on mastication muscles affected by dissection. Compressive therapy, including elastic wraps and cheek bolsters, supports soft tissue approximation and decreases edema. Bolsters are generally removed within 1 to 2 days, as the periosteum and bony surfaces reapproximate within 24 to 48 hours. Follow-up visits allow for early identification of complications, including infection, implant migration, asymmetry, or nerve injury, enabling timely intervention to optimize long-term outcomes [37]. Overall, the technique for facial implant placement integrates preoperative planning, careful dissection, implant sizing and fixation, and meticulous postoperative management. Proper execution minimizes complications while ensuring symmetry, stability, and functional integrity, ultimately achieving both aesthetic and structural goals.

Complications

Complications following facial implant placement may occur during the immediate postoperative period or emerge months to years later. Early complications typically manifest within the first few weeks of soft tissue healing, while late complications may develop gradually as the implant interacts with surrounding tissues over time [38]. Recognition and management of these complications are essential to ensure patient safety, preserve function, and maintain aesthetic outcomes. Bleeding is a common early complication, often presenting as a hematoma. Hematomas may expand rapidly, requiring prompt drainage, and are usually caused by inadequate intraoperative hemostasis. Seroma formation is another early complication that arises due to the inflammatory response to the implant or disruption of local glandular tissue. The risk of fluid accumulation can be minimized through conservative subperiosteal dissection and meticulous handling of soft tissues. Management may involve observation, antibiotic therapy, fluid aspiration, or, in severe cases, surgical intervention to evacuate the collection and control ongoing bleeding. Wound dehiscence, though less common, can occur if closure is under tension or in the presence of infection, necessitating early recognition and appropriate repair to prevent further morbidity. Late complications are more diverse and often involve the implant or underlying bone. Infection is a critical concern, with pooled rates for alloplastic implants reported between 2% and 5%. Intraoral approaches reduce visible scarring but may carry a slightly higher infection risk, a point still debated in the literature. Persistent infection unresponsive to conservative therapy may require implant removal to prevent progression to deeper tissue involvement or osteomyelitis. Implant mobilization, extrusion, or migration can result from inadequate fixation, suboptimal pocket creation, or patient-specific anatomical factors. Porous polyethylene implants have been shown to reduce the risk of bone resorption compared with solid silicone implants due to tissue ingrowth and more favorable load distribution. Proper implant sizing, fixation, and careful subperiosteal placement are critical to preventing these issues [38].

Esthetic complications often result from malposition, asymmetry, or implant folding. Improper sizing or placement may compromise facial symmetry and function. Chin implants, in particular, are susceptible to functional complications when the mentalis muscle is actively engaged against the underlying implant. Placement at the inferior mandibular border, where cortical bone is thicker, reduces resorption and distributes muscular forces more evenly. Implant fixation further mitigates micromovements that contribute to bone erosion. Surgical correction of malpositioned implants may involve repositioning, replacement, or fixation enhancement to achieve optimal results. Neurologic complications primarily involve the mental and infraorbital nerves. Mental nerve injury is reported in approximately 2.4% of cases, often in association with alveolar ridge resorption or improper implant placement. Neurologic sequelae include hypoesthesia, dysesthesia, or anesthesia affecting the ipsilateral chin and lower lip. Identification and careful preservation of nerves during dissection are paramount, as persistent deficits may necessitate implant removal or adjustment. Injury to the infraorbital nerve during malar implant placement can similarly result in sensory disturbances to the midface. Functional complications can include lip incompetence, particularly when chin implants are improperly sized or positioned. Excessive pressure from the mentalis muscle may exacerbate ptosis or "witch's chin," a deformity resulting from inadequate reapproximation of the muscle during intraoral approaches. While extraoral approaches eliminate the risk of mentalis ptosis, they carry the potential for visible submental scarring. Attention to surgical technique, including layered closure and muscle reapproximation, is essential to minimize these outcomes. Overall, facial implant complications encompass a spectrum of early and late events, including bleeding, seroma, infection, implant migration, bone resorption, poor cosmesis, and nerve injury. Effective prevention relies on meticulous surgical planning, precise dissection, accurate implant selection, secure fixation, and rigorous postoperative monitoring. Early recognition and intervention are critical to preserving function and aesthetic results while minimizing the need for secondary procedures. The interplay of implant material, surgical technique, anatomical variations, and patient-specific factors dictates complication risk, highlighting the importance of individualized treatment planning [38].

Clinical Significance

Facial implant surgery offers a versatile and less invasive alternative to traditional osteotomies and other complex bony procedures. These interventions allow targeted augmentation of the chin, malar region, and mandibular angles without the extensive surgical trauma associated with horizontal genioplasty or orthognathic procedures. Reduced invasiveness directly correlates with shorter operative times, lower anesthetic requirements, and decreased procedural costs. For instance, a study conducted at the University of California, Los Angeles, reported that operating room expenses may exceed $35 per minute [39]. Facial implant placement under local anesthesia or intravenous sedation can mitigate these costs while reducing the risks linked to general anesthesia, offering a safer option for patients with medical comorbidities or financial constraints. Recovery following facial implant surgery is typically faster than with bony osteotomies, as healing relies primarily on soft tissue adaptation rather than skeletal stabilization. Soft tissue edema generally resolves within several weeks, allowing patients to resume daily activities sooner than after extensive bone surgery. This accelerated recovery enhances patient satisfaction and reduces overall healthcare resource utilization.

Chin implants provide precise control over anterior and lateral projection, permitting modifications in shape and contour that harmonize the lower face. They can also correct subtle asymmetries, narrow or widen the chin, and complement other facial aesthetic procedures without altering bony architecture. Malar implants enhance midfacial projection, restoring volume lost due to aging, trauma, or congenital deficiencies, contributing to improved facial symmetry and a youthful appearance. Mandibular angle implants improve jawline definition, augment lower facial width, and may correct deficiencies resulting from trauma, growth anomalies, or age-related skeletal resorption. Such augmentation is particularly relevant for patients seeking masculinization of the lower face during gender-affirmation procedures or for individuals requiring posttraumatic reconstruction. Beyond cosmetic enhancement, facial implants restore structural support, preserving the overlying soft tissue and mitigating ptosis associated with age-related bone resorption. The procedure also facilitates interdisciplinary collaboration among surgeons, anesthesiologists, and allied healthcare providers, particularly in complex cases such as gender-affirmation surgery or reconstructive interventions. With proper training and meticulous surgical planning, facial implant placement is associated with a high safety profile and predictable outcomes, offering a reliable method to achieve aesthetic and functional facial improvement while minimizing procedural morbidity. Overall, facial implant surgery represents a practical, efficient, and customizable option for facial reconstruction and aesthetic enhancement, providing substantial clinical benefits for patients with congenital, posttraumatic, or age-related facial deficiencies [39][40].

Conclusion:

Facial implant surgery has evolved into a predictable, versatile, and highly effective modality for restoring structural support, correcting congenital or acquired deformities, and enhancing facial harmony. Advances in three-dimensional imaging, virtual planning, and improved implant materials have significantly elevated precision in both diagnosis and treatment planning, reducing intraoperative uncertainty and supporting individualized patient care. The availability of multiple implant materials—including titanium, silicone, and high-density polyethylene—allows surgeons to tailor augmentation strategies based on anatomical requirements, desired stability, and long-term tissue response. Despite its advantages, facial implant surgery is not without risk. Complications such as hematoma, seroma, infection, nerve injury, implant migration, and contour irregularities underscore the need for meticulous technique and diligent postoperative monitoring. Preoperative assessment remains central to success; understanding soft tissue thickness, skeletal architecture, nerve pathways, and patient expectations ensures safe and effective augmentation. Compared with more invasive osteotomies, implant-based augmentation offers reduced surgical trauma, quicker recovery, and the capacity for highly focused aesthetic refinement. When integrated within a multidisciplinary clinical framework—including radiology, pharmacy, dentistry, nursing, and emergency preparedness—facial implant surgery achieves high levels of safety, functionality, and patient satisfaction. Ultimately, the contemporary approach to facial implants emphasizes precision, anatomical respect, and comprehensive care to achieve durable and natural-appearing outcomes.

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