Facial Plastic and Reconstructive Surgery

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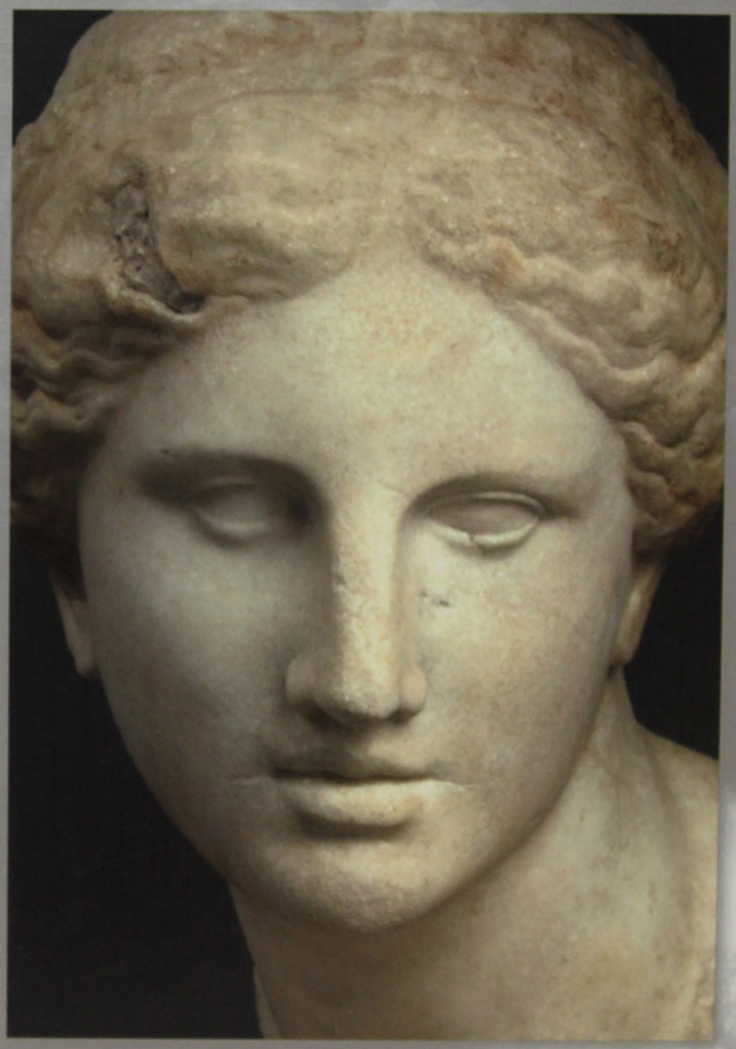
Third Edition



Thieme

32 Aesthetic Facial Implants

William J. Binder, Babak Azizzadeh, and Geoffrey W. Tobias

Over the last 2 decades, the marked improvement in biomaterial and the design of facial implants have expanded their use in aesthetic surgery. Alloplastic implants offer a long-term solution to augment skeletal deficiency, restore facial contour irregularity, and rejuvenate the midface. Common implant procedures include cheek augmentation to balance the effects of malar hypoplasia; mandibular augmentation to create a stronger mandibular profile and better nose–chin relationship; mandibular prejowl and angle implants to augment traditional cervicofacial rhytidectomy; submalar and midfacial implants to augment the hollowness that occurs during the aging process; nasal implants for dorsal augmentation; and premaxillary implants to augment a retrusive midface. Computer-assisted custom-designed implants now provide solutions for more complex facial defects due to trauma, congenital deformities, and human immunodeficiency virus (HIV) lipoatrophy.[1,2]

The concept of facial contouring implies a change in the shape of the face. The surgeon can produce substantive contour changes by judiciously altering mass and volume in different anatomical regions and redistributing the overlying soft tissue. Accurate facial analysis is critical to the success of using facial implants. The appropriate implant will depend on the relationship between different bony promontories and the surrounding soft tissue. The individual configuration of the nose, malar–midface area, and mandible–jawline determine the fundamental architectural proportions and contour of the face. Balance between these structures and the constant distribution of the overlying soft tissue structures determines facial beauty and harmony. Modern hallmarks of beauty are distinguished by bold facial contours that are accentuated by youthful convex malar–midface configurations and a sharp, well-defined jawline. Any of these promontories that are too small or too large affect the aesthetic importance of the others. For example, reducing the nasal prominence causes both the malar–midface and the mandibular–jawline volume and projection to appear relatively more distinct. In the same manner, enhancement of the mandibular or malar–midface volumes makes the nose appear smaller and less imposing. Typically, when augmentation is the desired goal, it is accomplished through selecting implants with the proper shape and design while controlling their position over the facial skeleton and soft tissue. As a result alloplastic facial contouring can be utilized to augment bony or soft tissue anomalies.

Implants and Biomaterials

All implant materials induce the formation of fibroconnective tissue encapsulation, which creates a barrier between the host and the implant.[3,4] Adverse reactions are a consequence of unresolved inflammatory response to implant materials. The behavior is also a function of configuration characteristics of the site of implantation such as the thickness of overlying skin, scarring of the tissue bed, and underlying bone architecture that would tend to create a condition for implant instability. For example, implants that are more deeply placed with thicker overlying soft tissue rarely become exposed or extrude. Other important factors such as prevention of perioperative hematoma, seroma, and infection can significantly reduce host–implant interaction and thereby improve implant survivability.

The Ideal Implant

The ideal implant material should be cost-effective, nontoxic, nonantigenic, noncarcinogenic, and resistant to infection. It should be inert, easily shaped, conformable, placed effortlessly, and able to permanently maintain its original form. The implant should be easy to modify and customize to the needs of the recipient area during the surgical procedure without compromising the integrity of the implant and should be easy to autoclave without degradation.

Favorable surface characteristics are important for implant placement and stabilization, and, paradoxically, equally important to facilitate easy removal and exchangeability without causing injury to surrounding tissues. Implant immobilization is related to their ability to be fixed in place for the lifetime of the patient. The characteristics of implant materials such as silicone elastomer induce the formation of a surrounding capsule that maintains implant position, while expanded polytetrafluoroethylene (ePTFE) (W. L. Gore & Associates, Inc., Flagstaff, AZ) which encapsulates to a lesser degree, provides fixation with minimal tissue ingrowth. Each material–host interaction provides certain advantages in different clinical settings. Materials that cause significant tissue ingrowth and permanent fixation are often undesirable, particularly if the patient desires to change augmentation characteristics in later years. The natural encapsulation process of silicone and the minimal surface

Fig. 32.1 The Conform type of implant (Implantech Associates, Ventura, CA) is made from a softer silicone material and has a grid design on the posterior surface of the implant that reduces its memory to more easily adapt to the underlying bone surface. The grid feature also reduces the chances of implant slippage and prevents displacement.

ingrowth in ePTFE products insure immobility yet provide exchangeability without damage to surrounding soft tissue.

The ideal implant design should have tapered margins that blend on to the adjacent bony surface to create a nonpalpable and smooth transition to the surrounding recipient area. An implant that is malleable and readily conforms to the underlying structures further reduces mobility, whereas the anterior surface shape should imitate the desired natural anatomical configuration. Newer silicone implants are currently being engineered for enhanced conformability to the underlying bony surface and surrounding soft tissue. For example, Conform implants (Implantech Associates, Ventura, CA) with a new type of grid backing reduces the memory of the silicone elastomer and improves flexibility. Greater adaptability to irregular bony surfaces reduces chances of movement and prevents posterior dead space from occurring between the implant and underlying bone (**Fig. 32.1**). Renewed interest in research and development in biomaterial engineering has developed a composite implant (using both silicone and ePTFE) that promises to combine the advantages two biomaterials for future use in facial implants.[5]

Implant Biomaterials

Polymeric Materials/Solid Polymers

1. *Silicone polymers*. Since the 1950s, various forms of silicone have been clinically used with an excellent safety-efficacy profile. Silicone is polymerized dimethylsiloxane that can be solid, gel, or liquid depending on its polymerization and cross-linkage. Solid silicone products tend to be more stable. The gel form of silicone can potentially over time leak some of its internal molecular substances. However, the most recent studies on breast implant gel silicone have shown no objective cause and effect for silicone in producing scleroderma, lupus, collagen vascular, or other autoimmune diseases.[6,7] Solid silicone elastomer has a high degree of chemical inertness. It is hydrophobic and extremely stable without any evidence of toxicity or allergic reactions.[8] Tissue reaction to solid silicone implants is characterized by a fibrous tissue capsule without tissue ingrowth. When unstable or placed without adequate soft tissue coverage, the implants are subject to moderate ongoing inflammation and possible seroma formation. Capsular contracture and implant deformity rarely occurs unless the implant is placed too superficially or if it migrates to the overlying skin.
2. *Polymethacrylate (acrylic) polymers*. This is supplied as a powdered mixture and catalyzed to produce a very hard material. The rigidity and hardness of the acrylic implants cause difficulty in many of the applications for using large implants inserted through small openings. In the preformed state, there is difficulty in conforming the implant to the underlying bony contour.
3. *Polyethylene*. Polyethylene can be produced in a variety of consistencies, now most commonly used in a porous form. Porous polyethylene, also known as MEDPOR (Porex Surgical, Inc., Newnan, GA) causes minimal inflammatory cell reaction. The material, however, is hard, and difficult to sculpt. The porosity of polyethylene permits extensive fibrous tissue ingrowth that provides an advantage for enhanced implant stability but makes it extremely difficult to remove.
4. *Polytetrafluoroethylene*. Polytetrafluoroethylene comprises a group of materials that have had a defined history of clinical application. The known brand name was Proplast, which is no longer made in the United States because of the related complications of its use in temporomandibular joints. Under excessive mechanical stress, this implant material was subject to breakdown, intense inflammation, thick capsule formation, infection, and ultimate extrusion or explantation.
5. *Expanded polytetrafluoroethylene*. ePTFE was originally produced for cardiovascular applications.[9,10] Animal studies showed the material to elicit limited fibrous tissue ingrowth without capsule formation and minimum inflammatory cell reaction. The reaction seen over time compared favorably with many of the materials in use for facial augmentation. The material has found acceptable results in subcutaneous tissue augmentation and for use as preformed implants. Due to lack of significant tissue ingrowth, ePTFE offers advantages in subcutaneous tissue augmentation because it can be modified secondarily and removed in the event of infection.
6. *Mesh polymers*. The mesh polymers, which include Marlex (Chevron Phillips Chemical Company, The Woodlands, TX), Dacron (Unifi, Inc., Greensboro, NC), and Mersilene (Ethicon, Cincinnati, OH), have similar advantages of being able to be folded, sutured, and shaped with relative ease, but they also promote

fibrous tissue ingrowth causing difficulty with secondary removal. Supramid (Resorba Wundversorgung, Nürnberg, Germany) is a polyamide mesh derivative of nylon that is unstable in vivo. It elicits a mild foreign body reaction with multinucleated giant cells, and over time causes implant degradation and resorption.[11]

Metals

Metals consist essentially of stainless steel, vitallium, gold, and titanium. Except for use of gold in eyelid reanimation and dentistry, titanium has become the metal of choice for long-term implantation. The advantages of titanium include high biocompatibility, corrosion resistance, strength, and minimal x-ray attenuation during computed tomographic scanning or magnetic resonance imaging. Titanium is primarily used in craniofacial reconstruction and has no use in facial augmentation.

Calcium Phosphate

Calcium phosphate or hydroxyapatite materials are not osteoconductive but do provide a substrate into which bone from adjacent areas can be deposited.[12] The granule form of hydroxyapatite crystals is used in oral and maxillofacial surgery for augmenting the alveolar ridge. The block form has been used as interpositional grafts in osteotomies.[13] However, they have been shown to be of less value as an augmentation or onlay material due to its brittleness, difficulty in contouring, and inability to adapt to bone surface irregularities and mobility.

Autografts, Homografts, and Xenografts

Autografts, available as autogenous bone, cartilage, and fat are limited by donor site morbidity and limitation of available donor material. Processed homograft cartilage has been used in nasal reconstruction, but eventually succumbs to resorption and fibrosis.

Tissue-Engineered Biocompatible Implants

During the past several years, tissue engineering has emerged as an interdisciplinary field. Properties of synthetic compounds are manipulated to enable delivery of an aggregate of dissociated cells into a host to re-create new functional tissue. The field of tissue engineering has evolved by combining scientific advances in multiple fields, including material science, tissue culture, and transplantation. These techniques facilitate the seeding of cells into a suspension that provides a three-dimensional environment that promotes matrix formation. This structure anchors cells and permits nutrition and gas exchange with the ultimate formation of new tissue in the shape of a gelatinous material.[14] Several tissue-engineered cartilage implants have previously been generated based upon these new principles. This includes joint articular cartilage, tracheal rings, and auricular constructs. Tissue engineering offers the potential to grow cartilage in a precisely predetermined shape, and presently is in the developmental stage of generating various types of contoured facial implants consisting of immunocompatible cells and matrix.[15] Once employed on a commercial basis, these techniques would require minimal donor site morbidity and, like alloplastic implants, reduce operative time.

Surgical Considerations for Alloplastic Implants

General

Patients endowed with strong, well-balanced skeletal features will best endure the negative effects of aging.[16] Analysis of the faces of teens reveals an abundance of soft tissue that provides the underlying framework for the harmonious composite of youthful facial form. Full cheeks with smooth, symmetrical contours and free of sharp, irregular projections, indentations, rhytids, or dyschromias commonly embody these youthful qualities.[17] Facial aging is influenced by genetic factors, sun exposure, smoking, underlying diseases, gravity, and the effects of muscular action, which produce hyperfunctional lines of aging.[18]

Depending upon the underlying skeletal structure, involutional soft tissue changes associated with the aging process bring about definable configurations of the face that appear progressively more obvious and pronounced with time. Recognizing these various defects and configurations is an integral part of determining if a patient is a candidate for facial contouring procedures. Facial involutional changes contribute to the flattening of the midface, thinning of the vermillion border of the lips, development of deep cavitary depressions in the cheek, and formation of deep skin folds and rhytides.[19] Other specific soft tissue configurations include the prominence of the nasolabial folds, flattening of the soft tissue button of the chin, and formation of the prejowl sulcus[20,21] (**Fig. 32.2**).

The ability to permanently replace soft tissue volume in sufficient quantity is one of the most elusive aspects of facial rejuvenation. The recent popularity of fat transplantation has reemphasized tissue replacement as a key component of the rejuvenation process. Alloplastic augmentation techniques are able to permanently address these problems by softening sharp angles or depressions, reexpanding the underlying surface to reduce rhytids as well as enhance inadequate skeletal structure.[22–24]

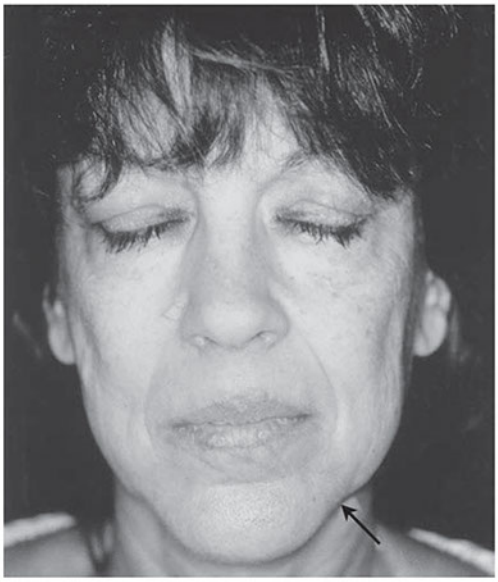


Fig. 32.2 Resorption of bone within the anterior mandibular groove, coupled with relaxation of the soft tissue causing progressive encroachment of the jowl, creates the prejowl sulcus and contributes to the development of the marionette lines (*arrow*). In these conditions, the prejowl implant is used to augment and help correct this specific deficiency and assist the rhytidectomy to achieve the desired straight mandibular line and prevent recurrence of the jowl. (From Binder WJ. A comprehensive approach for aesthetic contouring of the midface in rhytidectomy. Facial Plastic Surgery Clinics of North America 1993;1:231–255.)

Nasal Augmentation

The relatively thin skin overlying the nasal dorsum often fails to provide adequate camouflage for poorly contoured replacement tissue. Nasal augmentation has been performed using many different materials. Effective long-term dorsal nasal reconstruction has continued to remain problematic despite extensive efforts to use a wide variety of autografts, allografts, and alloplastic materials. A suitable replacement implant to reconstruct the original nasal profile must possess several unique characteristics. Its shape must be of adequate length, consistent curves, thickness, and tapered edges so that it can fit well over the nasal bridge and blend in with the surrounding soft tissues and bone. It must also possess a high degree of malleability, flexibility, and compliance so that the implant can endure long-term stress and trauma.

Autogenous tissues such as calvarial bone grafts as well as septal, conchal, and costal cartilage are always preferred. However, septal and conchal cartilages often do not provide adequate volume. Costal cartilage and calvarial bone grafts have additional donor site morbidity. Costal cartilage also has the potential to warp if not carved properly. Homograft cartilage has also been utilized for nasal reconstruction but has a high percentage of resorption. Currently, the most commonly used alloplastic implants for nasal augmentation consist of silicone, ePTFE (Gore-Tex) and polyethylene (MEDPOR). Silicone can eventually produce overlying skin atrophy and must be anchored to prevent movement. Silicone and ePTFE have the potential for infection but are easily removed and replaced. Polyethylene implants, as with any other implant that promotes significant tissue ingrowth, have the potential for major soft tissue damage to the overlying skin if removal becomes necessary. Currently, silicone is the most commonly used alloplastic implant in Asian rhinoplasty, whereas ePTFE is favored for non-Asian augmentation.

The use of autogenous tissue avoids the problem of incompatibility but sometimes fails to provide necessary volume to provide the size and shape. A more ideal substitute to replace deficient skeletal structure, particularly over the nasal dorsum, would be a neocartilage graft reproduced from one's own cells that closely mimics the original skeletal contour. This cartilage implant can be synthesized through the process of tissue engineering.[25] The concept involves use of donor septal cartilaginous tissue that is harvested and then broken down into its cellular components. The cells are cultured in vitro, permitting them to multiply. A synthetic alginate scaffold is created in the shape of a dorsal nasal implant through a molding process. The cells are impregnated into the gelatin scaffold, which is placed subcutaneously into mice and permitted to evolve in vivo into a final shape. It is during this phase that the alginate scaffold slowly dissolves and is replaced by viable hyaline cartilage. The cartilage is then harvested as an autogenous implant. This process has the potential of becoming a valuable addition to nasal and facial augmentation in the near future.[26]

Midface Augmentation

Rhytidectomy has become just one component of facial rejuvenation. Midfacial augmentation, midface lifts, and resurfacing techniques all must be considered when customizing a surgical plan for the patient. The pathophysiology of the aging process is a key factor in determining the correct surgical treatment. It is now well understood that the aging process not only results in the descent of the midface but also in the atrophy of the soft-tissue in multiple facial planes. Midface rejuvenation can therefore be achieved not only through suspension techniques, but also by the augmentation of the soft tissue and skeletal foundation. Alloplastic augmentation is an effective way to alter the midface appearance in appropriate candidates. Midface augmentation is

a straightforward, long-lasting, and relatively low-risk surgical option that can consistently and predictably improve midface aesthetics. It has the ability not only to replace lost facial soft tissue volume but also to increase the anterolateral projection of the area thereby improving midface laxity and decreasing the depth of the nasolabial folds. Implants are readily reversible and can be combined with standard rhytidectomy procedures. The net effect is softening of the sharp angles and depressions of the aged face resulting in a natural "unoperated" look. In appropriate candidates, moderate facial rejuvenation can be achieved simply with the placement of submalar midface implants without concomitant rhytidectomy.

Midface augmentation can also facilitate rhytidectomy in several ways. The skin and soft tissue can be draped over a broader, more convex midface region after implant augmentation. There is also minimal traction on the perioral tissues and lateral commissure if placed prior to the rhytidectomy, which can help to avoid an "over-pulled" appearance. Many patients who present for revision rhytidectomy that require volume restoration can also be improved by expanding the midface region, while decreasing downward vertical traction forces on the lower eyelid.

Specific criteria are available for determining regions of aesthetic deficits and their corresponding alloplastic solutions.[27,28] In addition, other regions that contribute to the midfacial appearance must be carefully considered during patient evaluation. In the periorbital region, the aging process results in the weakening of the orbital septum and herniation of the periorbital fat, causing infraorbital bulges. The orbicularis muscle becomes ptotic, especially in its most inferior aspect. The use of conventional blepharoplasty will tend to exacerbate laxity of the lower canthal ligament, which can contribute to the formation of the "tear-trough" deformity and lower lid malposition.[29,30] Attendant with aging is subcutaneous tissue atrophy, which has more damaging affects on the very thin infraorbital skin accounting for the hollowness of the eyes with advanced aging. Skeletal insufficiency and imbalances are usually caused primarily by the hypoplastic development and inherent bony imbalances of the facial skeleton that are exacerbated by the aging process. Midfacial descent involves ptosis of the infraorbital subcutaneous tissues, malar fat pad, suborbicularis oculi fat (SOOF), and orbicularis muscle. The SOOF is the transition tissue between the orbital septum and the malar fat pad. This is a thin layer of granular fat present under the lower orbicularis fibers. It is *not* connected with the periorbital fat, which remains separated from the SOOF by the orbital septum and its insertion onto the inferior orbital rim at the arcus marginalis.

As the cheek falls and collects on the upper nasolabial fold, the thicker tissues of the malar fat pad descend and leave the infraorbital region exposed to thin soft tissue covering. Thus the nasojugal/tear trough region becomes prominent, the lower eyes appear hollow, and the infraorbital rim becomes more prominent. The loss of subcutaneous tissues occurs throughout the body, but in particular affects midfacial tissues more severely, including the buccal fat pad, the malar fat pad, and the SOOF. As these tissues continue to lose volume and descend, different patterns of midfacial aging develop in the infraorbital and cheek regions.

In the midface, most soft tissue deficiencies are found within the recess described as the "submalar triangle."[31] This inverted triangular area of midfacial depression is bordered above by the prominence of the zygoma, medially by the nasolabial fold, and laterally by the body of the masseter muscle (**Fig. 32.3**). The aging process is exaggerated when severe soft tissue involutional changes are associated with deficient underlying bone structure. Facial depressions can also become apparent in individuals who have prominent cheek bones combined with thin skin lacking subcutaneous or deep supporting fat. This type of pattern causes a gaunt appearance in an otherwise healthy person. The severe form of this midfacial pattern can be seen in anorexia nervosa, starvation, or HIV-associated lipoatrophy. In combination with the primary disease process, protease inhibitors and other

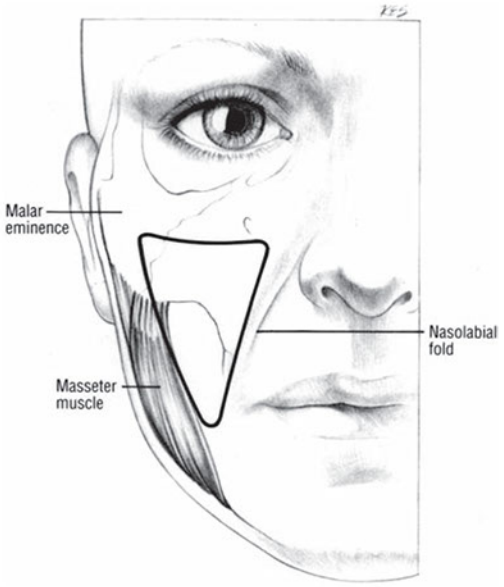


Fig. 32.3 The inverted submalar triangle is an area of midfacial depression bordered medially by the nasolabial fold, superiorly by the malar eminence, and laterally by the main body of the masseter muscle.

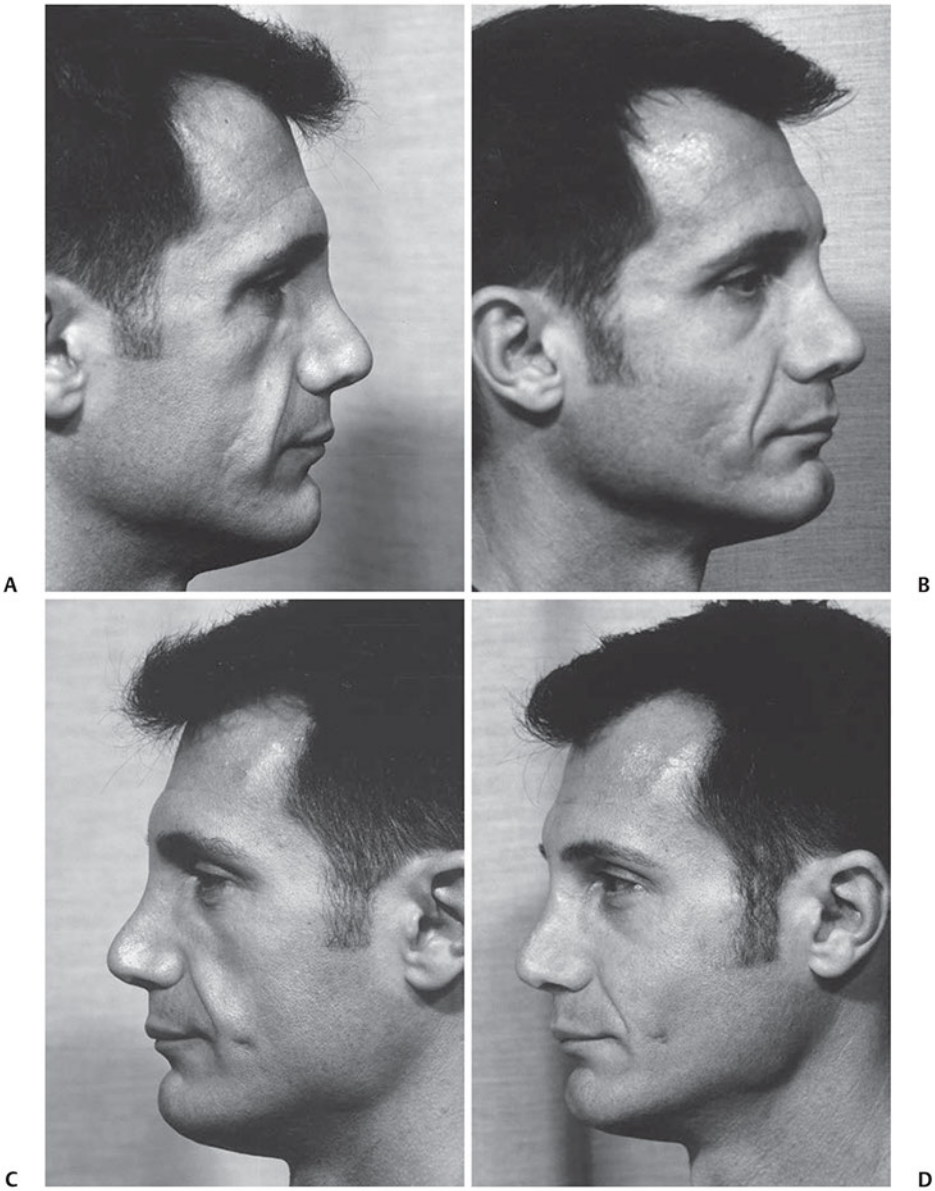


Fig. 32.4 (**A,C**) Preoperative photographs of a human immunodeficiency virus (HIV) patient who has been treated with protease inhibitors for a prolonged period of time. Many patients eventually develop complete erosion of the midfacial fat and the buccal fat pad leaving a particularly deep cavitary depression in the midface. (**B,D**) At 1 year postsurgery, the condition was successfully treated with computer-assisted, custom-designed midfacial implants.

newer-generation HIV therapies have a predilection for erosion of the midfacial fat and the buccal fat pad (**Fig. 32.4**).[1,2] These conditions of volume loss that are also associated with the aging process often preclude rhytidectomy, alone, to completely rejuvenate the face and are currently being successfully treated with the use of computer-assisted custom-designed facial implants.[32]

For successful rejuvenation of the midface, a three-dimensional approach must be utilized. The descent and volume loss of the midface must be camouflaged,

corrected, or replaced. The surgeon must therefore approach facial rejuvenation using a multilevel as well as a multimodality method. Camouflage techniques such as lower blepharoplasty with fat repositioning can result in the blunting of the nasojugal groove/tear trough region by securing the infraorbital fat past the arcus marginalis.[33] Midface cheek lift techniques reverse midfacial descent by lifting the midfacial tissues and anchoring them in a more superior-lateral direction.[34] Alloplastic or autogenous augmentation techniques reverse the effects of midfacial descent by replacing midfacial volume loss and providing soft tissue support at the deepest plane. Acknowledging the many elements of structural deficiency and phenomena of aging, multimodality treatments are necessary to restore the face to a more youthful appearance.

Preoperative Analysis for Facial Contouring

General

Facial augmentation is a three-dimensional procedure that exponentially increases the variability of structural diagnosis and treatment. A good understanding of skeletal anatomy and the ability to identify specific types of topographical patterns guide the surgeon in making the final determination for optimal implant selection and placement. Evaluation of the face for contouring procedures starts with an understanding of specific zones of skeletal anatomy and identifying distinctive and recognizable configurations of facial deficiency. Correlating these elements of structural and topographical variations is essential for choosing the optimal implant shape, size, and position to obtain the best results in facial contouring.

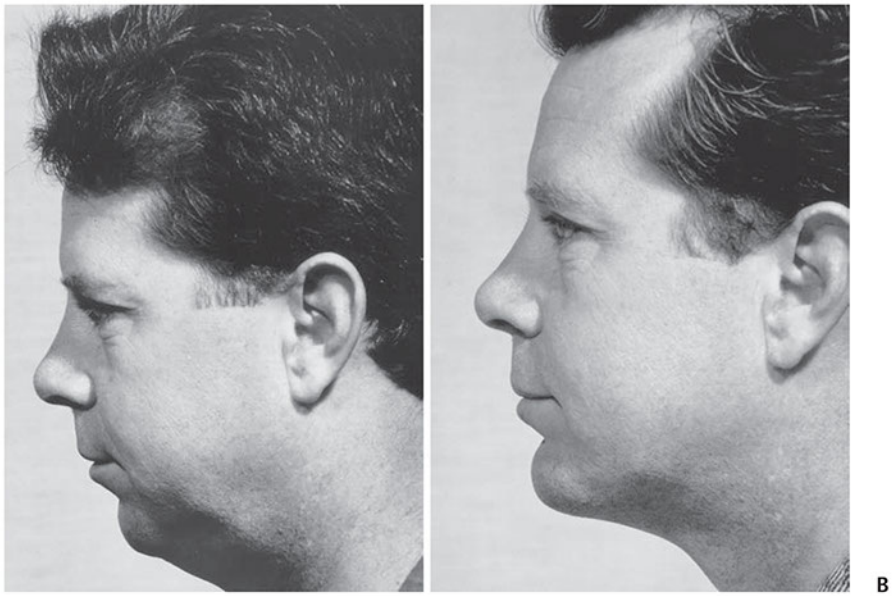
Mandibular Contour Defects

Chin projection is one of the most important features of the face. Appropriate chin projection and shape can provide an advantageous anatomical feature for facial rejuvenation as well as rhinoplasty. Poor chin projection can exaggerate the appearance of the nose. Prejowl sulcus can develop in the setting of soft tissue atrophy and bony erosion in the symphyseal region. After dental occlusion evaluation, the chin position can be assessed from the lateral view. Gonzalez-Ulloa developed a simple method based on the Frankfort line to analyze facial and chin projection. The Frankfort plane is a straight horizontal line drawn between the supratragal notch and the infraorbital rim. A perpendicular line, designated as the 0° meridian, is then drawn from the Frankfort plane at the level of the nasion to determine the amount of chin projection. If the pogonion is posterior to this line, the patient has microgenia. In women, the 0° meridian is generally 1 to 2 mm anterior to the pogonion.

Delineation of zonal principles of anatomy within the premandible space allows the surgeon to create specific chin and jawline contour.[27] Traditionally, chin implants were placed over the area between the mental foramina. This familiar location constitutes only one segment or zone of the mandible that can be successfully altered. Implants placed in the central segment alone and without lateral extension often produce abnormal round protuberances that are unattractive. A midlateral zone within the premandibular space can be defined as the region extending from the mental foramen posteriorly to the oblique line of the horizontal body of the mandible. Augmentation of this zone in addition to the central mentum results in a widening of the anterior jawline contour. This is the basis for the development of the extended anatomical and prejowl chin implants (**Fig. 32.5**). The posterior lateral zone is the third zone of the premandibular space, which encompasses the posterior half of the horizontal body, including the angle of the mandible and the first 2 to 4 cm of the ascending ramus. This zone can be modified with a mandibular angle implant that will either widen and/or elongate the posterior mandibular angle to produce a stronger posterior jawline contour. This area should be approached with extreme caution by the novice surgeon.

Midfacial Contour Defects

We have modified our previous midface deformity classification to simplify the analysis of the area during the consultation (**Table 32.1, Fig. 32.6**). It is prudent to separately evaluate the bony malar region and the soft tissue submalar area to best determine the appropriate surgical procedure. Patients with type I deformity have primary malar hypoplasia with adequate submalar soft tissue. This defect is best addressed with malar shell implants that cover the bony midface and project the cheek in a lateral direction (**Fig. 32.7**). Type II deficiency occurs in individuals who have submalar soft tissue deficiency with normal malar skeleton. This is the most common deficiency found in the aging population. Inferior descent and soft tissue atrophy of the submalar soft tissue leaves a flat and hollowed appearance to the midface. Type II deficiency is best treated surgically with submalar implants, which restore midface convexity and provide greater anterior projection to the flattened face (**Figs. 32.8 and 32.9**). Submalar implants can be used alone or in combination with rhytidectomy for facial rejuvenation. Type III deformity occurs when there is a combined bony malar hypoplasia and soft tissue paucity. These patients can undergo exaggerated effects of aging because ptotic soft tissues have little bony support and readily descend along the nasolabial folds



A B

Fig. 32.5 (**A**) Preoperative and (**B**) postoperative photographs of a patient who underwent an extended mandibular implant combined with submental liposuction.

and oral commissure. Rhytidectomy alone would provide suboptimal results in these patients because they have limited underlying skeletal support with which to resuspend the skin and soft tissue. Combined malar–submalar implants can significantly improve the overall appearance of type III patients (**Fig. 32.10**).

Surgical Procedure

General Guidelines for Facial Implants

The basic principles for augmenting the malar, midfacial, premandibular spaces or nasal augmentation are identical, while controlling the shape, size, and positioning of the implant will determine the overall final facial contour. The surgeon must be prepared to have all anticipated designs, shapes, and/or materials available and be prepared to modify the implant intraoperatively. Since all faces are different, it should be the rule, rather than the exception, that implants require modification. Therefore, failure to have the right implant for a particular patient can only yield a suboptimal result.

The day prior to surgery, patients are started on broad-spectrum antibiotics, which will be continued for 5 days after surgery. Intravenous antibiotics and dexamethasone are also administered perioperatively. Before starting anesthesia, the patient must be in an upright position while the precise area to be augmented is outlined with a marking pen. This initial outline that is drawn on the

Table 32.1 Pattern of Midfacial Deformity and Type of Implant for Correction

Deformity Type	Description of Midfacial Deformity	Type of Augmentation Required	Type of Implant Predominantly Used
Type I	Primary malar hypoplasia; adequate submalar soft tissue development	Requires projection over the malar eminence	Malar Implant: "shell-type" implant extends inferiorly into submalar space for more natural result
Type II	Submalar deficiency; adequate malar development	Requires anterior projection; implant placed over face of maxilla and/or masseter tendon in submalar space; also provides for midfacial fill	Submalar Implant (New Conform type (Implantech Associates, Ventura, CA) or Generation I Submalar Implant)
Type III	Malar hypoplasia and submalar deficiency	Requires anterior and lateral projection; "volume replacement implant" for entire midface restructuring	"Combined" Submalar-Shell Implant; lateral (malar), and anterior (submalar) projection; fills large midfacial void

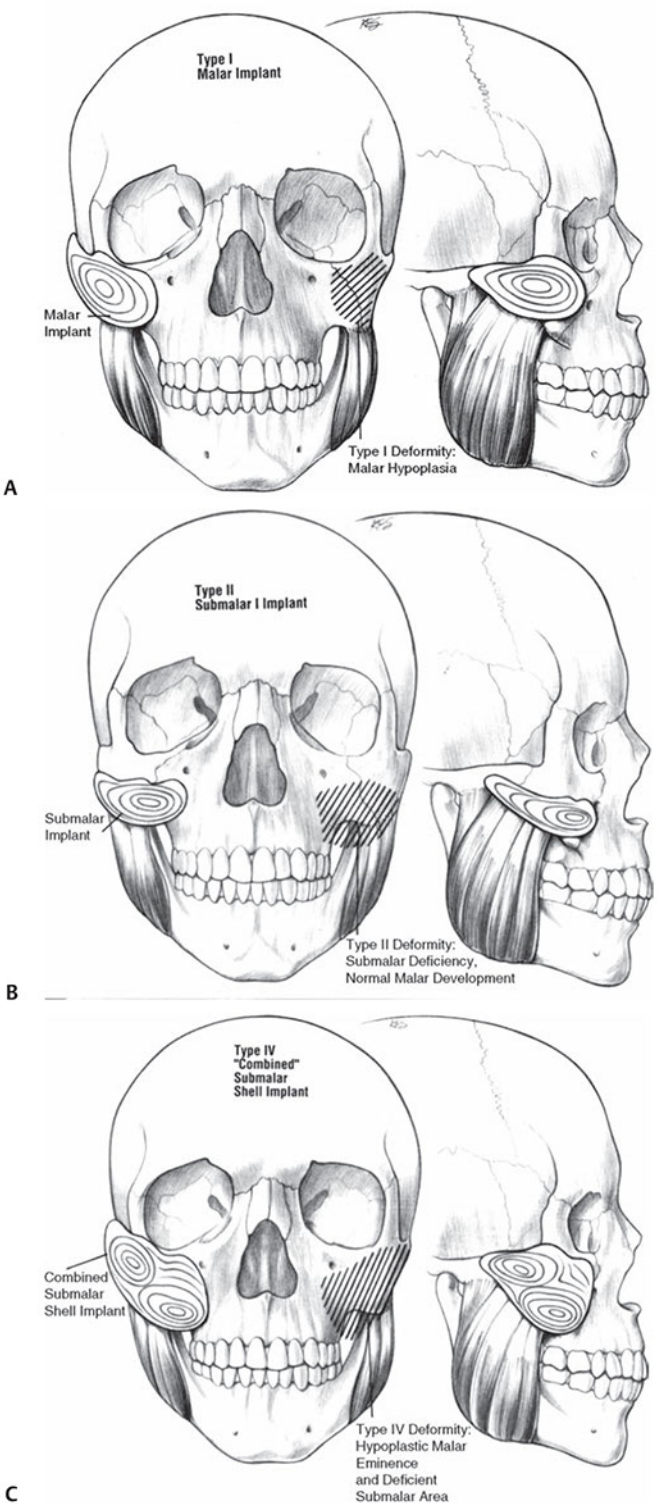


Fig. 32.6 Frontal and lateral drawings illustrate the anatomical areas of the midface and three distinctive topographical patterns of midfacial deformity. Specific implants that are directly correlated with and used to correct these specific patterns of midfacial deformity are selected (Table 32.1).

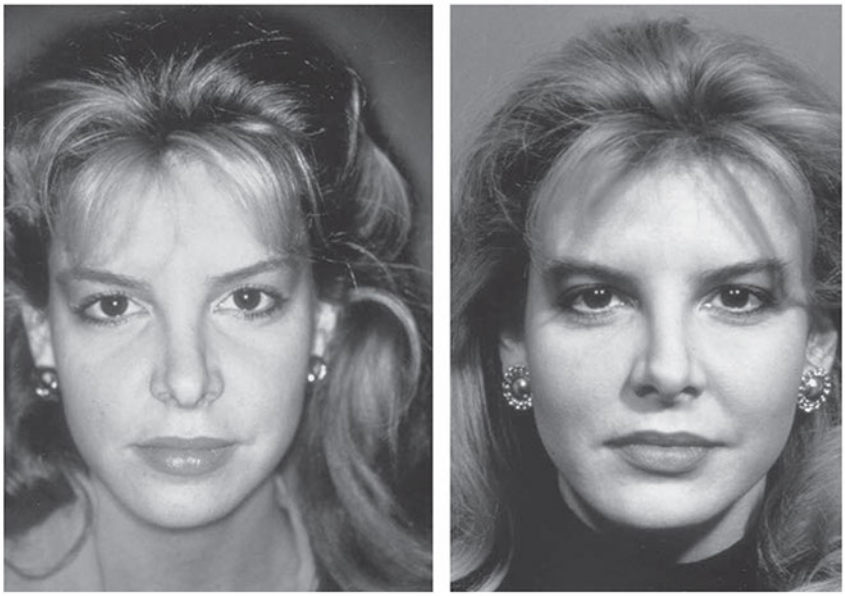
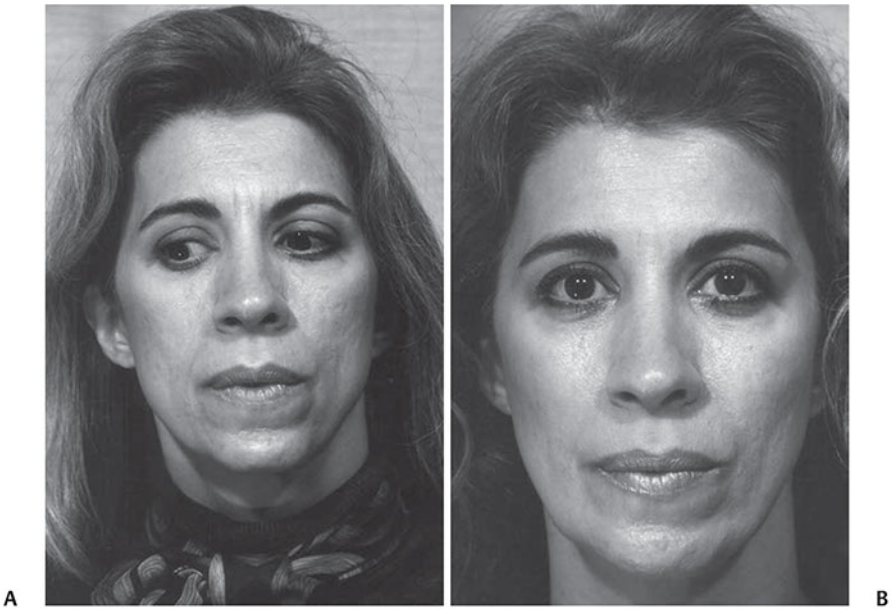


Fig. 32.7 (**A**) Preoperative example of malar hypoplasia (type I deficiency). (**B**) Eight months after malarplasty using a malar shell implant. Augmentation of a greater surface area and extension inferiorly into the submalar space produces a more natural high cheekbone effect.



A **B**

Fig. 32.8 (**A**) Preoperatively, this patient has a relatively good malar bone structure but was complaining of early flatness to the midface (type II deformity) in addition to a mandibular parasymphyseal depression caused by an earlier performed genioplasty. (**B**) Submalar augmentation restored the anterior projection to the midthird of the face, providing a more youthful expression as well as reducing the depth of the nasolabial folds, while a custom implant was used to fill in the parasymphyseal depression.

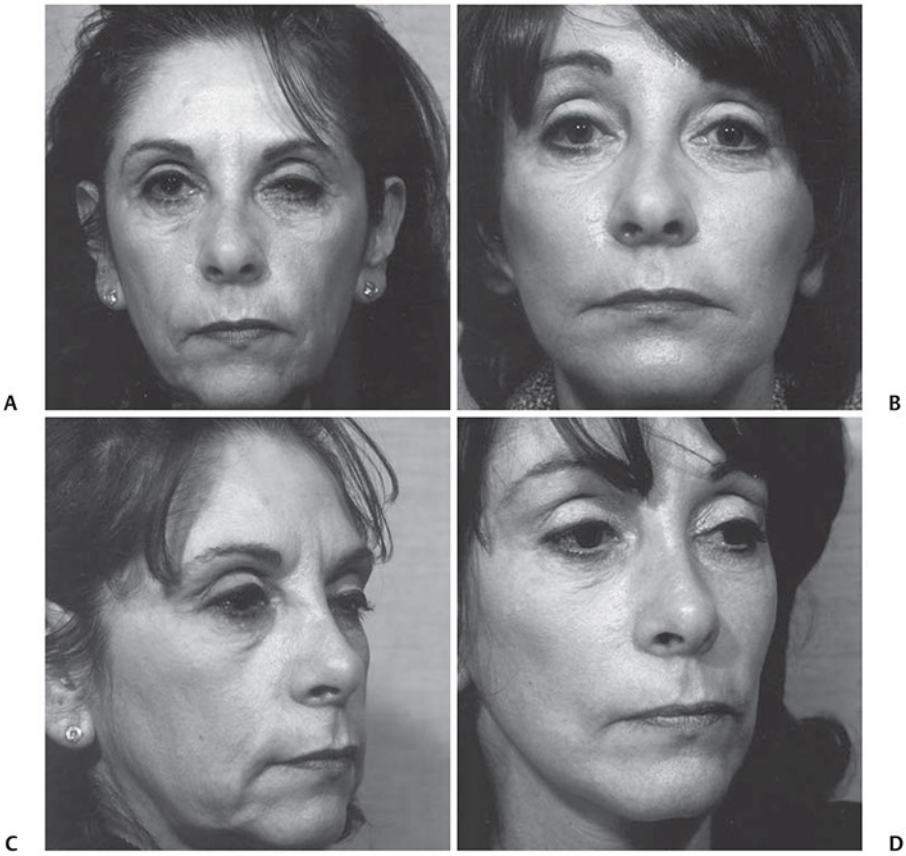


Fig. 32.9 (**A,C**) Preoperative. (**B,D**) Six month postoperative. In conjunction with rhytidectomy, lower blepharoplasty, and brow lift, a Conform submalar implant (Implantech Associates, Ventura, CA) was used as adjunctively to help restore volume and structure and to establish the basis for a greater longevity to the facelift operation.

skin is then explained to the patient so that a cooperative effort is made to finalize both the surgeon's and the patient's perception of implant shape, size, and position to optimize their mutual goals (**Fig. 32.11**).

Surgical Technique for Mandibular Augmentation

Anterior Mandibular Implants

Either an intraoral or an external route can accomplish access to the premandibular space. The intraoral route provides the obvious advantage of leaving no external scars. The entry wound for the intraoral route is a transverse incision made through the mucosa. The mentalis muscle is divided vertically in the midline raphe to avoid transection of the muscle belly or detachment from the bony origins. This midline incision provides adequate access inferiorly to the bone of the central mentum and eliminates potential muscle weakness that may occur if transected. Lateral dissection requires identification and retraction of the mental nerves. The external route utilizes a 1.0 cm to 1.5 cm incision in the submental crease. The advantages of the external route include avoidance of intraoral bacterial contamination, direct access to the inferior mandibular border where cortical bone is present, limited retraction of the mental nerve, and easy fixation of the implant to the inferior mandibular periosteum. Fixation of the implant prevents side-to-side or vertical slippage of the implant.

Basic technical rules should be followed for safe and accurate mandibular augmentation. (1) The dissection should stay on bone. Placement of implants in the subperiosteal plane creates a firm and secure attachment of the implant to the bony skeleton. Strong adherence of periosteum along the anterior-inferior border of the

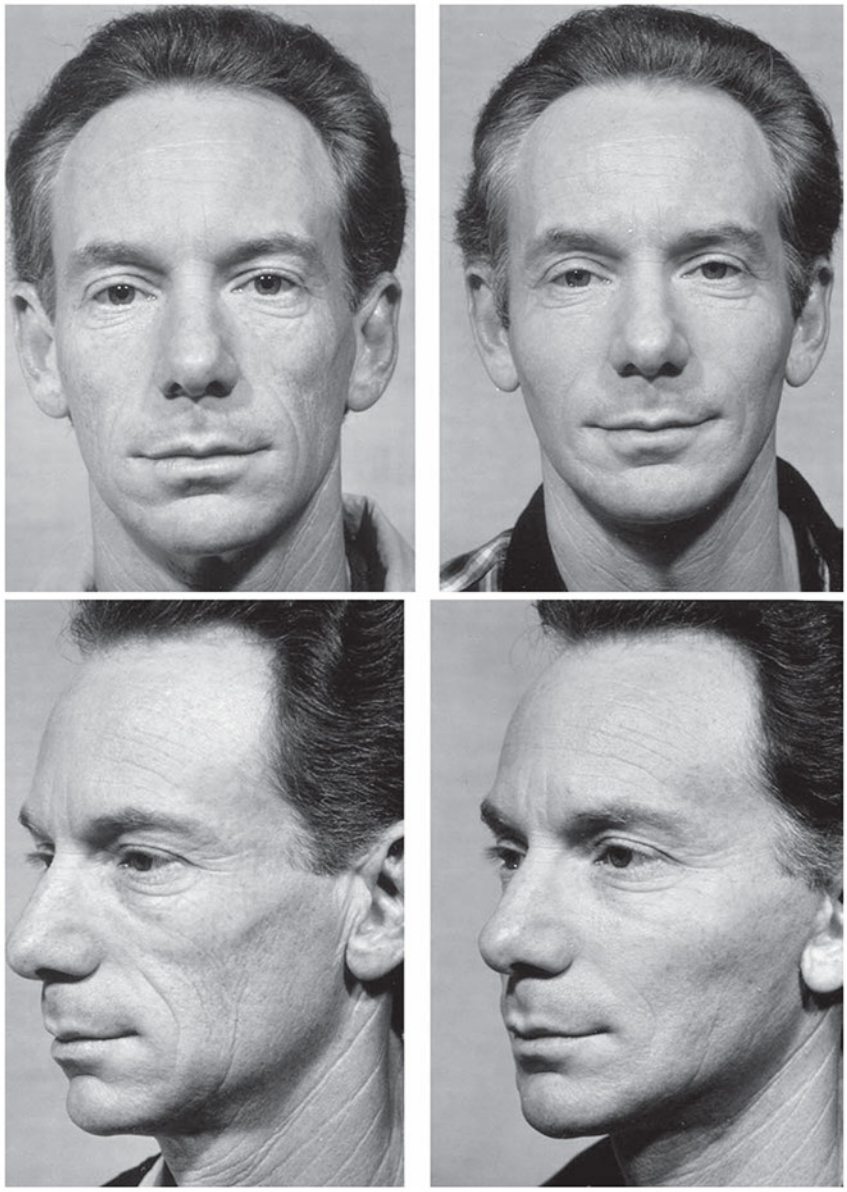


Fig. 32.10 (**A**) Frontal; (**B**) oblique. *Left:* Preoperative analysis of the facial configuration in this 40-year-old patient reveals the presence of severe deficiency in both skeletal structure and soft tissue volume contributing primarily to the excessive wrinkling of the skin in the area of the midface. *Right:* Seven months postoperative; performed concurrently with rhytidectomy, the combined submalar-shell implants were used to restructure the entire midface, and a prejowl implant was used to add width to the mandible. In this patient, these augmentation procedures were essential for the structural and volumetric enhancement required for the facelift procedure to provide a meaningful, long-term improvement. (From Binder WJ. A comprehensive approach for aesthetic contouring of the midface in rhytidectomy. Facial Plastic Surgery Clinics of North America 1993;1:231–255. Reprinted by permission.)

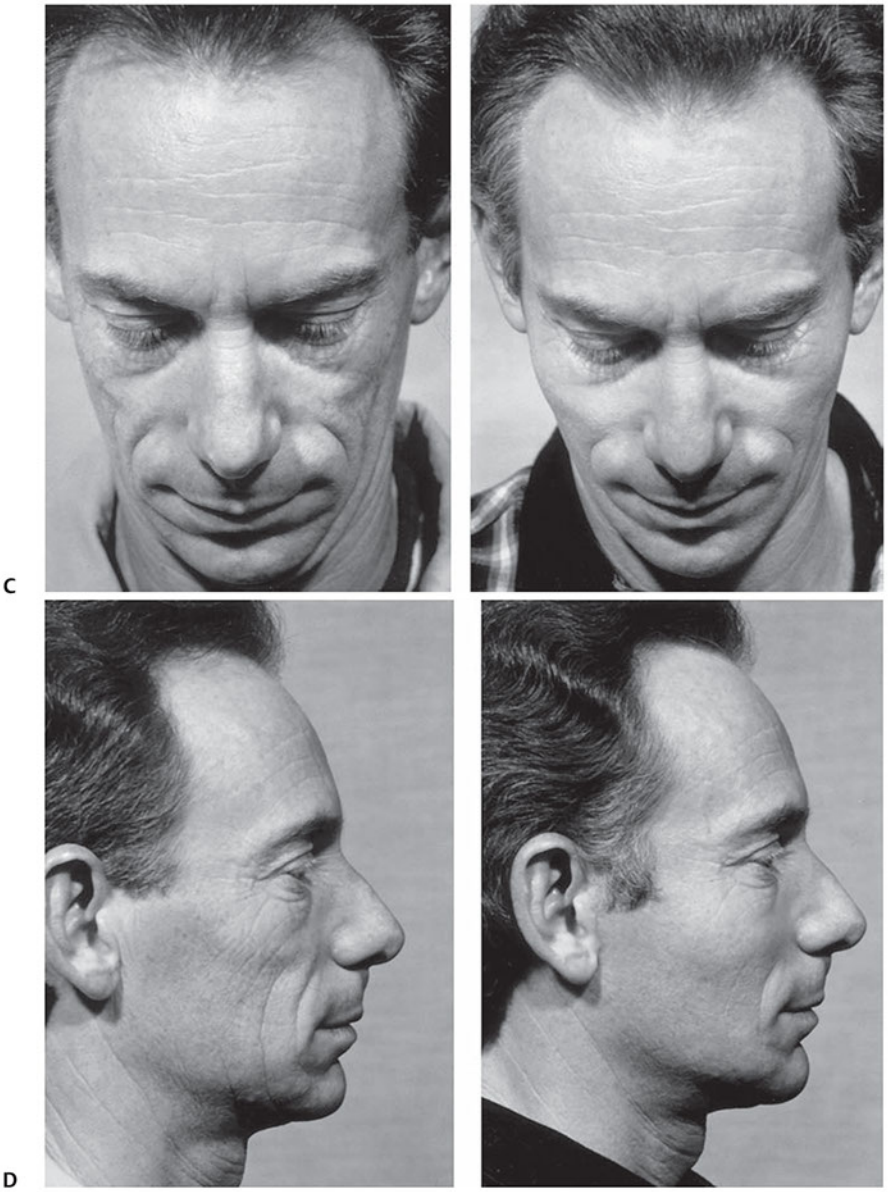


Fig. 32.10 (*Continued*) (**C**) head down; (**D**) lateral.

mandible comprises the origins of the anterior mandibular ligament, which defines the prejowl sulcus at the inferior aspect of the aging marionette crease. It is often necessary to incise these ligamentous attachments to allow dissection to continue along the inferior segment of the mandible. (2) The dissection must be adequately expanded to accommodate the prosthesis comfortably. A sharp dissecting instrument may be used centrally, but only blunt instruments are used around the nerves and adjacent to soft tissues. (3) The mental nerve should be avoided. This is accomplished by compressing the tissues around the mental foramen with the opposite hand that helps to direct the elevator away from the nerve and along the inferior border of the mandible. A dry operative

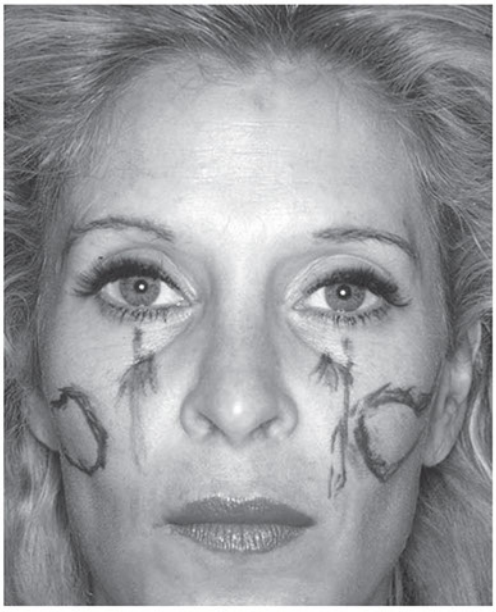


Fig. 32.11 Prior to infiltration of local anesthetic, the areas requiring augmentation are specifically outlined with the patient sitting in the upright position. In the majority of cases, the medial border of submalar or malar implants is placed lateral to the infraorbital foramen corresponding approximately to the midpupillary line. (From Binder WJ. A comprehensive approach for aesthetic contouring of the midface in rhytidectomy. Facial Plastic Surgery Clinics of North America 1993;1:231–255. Reprinted by permission.)

field is essential for accurate visualization, precise dissection, proper implant placement, and the prevention of postoperative hematoma or seroma.

A Joseph's or 4 mm periosteal elevator is used to perform the dissection along the inferior mandibular border. Once the pockets are large enough, one side of the implant is inserted into the lateral portion of the pocket on one side and then folded upon itself whereby the contralateral portion of the implant is inserted into the other side of the pocket. The implant is then adjusted into position. If the implant material does not allow flexibility, then the incision either must be made larger or the procedure must be performed through an intraoral incision. Implants expanding into the midlateral or parasymphyseal region accomplish anterior widening of the lower third of the facial segment. The average central projection necessary is between 6 and 9 mm for men and 4 to 7 mm for women. Occasionally, in a patient with severe microgenia, implants measuring 10 to 12 mm in projection or greater may be necessary to create a normal profile and a broader jawline.

Mandibular Angle Implants

Access to the angle of the mandible is achieved through a 2 to 3 cm mucosal incision at the retromolar trigone. This gives direct access to the angle of the mandible. Dissection is performed on bone and beneath the masseter muscle to elevate the periosteum upward along the ramus and then anteriorly along the body of the mandible. A curved (90 degree) dissector is used to elevate the periosteum around the posterior angle and ramus of the mandible. This permits accurate placement of the angle implants that are specifically designed to fit the posterior bony border of the ascending ramus and enhance angle definition. These implants are secured with a titanium screw.

Surgical Techniques for Malar and Midface Contouring

The primary route for entering the malar–midfacial areas is the intraoral approach. Other approaches include the subciliary (via lower blepharoplasty), transconjunctival, rhytidectomy, zygomaticotemporal, and transcoronal routes. The intraoral route is the most common and the preferred route for most midfacial implants. After infiltration of the anesthetic solution, a 1 cm incision is made through the mucosa and carried directly down to bone in a vertical oblique direction above the buccal–gingival line and over the lateral buttress (**Fig. 32.12A**). Because the mucosa will stretch and allow complete visual inspection of the midfacial structures, a long incision through adjacent submucosal or muscular layers is not necessary and is discouraged. The incision should be made high enough to leave a minimum of 1 cm of gingival mucosal cuff. If the patient wears dentures, this incision must be placed above the dentures' superior border. Dentures can be left in place after the procedure, and in our experience they have not been found to cause extrusion or increase the incidence of complications. A broad Tessier-type elevator (10 mm wide) is directed through the incision onto the bone in the same orientation as the incision. A broad rather than narrow elevator helps to facilitate the dissection safely and with relative ease within the subperiosteal plane (**Fig. 32.12B**). While keeping the elevator directly on bone, the soft tissues are elevated obliquely upward off the maxillary buttress and the malar eminence. The elevator is kept on the bone margin along the inferior border of the malar eminence and the zygomatic arch. The external or free hand is used to help guide the elevator over the designated areas. For routine malar–submalar augmentation procedures, no attempt is made to visualize or dissect within the vicinity of the infraorbital nerve unless an implant is intended for this area. If necessary, the infraorbital nerve is easily visualized in a more medial location.

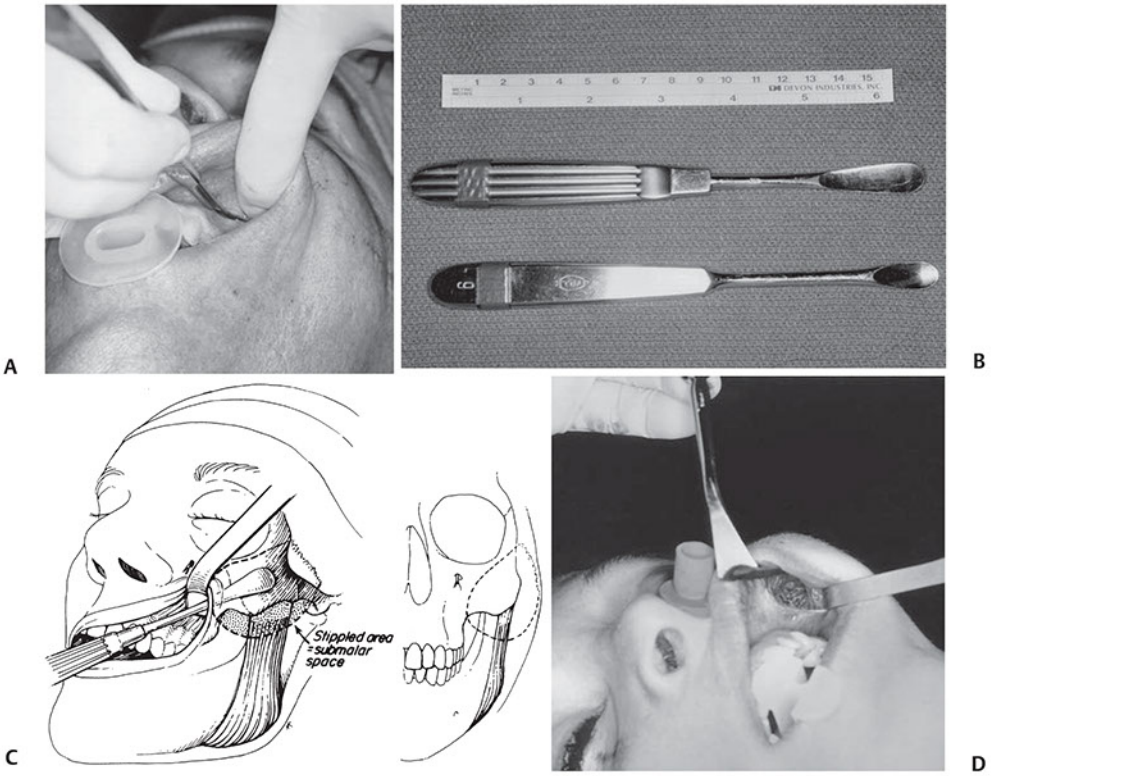


Fig. 32.12 (**A**) After injection with local anesthetic, the mucosa is compressed and a single incision is carried through mucosa and periosteum directly onto bone. The incision is small (1.0 to 1.5 cm) and is placed over the lateral aspect of the canine fossa and lateral buttress at least 1 cm above the buccal–gingival line. (**B**) Nine and 10 mm curved and straight periosteal elevators used for dissection. (**C**) This illustration demonstrates the general extent of dissection required for most midfacial implants. The dissection must be sufficiently extended posterolaterally over the zygomatic arch, and/or expanded inferiorly into the submalar space over the tendinous insertions of the masseter muscle so that the implant can be accommodated passively within the pocket. (**D**) Direct visual inspection of midfacial structure can be obtained through the intraoral route by retracting the overlying tissues. Using sizers or different implants helps to determine optimum size, shape, and position of the final implant selected. (The stippled area represents a sizer that has been placed within the pocket.) (**E**) *Left*: The external drawings made on the skin delineate the malar bone and submalar space below. *Right*: The shape and size of the superimposed implant should roughly coincide with the external topographical defect demarcated prior to surgery. In this case the inferior aspect of the implant extends downward to occupy the submalar space. (From Binder WJ. A comprehensive approach for aesthetic contouring of the midface in rhytidectomy. Facial Plastic Surgery Clinics of North America 1993;1:231–255. Reprinted by permission.)

The submalar space is created by elevating the soft tissue inferiorly over the masseter muscle below the zygoma (**Fig. 32.12C**). One is able to discern the correct plane of dissection by the glistening white fibers of the masseter tendons by direct vision. It is important to note that these masseteric attachments are not cut and are left completely intact to provide a supporting framework upon which the implant may rest. As the dissection moves posteriorly along the zygomatic arch, the space becomes tighter and is not as easily enlarged as the medial segment. However, gently advancing and elevating the tissues with a heavy, blunt periosteal elevator

can open part of this space. It is of utmost importance that the dissection is extended sufficiently so that the implant fits passively within the pocket. A pocket that is too small will force the implant toward the opposite direction, causing implant displacement or extrusion. Under normal conditions, the pocket is estimated to collapse and obliterate most of the space around the implant within 24 to 48 hours following surgery. Implant selection is aided by observing the actual topographical changes produced by placement of the different implant "sizers" into the pocket (**Fig. 32.12D**).

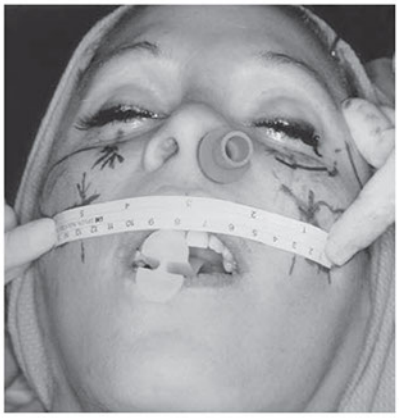
Final implant placement must correspond to the external topographical defects outlined on the face preoperatively (**Fig. 32.12E**). In *submalar* augmentation, the implant may reside below the zygoma and zygomatic arch, over the masseter tendon, or it may overlap both bone and tendon. *Malar* implants reside primarily on bone in a more superior and lateral position and may extend partly into the submalar space. The combined *malar–submalar* implants will occupy both areas. Any implant placed in patients with noticeable facial asymmetry, thin skin, or an extremely prominent bone structure may require modification to reduce its thickness or length to avoid abnormal projections. Among the advantages of silicone elastomer midfacial implants is flexibility enabling large implants to be compressed through small openings, which are then able to reexpand within the larger pocket created beyond the incision.[36] This avoids having to make larger incisions required for more rigid implants and allows for ease of implant insertion and removal during the selection process.

The most difficult task in achieving successful results in facial contouring is the management of facial asymmetry. During the preoperative consultation, a thorough discussion regarding this problem is essential because most patients are usually unaware of the qualitative or quantitative presence of their own facial asymmetry.[37] Meticulous attention to detail is required to visualize, perceptually integrate, and then make procedural adjustments to accommodate existing three-dimensional discrepancies. It is not unusual to find adequate malar development and a well suspended soft tissue pad with good external contour on one side of the face, and a hypoplastic malar eminence along with relative atrophy of the soft tissues and greater wrinkling of the skin on the other side. In these cases, it is essential to have an adequate selection of implants available and to anticipate carving or altering the implants to adjust to the differences in contour between the two sides. Unusual asymmetries may also require using different implants for each side or shims that can be carved from a silicone block and sutured to the posterior surface of the implant to increase the projection of a particular segment of the implant.

Once the implant position has been established, it is usually necessary to secure it. This can be accomplished by several different methods. Internal suture fixation relies on the presence of an adjacent stable segment of periosteum or tendinous structure upon which to anchor the implant. Stainless steel or titanium screws can also be used. External fixation sutures can also be used to stabilize midfacial implants. The *indirect lateral suspension technique* uses 2–0 Ethilon sutures (Ethicon, Inc., Somerville, NJ) wedged on large Keith needles and placed through the implant tail. These needles are then inserted through the pocket, directed superiorly and posteriorly, to exit percutaneously posterior to the temporal hairline. The sutures are then tied over a bolster exerting traction on the tail of the implant. This technique is more suitable for malar implants. *Direct external fixation* is the preferred method for submalar and combined malar–submalar implants to prevent slippage in the immediate postoperative period and to obliterate the anterior dead space. With this method, the implants are positioned directly to correspond with marks on the skin, which coincide with the two most medial fenestrations of the implant. The position of the medial fenestration should be marked on the external skin while the implant is inside the subperiosteal pocket. Locating these holes can be achieved with a right angle clamp that pushes the implant upward, underneath the fenestration, causing an external protuberance that can be marked on the external skin. Measuring the distance from the midline to both right and left medial markings ensures symmetric placement of the implants (**Fig. 32.13A**). The implants are then removed and placed on the skin by lining up the medial fenestration over its corresponding mark. The position of the lateral portion of the implant is then decided by placing a second mark corresponding to the adjacent implant fenestration. A double-armed 2–0 silk suture is then passed through the two medial fenestrations of the implant from a posterior to anterior direction. The needles are advanced through the pocket, passed perpendicularly through the skin, and exit at the respective external markings (**Fig. 32.13B**). The implant, following the needles, is guided into the pocket. The implant is then secured in place by tying the sutures over bolsters consisting of two dental roles (**Fig. 32.13C**).

Complications

Complications of implants in facial augmentation include bleeding, hematoma, infection, exposure, extrusion, malposition, displacement or slippage, fistula, seroma, persistent edema, abnormal prominence, persistent inflammatory action, pain, and nerve damage.[38] However, in most of the complications listed, very few are due solely to the implant material itself. It is extremely



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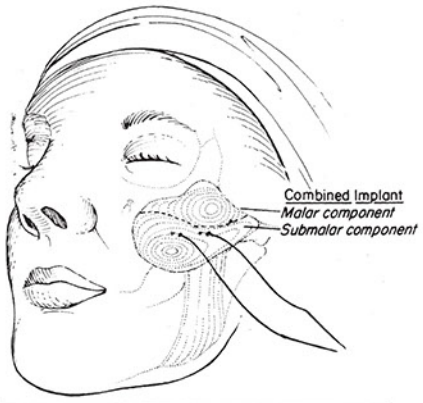

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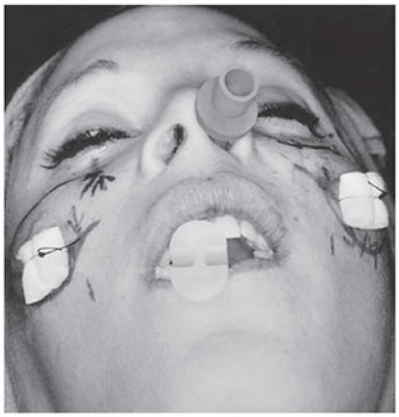

C

Fig. 32.13 (**A**) Symmetrical placement is assisted by measuring the distance from the midline to both the right and left marks. A second mark is then placed on the skin, which corresponds to the second, adjacent fenestration that determines the superior-inferior orientation of the lateral portion of the implant. (**B**) A double-armed 2–0 silk suture is passed around the posterior surface of the implant and through the fenestration. From inside the pocket, the needles are passed directly perpendicular to the skin, exiting at the respective external markings, thus providing two-point fixation. (This figure illustrates the two components (malar and submalar) that form the combined implant.) (**C**) The implant is stabilized by tying the suture directly over an external bolster (consisting of two cotton rolls). The suture and bolster are removed by the third postoperative day. (From Binder WJ. A comprehensive approach for aesthetic contouring of the midface in rhytidectomy. Facial Plastic Surgery Clinics of North America 1993;1:231–255. Reprinted by permission.)

difficult to separate out the surgical technique, the surrounding circumstances of the individual operation, as well as the individual patient risk factors that are not associated with the implant.

Extrusion should not occur if the technical rules outlined have been followed. The extended surface area of the larger or extended implants that fit along the midface and mandibular contours minimizes malposition and malrotation. Adequate dissection of the subperiosteal space large enough to create midlateral and posterolateral tunnels in the mandible and the desired pockets in the midface will maintain the implant in proper position. In mandibular augmentation, the mandibular branch of the facial nerve passes just anterior to the midportion of the mandible in the midlateral zone. It is important not to traumatize the tissues that overly this area. The course of the mental nerve is anatomically directed superiorly into the lower lip, which also helps to protect it from dissection trauma. Temporary hypesthesia of the mental nerve can occur for several days to several weeks after surgery. Permanent nerve damage is extremely rare and in one study represented less than 0.5% of a statistically large number of cases.[39] If encroachment on the nerve by the implant is detected due to misplacement or malrotation, then the implant should be repositioned below the nerve as early as possible.

The frontal branch of the facial nerve passes posterior to the mid aspect of the zygomatic arch and care must also be exercised when dissecting in this area. Infection can be minimized by irrigation of the pocket at the end of the procedure with either normal saline or bacitracin, 50,000 units per liter of sterile saline. Soaking the porous implants in antibiotic solution is advised. Drainage techniques are not ordinarily necessary in mandibular augmentation but may be used in midfacial augmentation if there is more than the normal amount of bleeding We have found that immediate application of pressure over the entire midface by using a full face compression garment considerably reduces the risk of hematoma, seroma, and swelling, and consequently the

Fig. 32.14 The immediate application of some pressure over the entire midface by using a full-face compression garment has been found to considerably reduce the risk of hematoma, seroma, and swelling.

postoperative complications related to fluid accumulation within the pocket (**Fig. 32.14**).

Bone resorption is more commonly found in mandibular augmentation than in other alloplastic implant procedures. Findings of bone erosion following chin implants were reported in 1960. However, since these early reports, there have not been reports of clinical significance after surveying large populations of surgeons.[39] As long as the implant is in the correct position over cortical bone, the condition appears to stabilize without the loss of any substantial projection or prior cosmetic enhancement.

Conclusion

Facial contouring is extremely predictable when the surgeon understands the principals of facial topography and anatomy as well as pays careful attention to the basic surgical techniques. Critical facial analysis with appropriate communication between the surgeon and patient will lead to optimal patient satisfaction. Many different types of facial implants are available for the surgeon to create a variety of contours to fulfill most needs. Reconstructing more complex contour defects can be accomplished by using three-dimensional computer imaging and computer-aided design and manufacturing (CAD/CAM) technology to manufacture custom implants.[27]

Facial implant procedures provide an excellent long-term solution for the facial plastic surgeon. Midface implants can be used to correct underlying skeletal abnormalities as well as restore a youthful appearance. Chin augmentation with alloplastic implants provide a safe alternative to correct microgenia. It can also be used with excellent outcome in facial rejuvenation for patients with prominent prejowl sulcus. Although challenging, there are very few procedures that can provide the major rewards that facial contouring procedures can offer.

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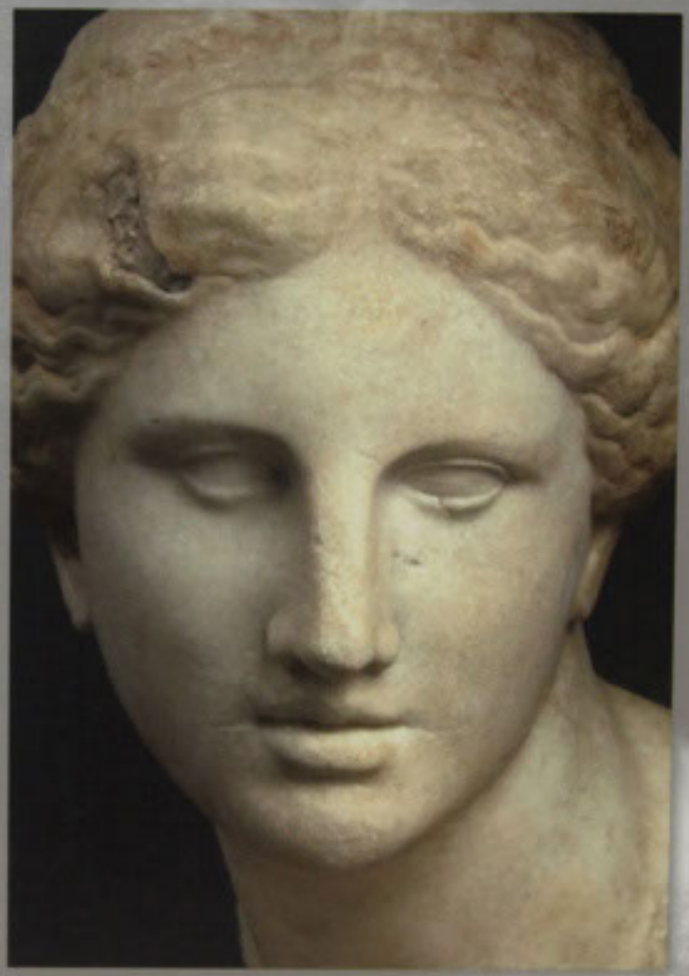

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