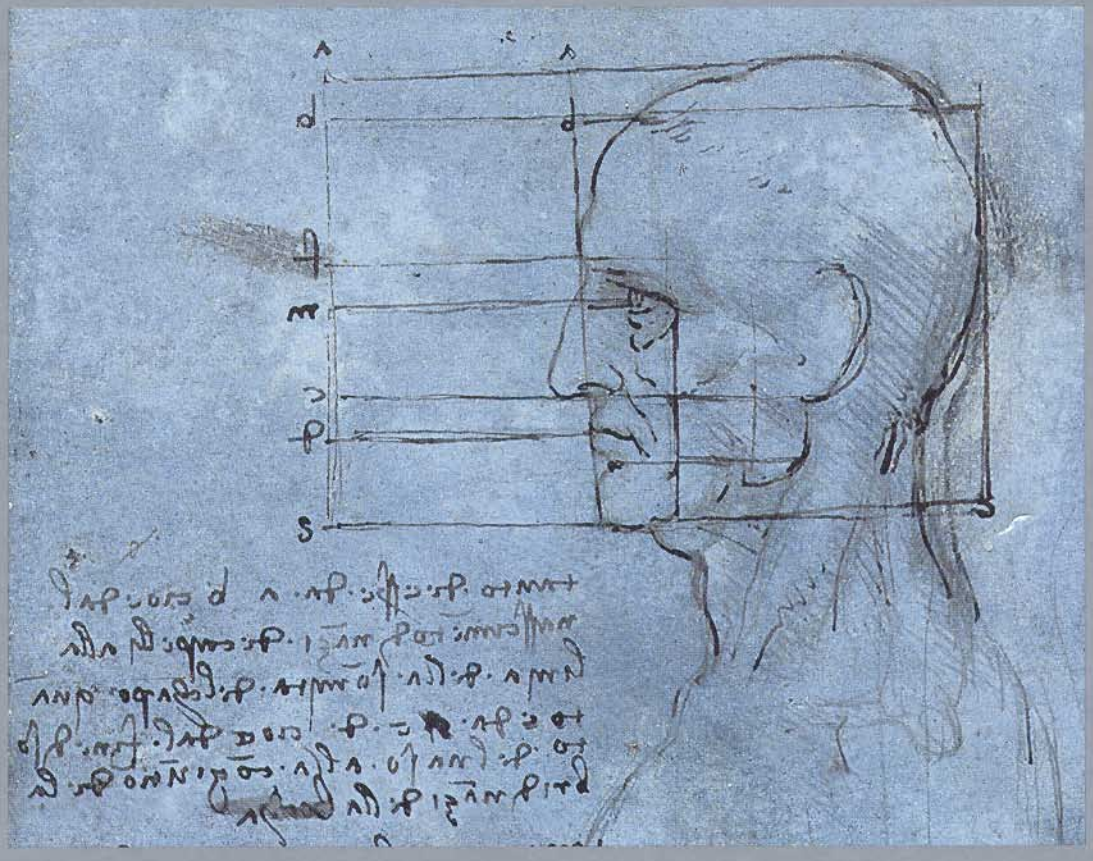
Facial Plastic and Reconstructive Surgery

second edition



Ira D. Papel

John Frodel
G. Richard Holt
Wayne F. Larrabee
Nathan Nachlas
Stephen S. Park
Jonathan M. Sykes
Dean Toriumi

Thieme

Chapter 25

Aesthetic Facial Implants

William J. Binder, Brent Moelleken, and Geoffrey W. Tobias

Over the past decade, the marked improvement in biomaterial and the design of facial implants have expanded their use in aesthetic surgery and offered ready-made solutions for replacement needs, avoiding donor morbidity and reducing operative complexity. Facial implants are currently used to augment skeletal dimension, to restore facial contour by expanding areas where facial volume loss occurs, or to work in combination with rhytidectomy or other procedures as part of the more current multimodality approach to facial rejuvenation surgery. 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 body and angle implantation to create a stronger lateral dimension to the mandible; submalar and midfacial implantation to fill out the hollowness and augment the flatness that occurs to the midface during the normal process of aging; nasal implantation in the form of dorsal or dorsal-columella shapes; or premaxillary (peripyriform) implantation to augment a retrusive midface. Computer-assisted custom-designed implants now provide solutions for more complex facial defects due to trauma, congenital causes, or acquired immunodeficiency diseases. Long-term HIV-positive patients become victim to an accelerated form of lipodystrophy, with complete loss of facial fat brought about by antiretroviral therapy and other factors related to the HIV virus itself that are not completely understood.[1,2]

Critical to the successful use of facial implants is the accurate assessment of facial anatomy. Distinguishing relationships between different bony promontories and determining the volume and thickness of surrounding soft tissue and skin will dictate the subtleties of choosing implant shape, type of material, and ultimate placement to attain both the patient's and the surgeon's vision of the end result.

CONCEPT OF FACIAL CONTOURING

The individual configuration of nose, malar-midface area, and mandible-jawline determines the fundamental architectural proportions and contour of the face. Balance between these structures and the even 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 malar-midface configurations and a sharp, well-defined jawline. Any of these promontories being too small or too large affects 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 more distinct, whereas accentuating the malar-midface or enhancing the mandibular or malar-midface volume makes the nose appear smaller and less imposing.

The concept of facial contouring implies a change in the shape of the face. Only by judiciously altering mass and volume in different anatomic regions and redistributing the overlying soft tissues can the surgeon produce substantive contour changes. Typically, when augmentation is the desired goal, it is accomplished through selection of implants with the proper shape and design, and controlling their position over the facial skeleton.

IMPLANTS AND BIOMATERIALS

Deciding which biomaterial to use for implantation requires an understanding of the histopathology of the individual implant material–tissue interface and the host response. 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 an unresolved inflammatory response to implant materials. The behavior is also a function of configuration characteristics of the site of implantation, such as 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 hematoma, seroma and infection both during surgery and in the postoperative stage, contribute to the prevention of host–implant interaction and to increasing implant survivability.

The Ideal Implant

The ideal implant material should be cost-effective, nontoxic, nonantigenic, noncarcinogenic, host-acceptable, and resistant to infection. It should be inert, easily shaped, easily conformable, easily insertable, and capable of permanently maintaining 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 team-autoclave without degradation of the implant.

The presence of favorable surface characteristics is important for implant placement and stabilization; paradoxically, it is just as important to facilitate easy removal and exchangeability without causing injury to surrounding tissues. Implant immobilization implies that the implant will be fixed in place for the lifetime of the patient. Implant materials such as silicone elastomer induce the formation of a surrounding capsule that maintains implant position, whereas expanded polytetrafluorethylene (ePTFE), which encapsulates to a lesser degree, provides fixation with minimal tissue ingrowth. Each type of 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 ingrowth into ePTFE products insures immobility yet provides exchangeability without damage to surrounding soft tissue.

The ideal implant design should include tapered margins that blend with the adjacent bony surface to create a nonpalpable, imperceptible transition to the surrounding recipient area. An implant that is malleable and conforms readily to the underlying structures further reduces mobility, while the anterior surface shape should imitate the desired natural anatomic configuration. The new silicone implant Conform (Implantech Associates, Inc., Ventura, CA) is currently being engineered for enhanced conformability to the underlying bony surface. For example, implants with a new type of grid backing reduce the memory of the silicone elastomer and improve flexibility. Greater adaptability to irregular bony surfaces reduces the chance of movement and prevents posterior dead space from occurring between the implant and underlying bone (Fig. 25–1). Renewed interest in research and development in biomaterial engineering has led to development of a composite implant (using both silicone and ePTFE) that promises to combine the advantages of two biomaterials for future use in facial implants (Personal Communication. Implantech Associates, Inc. and W.H. Gore, Inc., January, 1999).

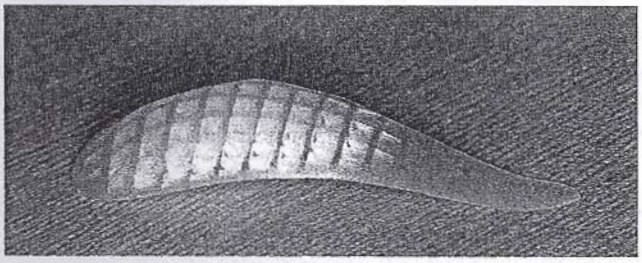


Figure 25–1 The Conform implant is made from a softer silicone material and has a grid design on the posterior surface of the implant that reduces its memory to more easily adapt to the underlying bone surface. The grid feature also reduces the chances of implant slippage and prevents displacement.

Implant Biomaterials

Polymeric Materials/Solid Polymers

Silicone Polymers

Beginning in the 1950s, silicone has had a long history of widespread clinical use with a continued, excellent safety–efficacy profile. The chemical name for silicone is polysiloxane. Currently, only silicone elastomer can be customized by the use of three-dimensional computer imaging and CAD/CAM technology. Differences in manufacture have significance in the purity and stability of the product. For example, the harder the implant the more stable it is. An implant that has a hardness (durometer) of less than 10 will approach the characteristics of a gel and over time potentially "leach" or 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, systemic lupus erythematosus, collagen vascular disease, or other autoimmune diseases.[5,6] Solid silicone elastomer has a high degree of chemical inertness, is hydrophobic, and is extremely stable, with no toxicity or allergic reactions.[7] 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 occur unless the implant is placed too superficially or migrates to the overlying skin.

Polymethacrylate (Acrylic) Polymer

Polymethacrylate polymer is supplied as a powdered mixture and catalyzed to produce a very hard material. The rigidity and hardness of the acrylic implants is a problem in many applications that involve inserting large implants through small openings. In the preformed state, there is difficulty in conforming the implant to the underlying bony contour.

Polyethylene

Polyethylene can be produced in a variety of consistencies, with the current most popular form being porous. Porous polyethylene, also known as Medpore (W. L. Gore, Flagstaff, Arizona), suggests stability with minimal inflammatory cell reaction. However, the material is hard and difficult to sculpt. The porosity of polyethylene permits extensive fibrous tissue ingrowth, which provides an advantage for enhanced implant stability. However, it is extremely difficult to remove secondarily, creating a condition for potential damage to surrounding soft tissue, particularly if placed in areas of thin soft tissue covering.

Polytetrafluoroethylene

Polytetrafluoroethylene comprises a group of materials that has had a defined history of clinical application. The known brand name was Proplast, which is no longer made in the United States because of complications related to its use in temporomandibular joints. Under excessive mechanical

stress, this implant material was subject to breakdown, intense inflammation, thick-capsule formation, infection, and, ultimately, extrusion or explantation.

Expanded Polytetrafluorethylene (ePTFE) (Gore-Tex, W. L. Gore, Inc.)

This material was originally produced for cardiovascular applications.[8,9] Animal studies showed the material to elicit limited fibrous tissue ingrowth without capsule formation and minimal 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 in 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.

Mesh Polymers

The mesh polymers, which include Marlex (Davol Corp., Providence, RI), Dacron (Dow Corning, Midland, MI), and Mersilene (Dow Corning, Midland, MI), have similar advantages of being easily folded, sutured, and shaped; however, they also promote fibrous tissue ingrowth, causing difficulty with secondary removal. Polyamide mesh (Supramid) is a derivative of nylon that is hydroscopic and unstable in vivo. It elicits a mild foreign body reaction with multinucleated giant cells and over time causes implant degradation and resorption.[10]

Metals

Metals consist essentially of stainless steel, vitallium, gold, and titanium. Except for use of gold in some indications, such as upper eyelid springs or in dentistry, titanium has become the metal of choice for long-term implantation. Reasons include high biocompatibility, high corrosion resistance, strength, and minimal x-ray attenuation during computer tomographic scanning or magnetic imaging.

Calcium Phosphate

Calcium phosphate or hypdroxyapatite materials are not osteoconductive but do provide a substrate into which bone from adjacent areas can be deposited.[11] The granule form of hydroxyapatite crystals is used in oral and maxillofacial surgery for augmenting alveolar ridge. The block form has been used as an interpositional graft material in osteotomies.[12] However, it has been shown to be of less value as an augmentation or onlay material due to its brittleness, difficulty in shaping or 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. Other forms of materials and injectables are commercially available (Table 25–1).

TABLE 25–1 Subdermal and Subcutaneous Injectable Filler Materials

Zyderm and Zyplast
Dermalogen
Autologen
Isolagen
AlloDerm
Autogenous dermal grafts
Autogenous fat
Human placental collagen
Hylaform gel
Restylane
Artecol
Liquid silicone

Tissue Engineering and Formation of 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 by a method that results in the formation of functional new 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.[13] A number of tissue-engineered cartilage implants have previously been generated based on these new principles. This includes joint articular cartilage, tracheal rings, and auricular constructs. For in vivo cartilage formation, alginate has been successfully employed with the injection by syringe for the treatment of vesicuolureteral reflux. This results in the formation of irregularly shaped beads of cartilage, which are capable of obstructing the regurgitating urinary flow found in urethral incompetence. 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.[14] Once employed on a commercial basis, these techniques would require minimal donor site morbidity and, like alloplastic implants, reduce operative time.

PATHOPHYSIOLOGIC FACTORS IN AGING

It is generally acknowledged that patients endowed with strong, well-balanced skeletal features will best endure the ravages of age.[15] 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 and smooth, symmetrical contours free of sharp, irregular projections, indentations or skin wrinkling, or dyschromias commonly characterize these youthful faces.[16] Facial structures, like the rest of the body, are in a state of constant flux and are influenced by many factors, such as sun exposure, weight loss, trauma, or disease. Even excessive exercise contributes to the development of certain consistent and identifiable facial contour defects. The development of lines and wrinkles is a result of genetic factors, sun exposure and other environmental exposures, smoking, underlying diseases, gravity, and the effects of muscular action.[17]

Depending on the underlying skeletal structure, involutional soft tissue changes associated with the aging process bring about different but definable configurations of the face that appear progressively more obvious and pronounced with time. Recognition of these various defects and configurations caused by aging is an integral part of the successful use of facial contouring procedures. These include the development of a generalized flattening of the midface, thinning of the vermilion border of the lips, formation of jowls, areas of deep cavitary depressions of the cheek, the formation of deep folds of the skin and rhytides.[18] 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[19,20] (Fig. 25–2).

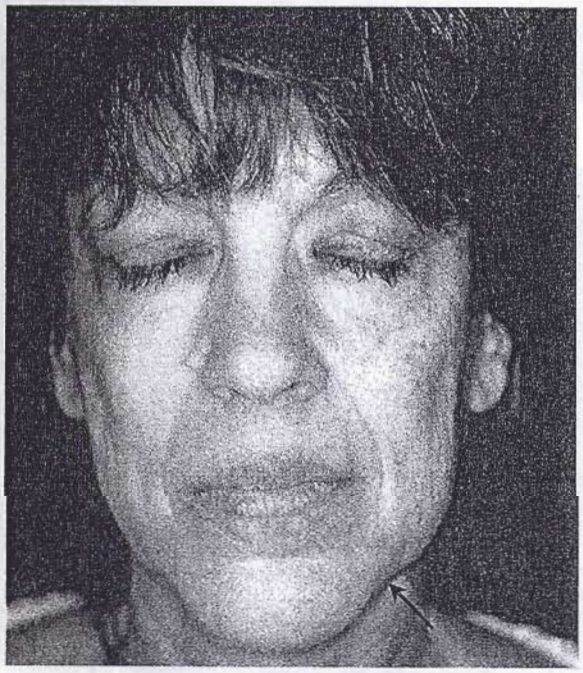


Figure 25–2 Resorption of bone within the anterior mandibular groove, coupled with relaxation of the soft tissue causing progressive encroachment of the jowl, creates the prejowl sulcus and contributes to the development of the marionette lines (*arrow*). In these conditions, the prejowl implant is used to augment and 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. *Fac Plast Surg Clin North Am* 1993;1:231–255. With permission.)

Among many techniques evolving in facial rejuvenation surgery, the missing link still remains the ability to permanently replace soft tissue volume in sufficient quantity and with lasting effect. The recent popularity of fat transplantation has reemphasized tissue replacement as a key component of the rejuvenation process. However, if autogenous fat is not available in the presence of an atrophic soft tissue component of the face that will not benefit from repositioning, then the options are limited to simulating its replacement with the use of alloplastic implants. Alloplastic augmentation techniques can volumetrically address these problems by softening sharp angles or depressions, reexpanding the underlying surface to smooth out wrinkles as well as enhance inadequate skeletal structure.[21–23]

Surgical Considerations in 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. Currently, the most commonly used implants consist of silicone, ePTFE, and polyethylene. Silicone eventually produces some overlying skin atrophy and must be anchored to prevent movement. Both ePTFE and silicone have the potential to cause infection but are easily removed and replaced. Polyethylene (Medpore) implants, as with any other implant that promotes significant tissue ingrowth, invites the potential for major soft tissue damage to the overlying skin if removal becomes necessary. Homograft cartilage has a high percentage of resorption and autogneous bone has an additonal problem of warping.

Because human hyaline cartilage has a limited capacity to regenerate, effective long-term dorsal nasal reconstruction has remained problematic despite extensive efforts to use a wide variety of autografts, allografts, and alloplastic materials. A suitable replacement implant intended to reconstruct the original nasal profile must possess a number of unique characteristics. It must be of adequate length and have consistent curves, thickness, and tapered edges so as to fit well over the nasal bridge and blend in with the surrounding soft tissues and bone. In addition, it must possess a high degree of malleability, flexibility, and compliance so as to endure despite long-term stresses and trauma.

The use of autogenous tissue avoids the problem of bioincompatibility 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 has been synthesized through tissue engineering.[24] The concept involves use of donor septal cartilaginous tissue that is harvested and broken down to its cellular components. The cells are cultured in vitro, thus 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 promises to be a valuable addition to the field of nasal and facial augmentation in the near future (Personal Communication, G. Tobias, September, 1999.)

Surgical Considerations in Midfacial Enhancement

Refinements in aesthetic contouring and lifting of the midface have increased patient expectations. Our ability to rejuvenate the midface and correct midface volume problems has improved dramatically. Rhytidectomy has become just one component of facial rejuvenation options. Now, browlift, midfacial augmentation procedures, cheeklift, midface lift, and resurfacing techniques all must be considered when customizing a surgical plan for a patient. If possible, the ultimate goal for midfacial enhancement is to combine the two key components of rejuvenation and augmentation. If, however, either surgical option by itself is insufficient to relocate ptotic soft tissue or augment volume loss, then the alternative solution must individually be combined with other procedures to provide the maximum multimodality approach to remedy the problem.

Specific criteria are available for determining regions of aesthetic deficits and their corresponding alloplastic solutions.[25,26] In addition, other distinguishing considerations in midfacial aging and imbalance must also be identified. They are periorbital aging, midfacial descent and volume loss, and facial bony maldevelopment with accompanying soft tissue imbalance, ptosis, and asymmetry.

Periorbital aging. With age, there is a 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. Use of conventional blepharoplasty tends to exacerbate laxity of the lower canthal ligament, which contributes to the formation of the "tear-trough" deformity or, in severe cases, causes senile ectropion.[27,28] 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, which are exacerbated by the aging process.

Midfacial descent and volume loss. Midfacial descent involves ptosis of the infraorbital subcutaneous tissues, the malar fat pad, the suborbicularis oculi fat (SOOF),[1] and the orbicularis muscle. 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 everywhere in the body but 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."[29] 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. 25–3). In patients, in whom the severe degenerative changes of the skin and the loss of underlying soft tissue and fat associated with deficient underlying bone structure are combined, the gravitational effects of aging will be exaggerated and cause further deepening of depressions, folds, and wrinkles. In other individuals who have exceptionally prominent cheek bone structure combined with thin skin lacking in subcutaneous or deep supporting fat, facial depressions will be further emphasized. This type of pattern causes a gaunt or haggard appearance in an otherwise healthy person. The severe form of this midfacial pattern can be seen in anorexia nervosa, starvation, or in a newly identified group of HIV-positive patients who have been on protease inhibitors for

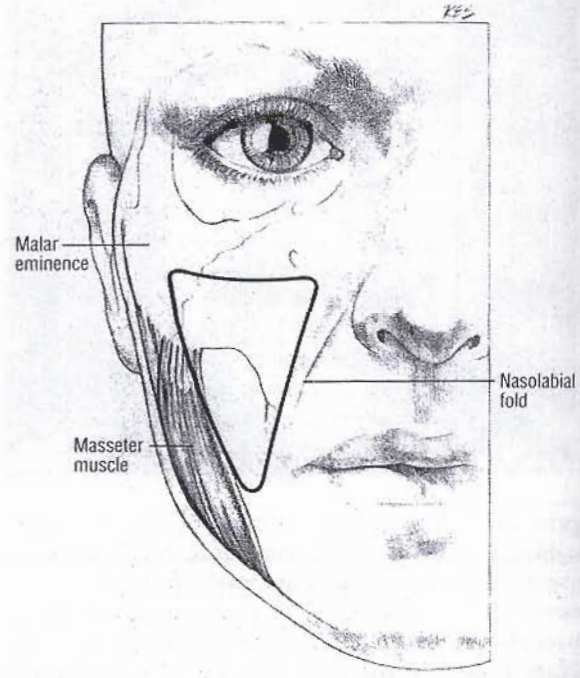


Figure 25–3 The inverted submalar triangle is an area of midfacial depression bordered medially by the nasolabial fold, superiorly by the malar eminence, and laterally by the main body of the masseter muscle.

[1]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 to 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.

prolonged periods. In combination with the primary disease process, the protease inhibitors and other newer generation HIV therapies have a predilection for erosion of the midfacial fat and the buccal fat pad.[1,2] (Fig. 25–4). These conditions of volume loss that are also associated with the aging process often preclude use of rhytidectomy alone for complete facial rejuvenation and are currently being successfully treated with the use of computer-assisted custom-designed facial implants.[30]

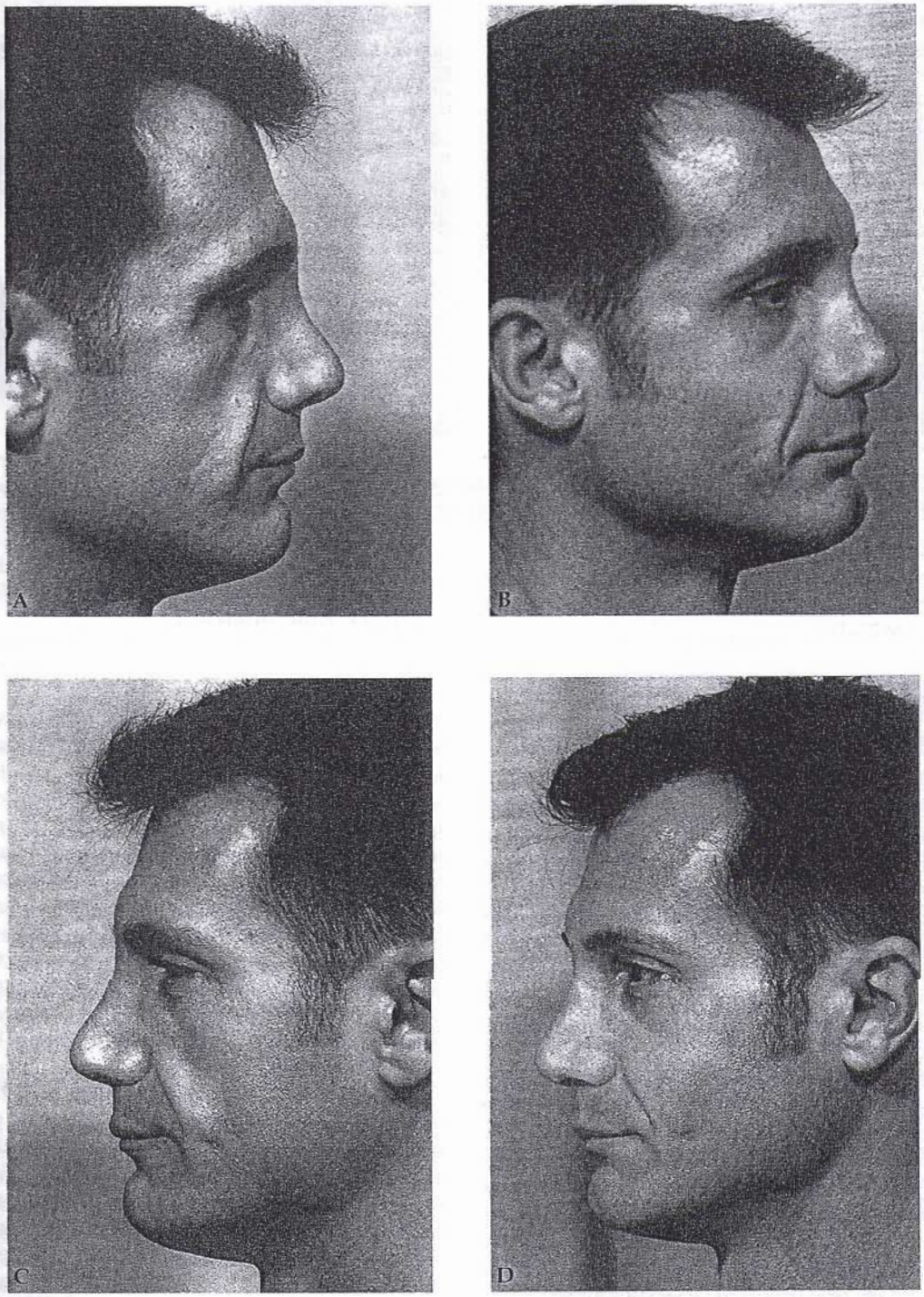


Figure 25–4 **(A, C)** This preoperative photograph represents a patient who has been treated with protease inhibitors for a prolonged period. Many patients eventually develop complete erosion of the midfacial fat and the buccal fat pad leaving a particularly deep cavitary depression in the midface. **(B, D)** At 1 year post surgery, the condition was successfully treated with computer-assisted custom-designed midfacial implants.

Midfacial Procedures: (A Mulimodality, "Multilevel" Approach)

For successful rejuvenation of the midface, this descent and volume loss must be camouflaged, corrected, or replaced. This now entails a multilevel as well as a multimodality approach to the pathophysiologic events of aging. *Camouflage techniques*, such as arcus marginalis blepharoplasty, cause blunting of the nasojugal groove/tear trough region by securing the infraorbital fat bulge past the arcus marginalis.[31] *Midlevel cheeklift techniques* reverse midfacial descent by lifting the midfacial tissues and anchoring them in a more superior-lateral direction.[32] Alloplastic or autogenous augmentation techniques reverse the effects of midfacial descent by replacing midfacial volume and providing soft tissue support at the deepest plane. Because there are many elements of structural deficiency and phenomena of aging, along with rhytidectomy, laser resurfacing, and many other adjunctive techniques, facial implants are used collectively as a necessary part of the framework to restore and extend the optimum aesthetic qualities of the youthful face. Imperfections related to the superficial, soft tissue component of the face, whether it be epidermis, dermis, subcutaneous fat, or, in some cases, muscle, have been corrected with the use of autogenous tissue and synthetic implants. Autogenous fat, homografts, and xenografts such as AlloDerm (Life Cell Corp., The Woodlands, TX), and collagen, as well as alloplastic materials such as ePTFE, are just a few of the materials that have been used. The myriad of soft tissue fillers currently on the worldwide market are testimony to the fact that the ideal soft tissue substitute to replace the superficial soft tissue component is still not available (Table 25–1).

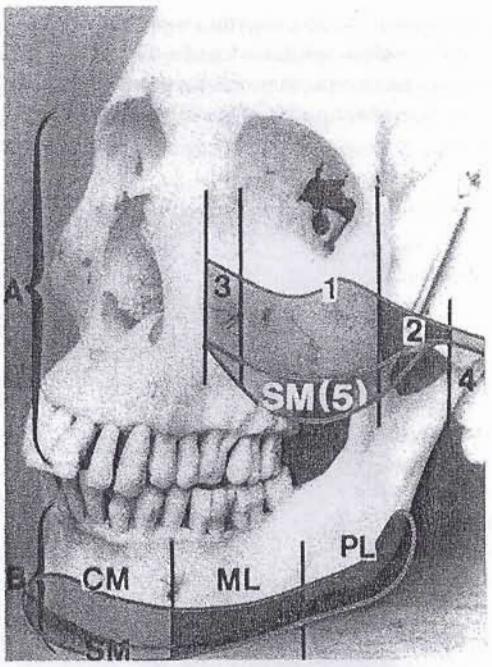


Figure 25–5 Alloplastic facial contouring by zonal principles of skeletal anatomy. The zones of mandibular augmentation: central mentum (CM), midlateral (ML), and posterolateral (PL); the zones of malar anatomy: submalar (SM), submalar zone 5 [SM(5)]. (From Binder WJ, et al. Augmentation of the malar-submalar/midface. *Fac Plast Surg Clin North Am* 1994;2: 265–283. With permission.)

PREOPERATIVE ANALYSIS FOR FACIAL CONTOURING

Considering the infinite variations of facial form that exist, most analytical measurements used in the determination of aesthetic guidelines have been unreliable. Recent analysis and angle guidelines have been helpful as a first step in decifering contour. However, facial augmentation is a three-dimensional procedure that exponentially increases the variabilities of structural diagnosis and ultimate treatment. Having a good understanding of skeletal anatomy and being able to identify specific types of topographic patterns guides the surgeon in making the final determination for optimal implant selection and placement.

Augmentation of the facial skeleton with alloplastic implants changes the deepest skeletal plane of the face with a three-dimensional modality. Evaluation of the face for contouring procedures starts with an understanding of specific zones of skeletal anatomy and identification of distinctive and recognizable configurations of facial deficiency. Correlating these elements of structural and topographic variations is essential for choosing the optimal implant shape, size, and position to obtain the best results in facial contouring.

Evaluation of Mandibular Contour Defects

Delineation of zonal principles of anatomy within the premandible space allows the surgeon to create specific chin and jaw line contour[25] (Fig. 25–5). 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. When this zone is augmented in addition to the central mentum a widening of the anterior jaw line contour results. This is the basis for the development of the extended anatomical and prejowl chin implant (Fig. 25–6). 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 widen or elongate the posterior mandibular angle to produce a stronger posterior jaw line contour.

Zonal principals of skeletal anatomy are useful for conceptualizing the malar midfacial region into distinct anatomical zones (Fig. 25–5). Zone 1, the largest area, includes the major portion of the malar bone and the first third of the zygomatic arch. Augmentation within this zone maximizes the projection of the malar eminence. It produces a high, sharp angular appearance. Zone 2 overlies the middle third of the zygomatic arch. Enhancement of this zone along with zone 1 accentuates the cheek bone laterally, producing a

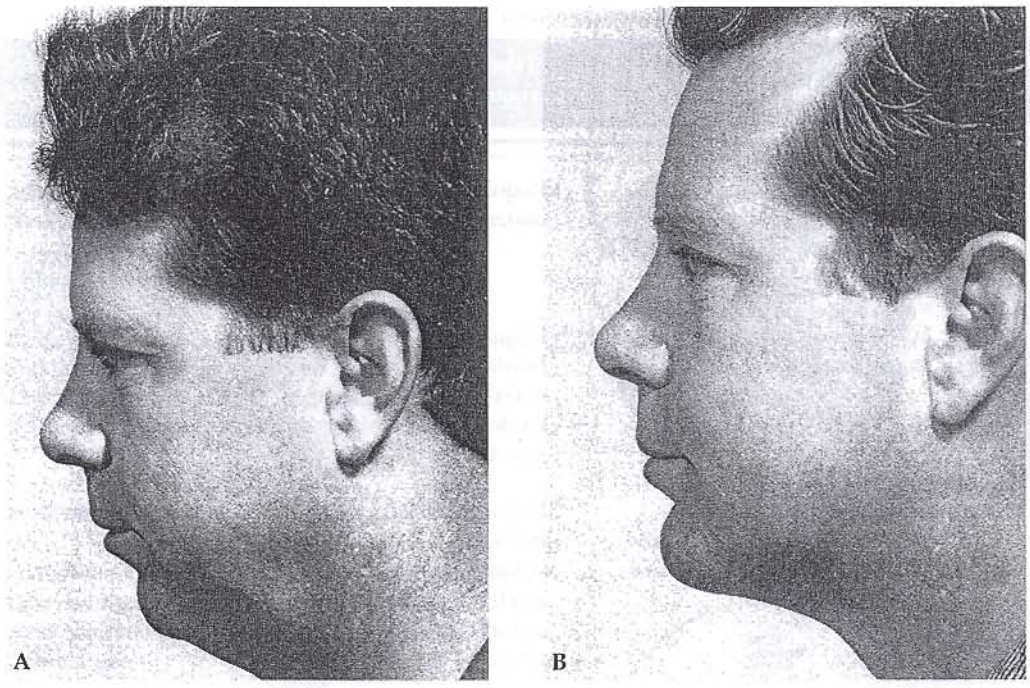


Figure 25–6 **(A)** Preoperative and **(B)** postoperative examples of use of an extended mandibular implant in addition to submental liposuction to create a significantly improved jaw- and neckline.

broader dimension to the upper third of the face. Zone 3, the paranasal area, lies midway between the infraorbital foramen and the nasal bone. A vertical line drawn from the intraorbital foramen marks the lateral border of zone 3, which is the medial extent of the dissection usually done for malar augmentation. Augmentation of zone 3 gives medial fullness to the infraorbital region. Zone 4 overlies the posterior third of the zygomatic arch. Augmentation in this area produces an unnatural appearance and in most cases is not indicated. The tissues overlying this zone are adherent to the bone, and dissection must be performed cautiously because the zygomaticotemporal division of the facial nerve passes superficially within the temporoparietal fascia over the zygomatic arch and would be prone to injury. Zone 5 is the submalar triangle.

Midfacial Contour Defects

A topographic classification of midfacial contour deficiencies has proven to be extremely useful as a basic reference guideline to correlate distinctive anatomic patterns of deformity to specific implants.[26] (Table 25–2; Fig. 25–7) Type I deformity occurs in a patient who has good midfacial fullness, but insufficient malar skeletal development. In this case, a malar shell implant to augment the zygoma and create a higher arch to the cheekbone would be desirable. The larger surface area of the implant imparts greater stability and helps reduce rotation or displacement. Inferior extension into the submalar space establishes a more natural transition from the localized area of maximal augmentation to contiguous areas of relative recession (Fig. 25–8). Type II deformity occurs in a patient who has atrophy or ptosis of the midfacial soft tissues in the submalar area with adequate malar development. In this case, submalar implants are used to augment or fill these depressions or provide anterior projection (Figs. 25–9). Type II deficiency is the most common, found most in the aging patient where the submalar implant is used effectively as an adjunct to the facelift surgery (Fig. 25–10). Type III deformity occurs in a patient who has thin skin and exceptionally prominent malar eminences. These characteristics combine to cause an abrupt transition from the cheek bone superiorly to an extreme area of hollowness found within the submalar region, producing an exceptionally gaunt or skeletonized facial appearance. In this group of patients, a second-generation submalar transition implant is used to fill the abrupt midfacial hollow. Type IV deformity is the result of malar hypoplasia and submalar soft tissue deficiency, which is described as the "volume-deficient" face. In this situation, a single combined malar-submalar implant must serve two purposes: it must proportionately augment a deficient skeletal structure over the malar area and fill the void created by absent midfacial soft tissue within the submalar area. Because this condition is also associated with premature aging of the skin in terms of excessive midfacial wrinkling and deep folds, these patients are often classified as suboptimal candidates for rhytidectomy. As seen in Fig. 25–11, total midfacial restoration and lateral mandibular augmentation, using a combined malar-submalar implant and prejowl implant, provide the structural basis for this patient to derive greater benefit from the concurrently performed rhytidectomy procedure and successfully eliminate the deep folds that were present in

TABLE 25–2 Patterns of Midfacial Deformities Correlated with Type of Implant

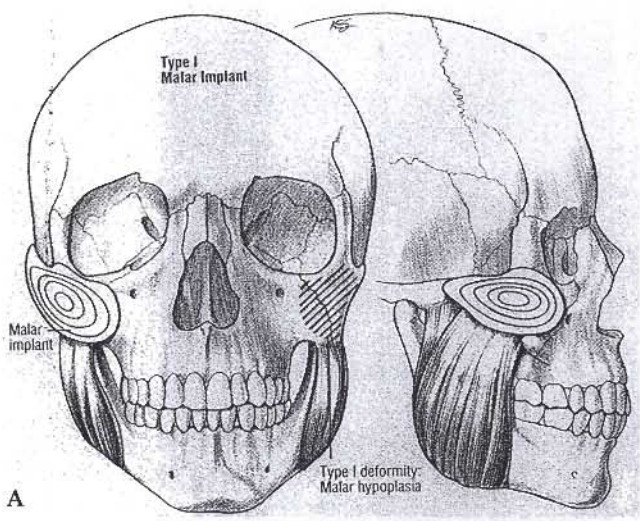
Deformity type	Midfacial deformity	Type of augmentation required	Type of implant predominantly used
I	Primary malar hypoplasia; adequate submalar soft-tissue development	Requires projection over the malar eminence	Malar implant: "shell-type" implant extends inferiorly into submalar space for more natural result
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 or Generation I submalar implant)
III	Extreme malar-zygomatic prominence; thin skin; with abrupt transition to a severe submalar recess	Requires normal anatomic transition between malar and submalar regions; plus moderate augmentation around inferior aspect of zygoma	Submalar implant (Generation II): "U"-shaped to fit w/in submalar space and around inferior border of prominent zygoma
IV	Both 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
V	Tear-trough deformity (Infraorbital rim depression or recess)	Requires site-specific augmentation along infraorbital rim	"Tear-trough implant"; to fit site-specific suborbital groove

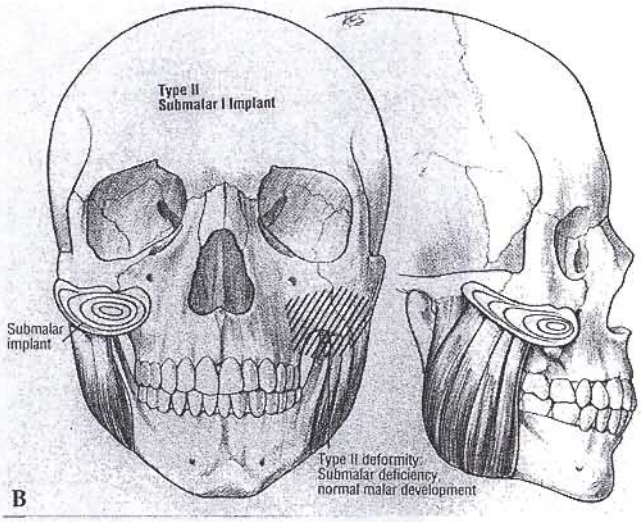
the medial middle third of the face. The tear trough (type V) deformity is specifically limited to a deep groove that commonly occurs at the junction of the thin eyelid and thicker cheek skin. In this deformity, a pronounced fold extends downward and laterally from the inner canthus of the eye across the infraorbital rim and the suborbital component of the malar bone. A tear trough silicone elastomer implant, ePTFE, and fat have been used in attempts to correct this deformity.[28,33]

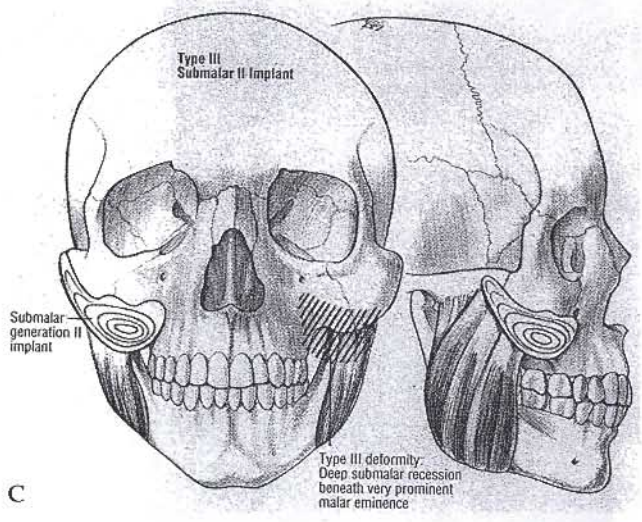
One specific approach to the hollow infraorbital and nasojugal region is an infraorbital/midfacial elevation technique, the superficial cheeklift.[32] This addresses the vector component of midfacial aging. The superficial cheeklift enables an elevation in the thicker cheekpad skin and subcutaneous tissue to cover the inferior orbital rim. This also reduces heaviness of the upper nasolabial fold (Fig. 25–12). The lateral and midpupillary region are most effectively treated. For a more severe tear trough deformity medially, a concomitant arcus marginalis use of infraorbital fat or tear trough implant can also be used concurrently if additional augmentation is necessary. The superficial dissection plane offers advantages in ease of performance, direct access to the pliable cheekpad, and lower complication rates over subperiosteal dissection techniques. Caution and experience in midfacial anatomy are still necessary before any midface elevation procedure can be undertaken. If excessive midfacial elevation (or overresection of seemingly loose infraorbital skin) is attempted, downward traction from the mouth can result in traction on the lower eyelid. Cheeklift techniques are new and are still undergoing modification as their role in midfacial rejuvenation increases.

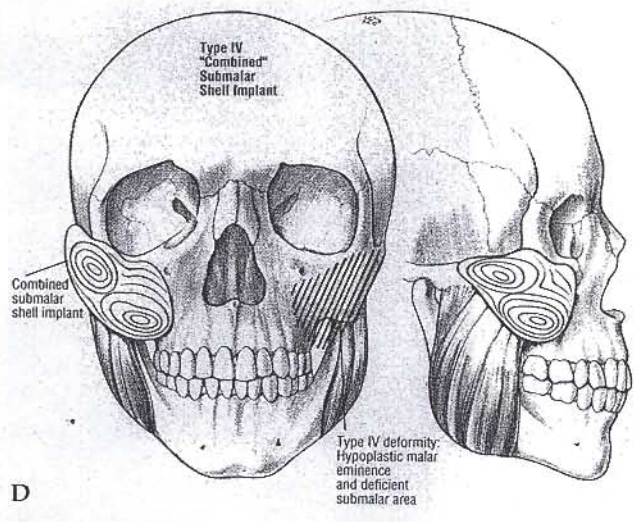
PROCEDURE

An implant of a particular shape or size that is used for a wide face may need to have its overall dimension or thickness reduced for a narrow face, or in the presence of thin skin. As all faces are different, it should be the rule that implants require modification. Therefore, the surgeon must









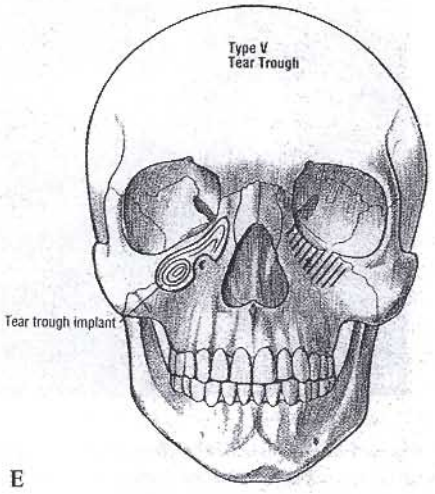


Figure 25–7 Frontal and lateral drawings illustrate the anatomical areas of the midface and five distinctive topographic patterns of midfacial deformity. Specific implants that are directly correlated with and used to correct these specific patterns of midfacial deformity are selected (see Table 25–2).

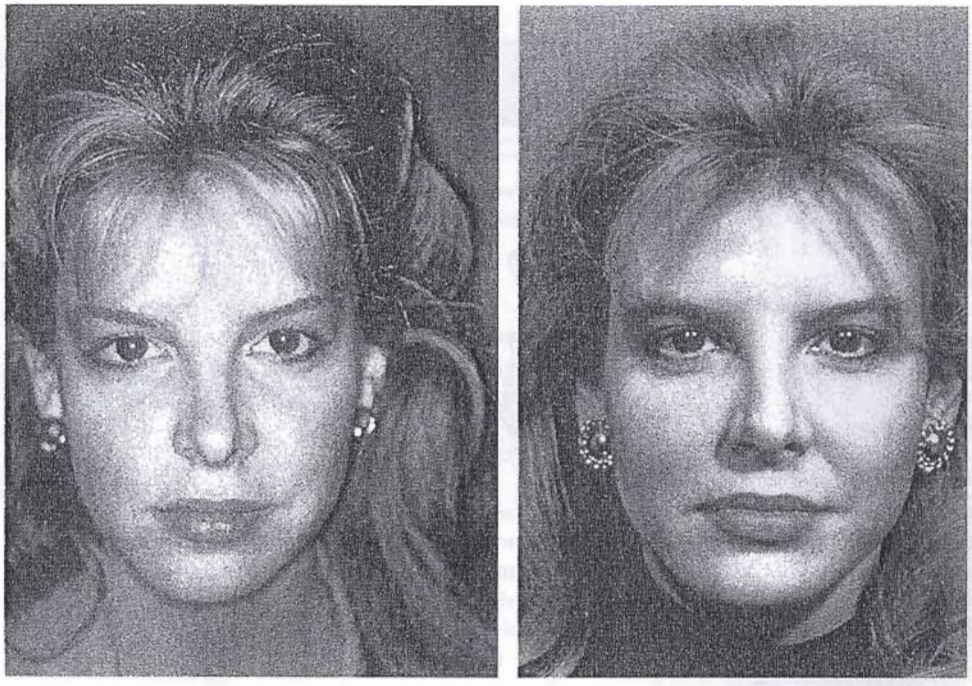


Figure 25–8 (*left*) Preoperative example of malar hypoplasia (type I deficiency). (*right*) Eight months after malarplasty using a Malar-Shell implant. Augmentation of a greater surface area and extension inferiorly into the submalar space produces a more natural high cheekbone effect.

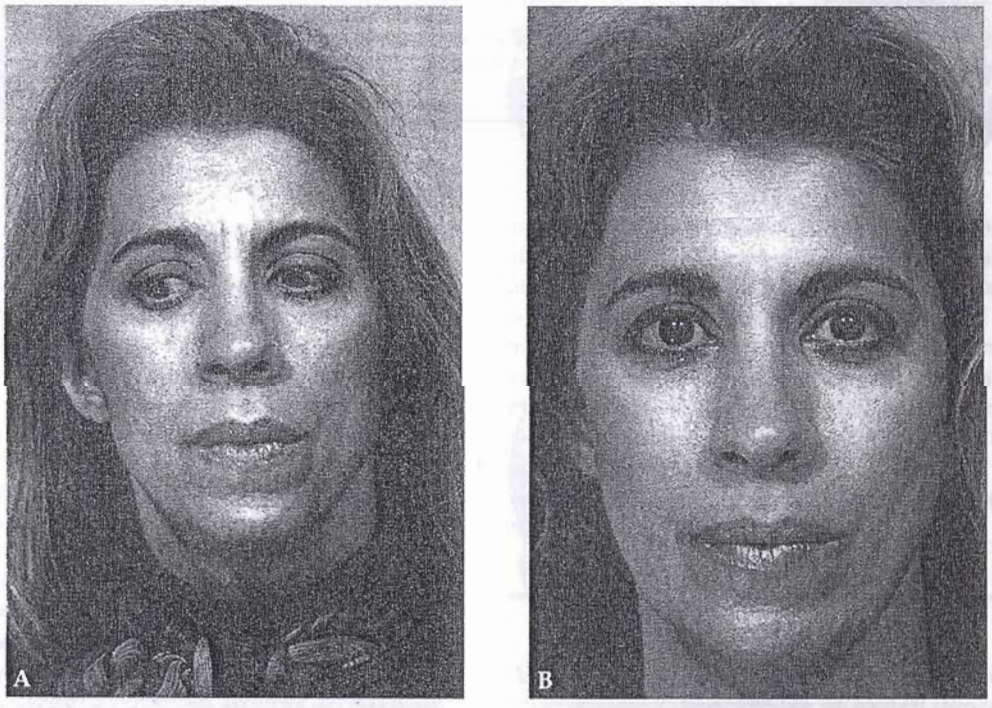


Figure 25–9 **(A)** Preoperatively, this patient has a relatively good malar bone structure but was complaining of early flatness to the midface (type II deformity) in addition to a mandibular parasymphyseal depression caused by an earlier performed genioplasty. **(B)** Submalar augmentation restored the anterior projection to the middle third of the face, providing a more youthful expression as well as reducing the depth of the nasolabial folds. A custom implant was used to fill in the parasymphyseal depression.

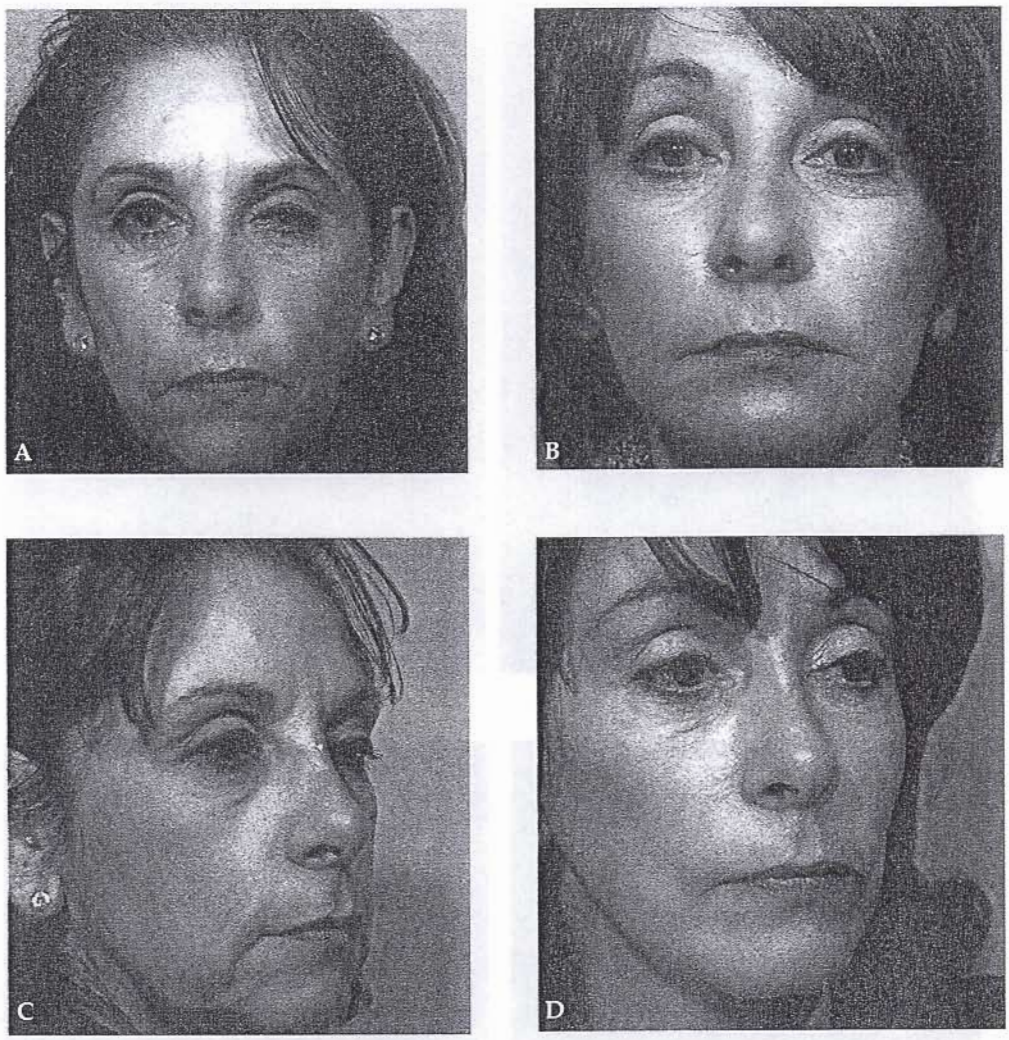


Figure 25–10 **(A, C)** Preoperative. **(B, D)** Six months postoperative. In conjunction with rhytidectomy, lower blepharoplasty, and browlift, a conform submalar implant was used as adjunctively to help restore volume and structure, and to establish the basis for a greater longevity to the facelift operation.

be prepared to have all anticipated designs, shapes, or materials available and be prepared to modify the implant on an impromptu basis. Failure to have the right implant for a particular patient can only yield a suboptimal result.

On the day prior to surgery, the patient is started on a broad-spectrum antibiotic regimen that will continue 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 skin is then explained to the patient so that a cooperative effort is made to finalize both the surgeon's and patient's perception of implant shape, size, and position to optimize their mutual goals (Fig. 25–13).

General Surgical Technique for Facial Implantation

The basic principles for augmenting the malar, midfacial, premandibular spaces or nasal augmentation are identical. Controlling the shape, size, and positioning of the implant will determine the overall final facial contour.

Surgical Technique for Mandibular Augmentation

Anterior Mandibular Implants

Access to the premandibular space can be accomplished by either an intraoral or an external route. The external route utilizes a 1 to 1.5-cm incision in the submental crease.

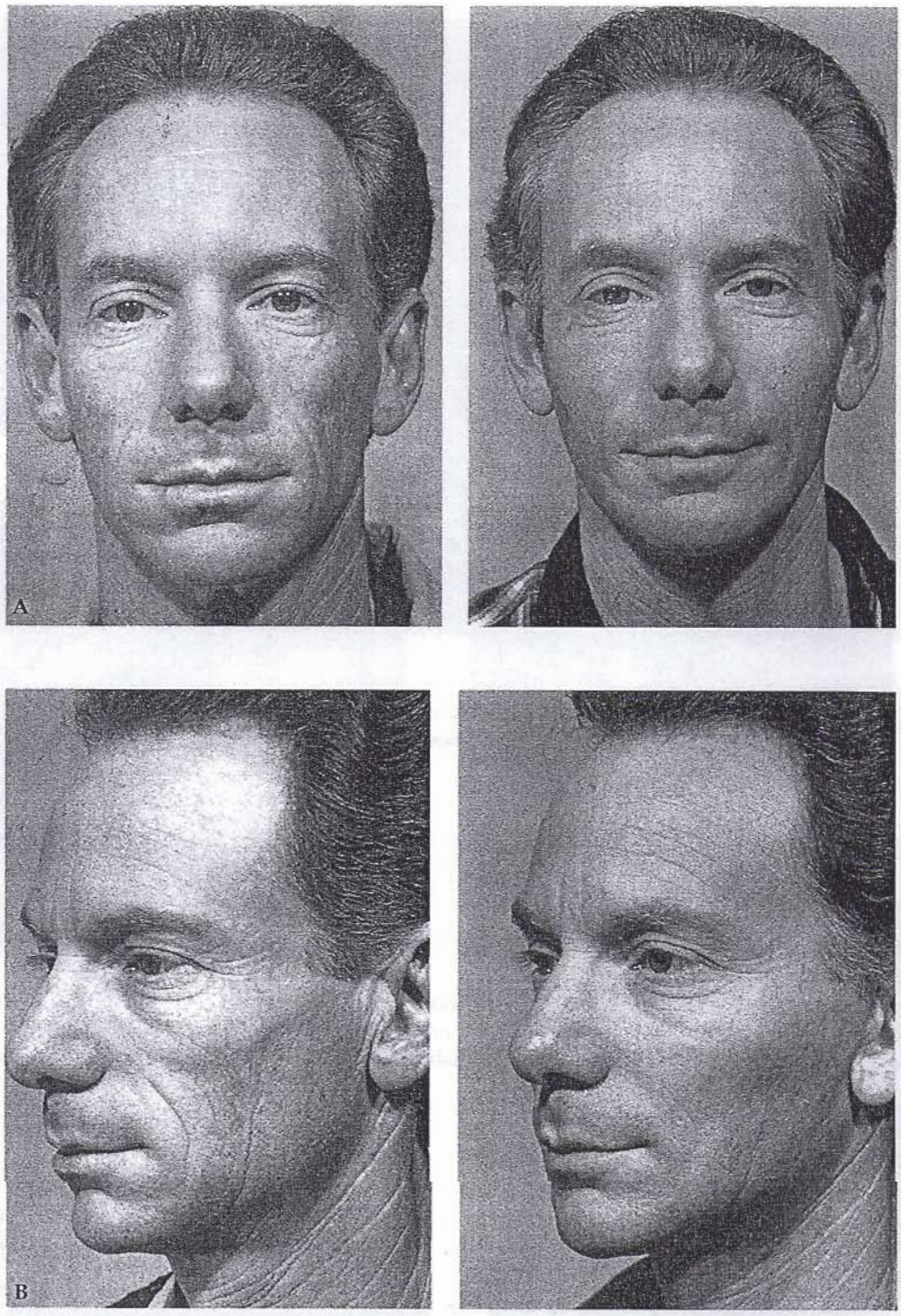


Figure 25–11 **(A)** frontal; **(B)** oblique; *(continues on next page)*

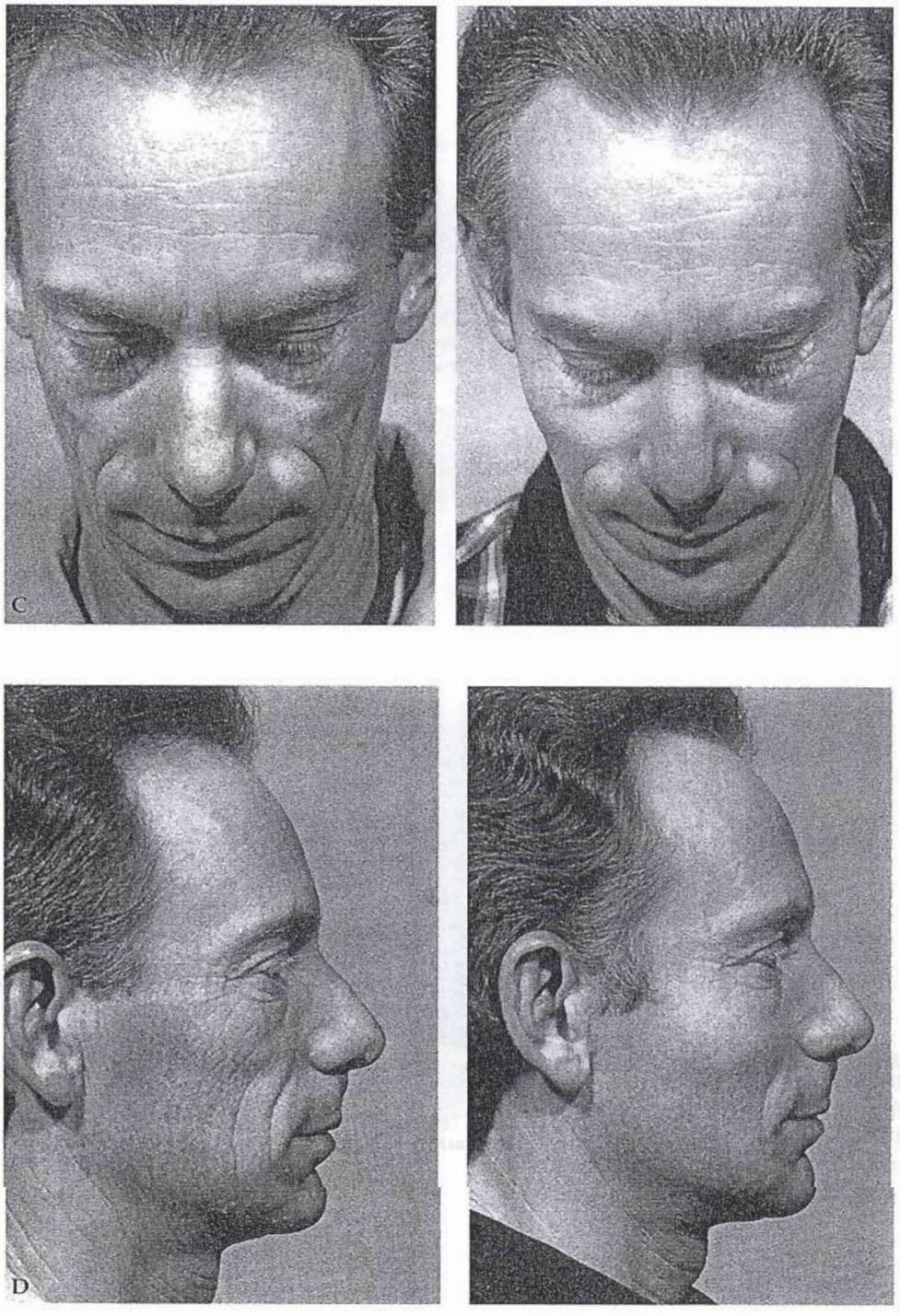
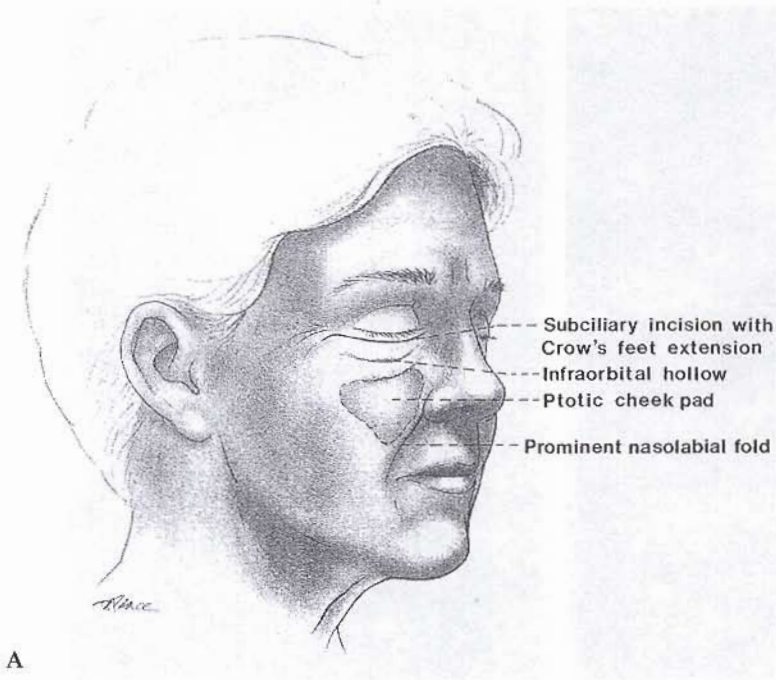


Figure 25–11 *(cont.)* **(C)** head down; **(D)** lateral. *Left* Preoperative analysis of the facial configuration in this 40-year-old patient reveals the presence of severe deficiency in both skeletal structure and soft-tissue volume contributing primarily to the excessive wrinkling of the skin in 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 meaningful, long-term improvement. (From Binder WJ. A comprehensive approach for aesthetic contouring of the midface in rhytidectomy. *Fac Plast Surg Clin North Am* 1993;1:231–255. With permission.)



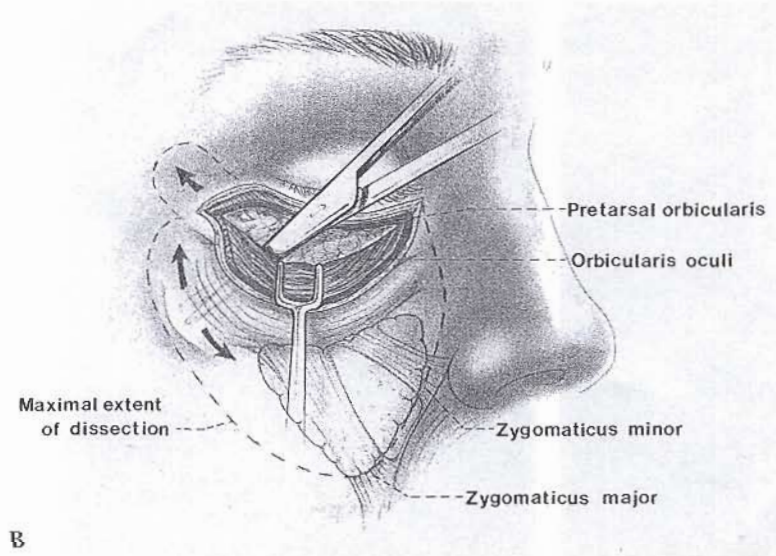
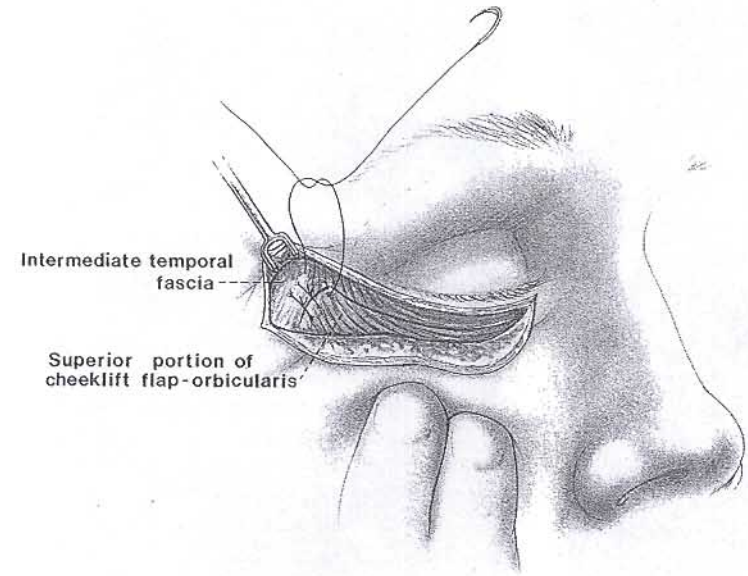


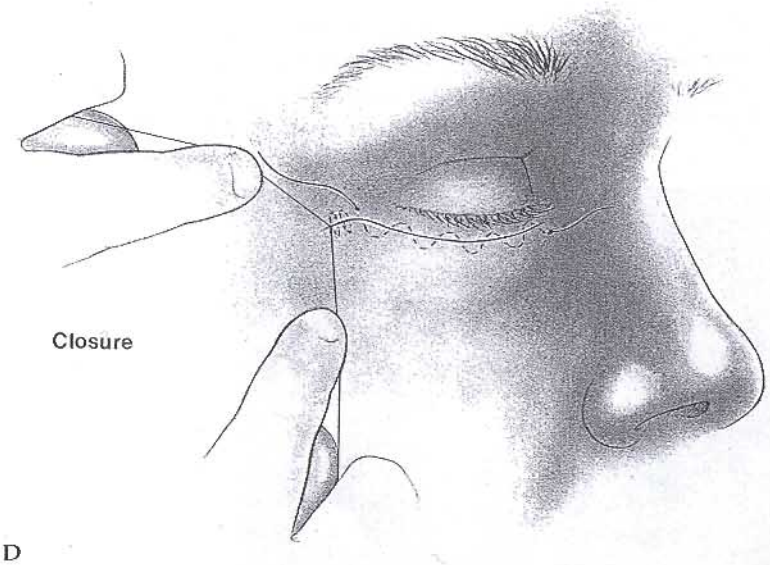
Figure 25–12 **(A)** Preoperative diagram showing infraorbital fat bulge, nasojugal and infraorbital hollowing, and ptotic malar fat pad. **(B)** Intraoperative dissection showing superficial cheeklift dissection in suborbicularis plane. *(continues on next page)*

Advantages of the external route are that it does not involve intraoral bacterial contamination; it has direct access to the inferior mandibular border where cortical bone is present; it does not require significant retraction of the mental nerves; and it allows the implant to be secured to the periosteum along the inferior mandibular border with simple suture fixation. This helps to prevent side-to-side or vertical slippage. 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 the potential muscle weakness that may occur if transection takes place. Lateral dissection requires identification and retraction of the mental nerves.

Basic technical rules for safe and accurate mandibular augmentation should be followed. (1) 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 mandible comprises the origins of the anterior mandibular ligament, which defines the pre-



C



D

Figure 25–12 *(cont.)* **(C)** Anchoring of freed orbicularis oculi flap to intermediate temporal fascia. **(D)** Closure of subciliary incision.
(continues on next page)

jowl 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) Dissection of this space 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, which helps to direct the elevator away from the nerve and along the inferior border of the mandible. A dry operative field is essential for accurate visualization, precise dissection, proper implant placement, and prevention of postoperative hematoma or seroma.

A Joseph or 4-mm periosteal elevator is used to perform the dissection along the inferior mandibular border. When 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 on 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 either the incision must be made larger or the procedure must be performed

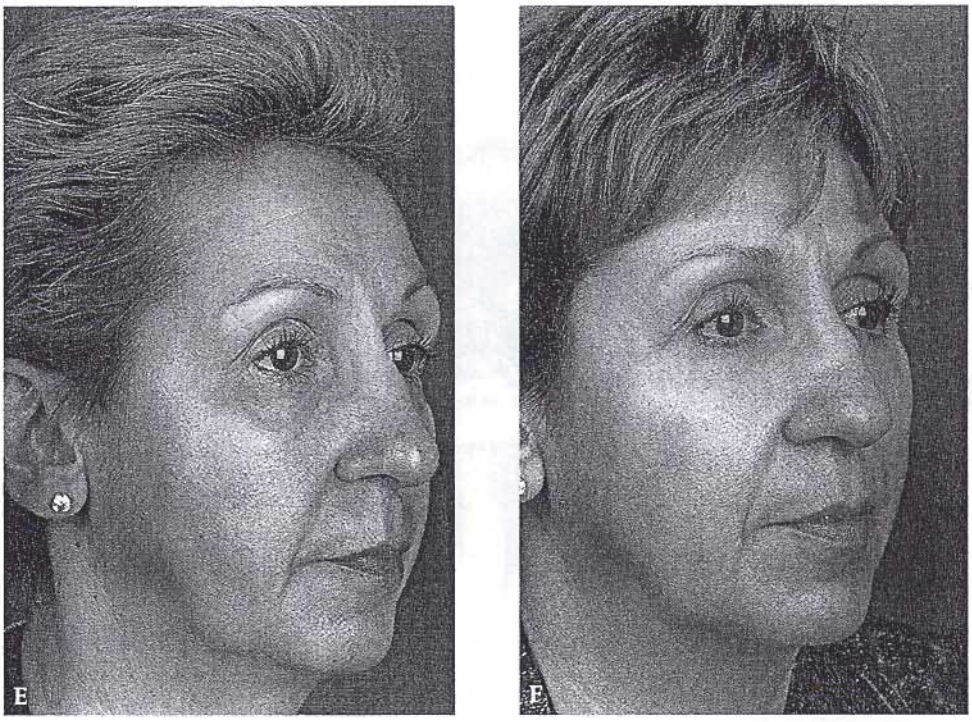


Figure 25–12 *(cont.)* **(E)** A 52-year-old woman, preoperative, with hollow infraorbital and nasojugal region. **(F)** Six months postoperative superficial cheeklift. (From Moelleken BRW. The superficial subciliary cheeklift: a technique for rejuvenating the infraorbital region and nasojugal groove—clinical series of 71 patients. *Plast Reconstr Surg* 1999;104(6). With permission.)

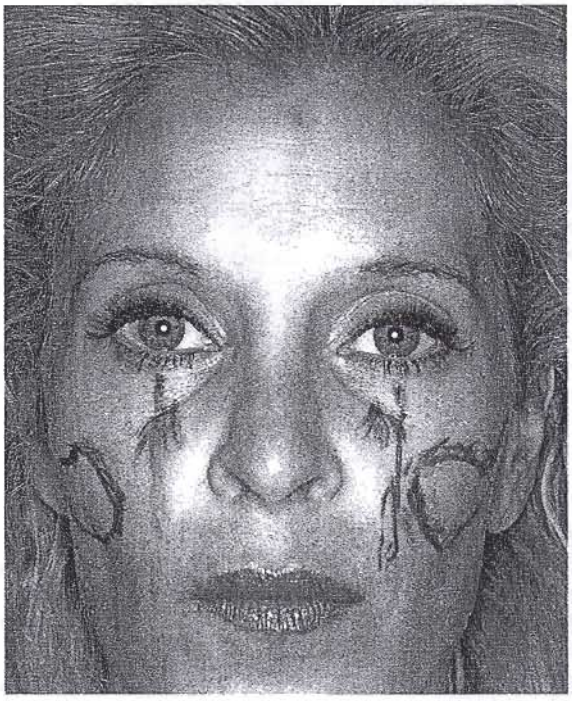


Figure 25–13 Prior to infiltration of local anesthetic, the areas requiring augmentation are specifically outlined with the patient sitting in the upright position. In the majority of cases, the medial border of submalar or malar implants is placed lateral to the infraorbital foramen corresponding approximately to the midpupillary line. (From Binder WJ. A comprehensive approach for aesthetic contouring of the midface in rhytidectomy. *Fac Plast Surg Clin North Am* 1993;1: 231–255. With permission.)

through an intraoral incision. Implants expanding into the midlateral or parasymphyseal zone accomplishes anterior widening of the lower third of the facial segment. The necessary average central projection is 6 to 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 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.

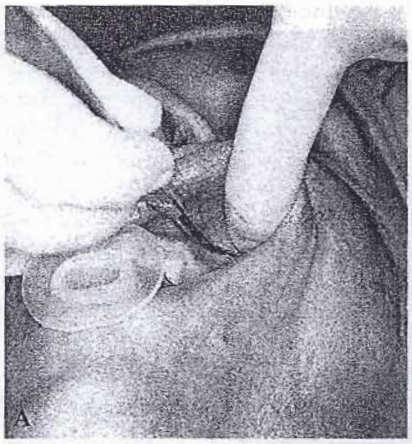
Intraoral Route

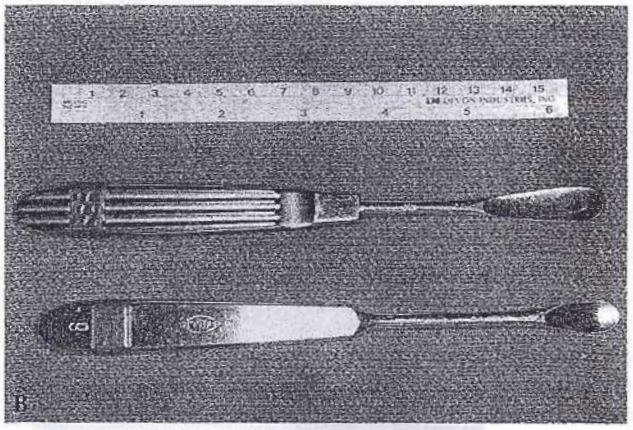
The intraoral route is the most common and the preferred route for most midfacial implantations with the exception of the tear trough implantation. After infiltration of the anesthetic solution, a 1-cm incision is made through the mucosa and carried directly down to bone in a vertical oblique direction above the buccal-gingival line and over the lateral buttress (Fig. 25–14). 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, which in our experience does not cause extrusion or increase the incidence of complications. A broad Tessier-type elevator (approximately 10 mm wide) is directed through the incision onto the bone in the same orientation as the incision. A broad elevator helps to facilitate the dissection safely and with relative ease within the subperiosteal plane (Fig. 25–14B). 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. The submalar space is created by elevating the soft tissues inferiorly over the masseter muscle below the zygoma (Fig. 25–14C). One can 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 on 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, part of this space can be opened by gently advancing and elevating the tissues with a heavy, blunt periosteal elevator. It is of utmost importance that the dissection be 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 topographic changes produced by placement of the different implant "sizers" into the pocket (Fig. 25–14D).

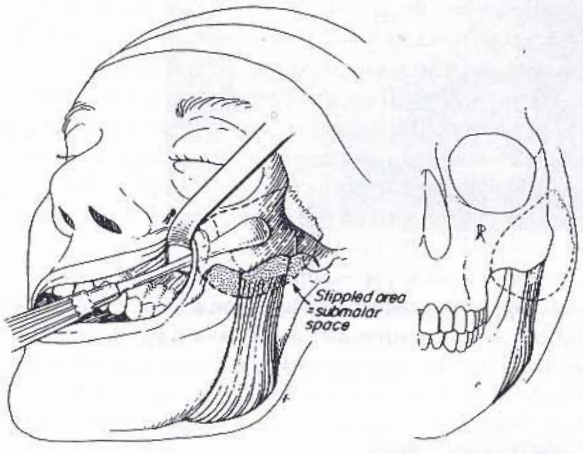
Final implant placement must correspond to the external topographic defects outlined on the face preoperatively (Fig. 25–14E). In submalar augmentation, the implant may reside below the zygoma and zygomatic arch, over the masseter tendon, or it may overlap both bone and tendon. The larger shell-type malar implants reside primarily on bone in a more superior lateral position and may extend partly into the submalar space. The combined implant 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 the thickness or length and 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 in the larger pocket created beyond the incision.[34] This avoids having to make the larger incisions required for more rigid implants and allows for ease of implant insertion and removal during the selection process.

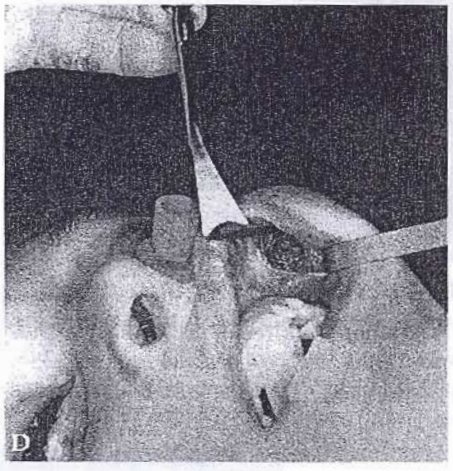
Facial Asymmetry

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.[35] 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









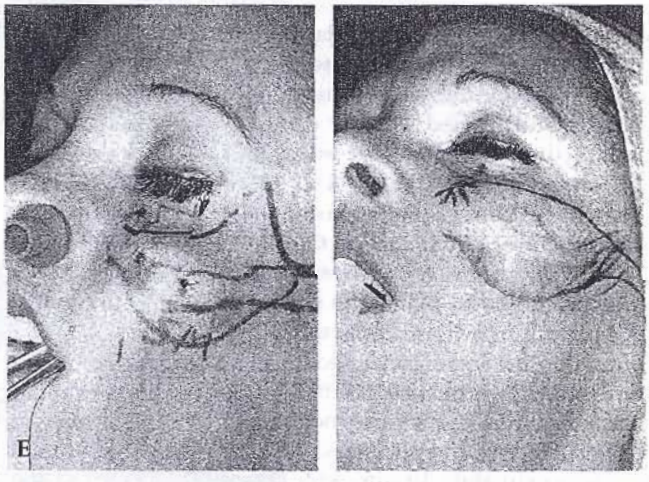


Figure 25–14 **(A)** After injection with local anesthetic, the mucosa is compressed and a single incision is carried through mucosa and periosteum directly onto bone. The incision is small (1 to 1.5 cm) and is placed over the lateral aspect of the canine fossa and lateral buttress at least 1 cm above the buccal-gingival line. **(B)** The 9- and 10-mm curved and straight periosteal elevators used for dissection. **(C)** 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. *Fac Plast Surg Clin North Am* 1993;1:231–255. With permission.)

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 use of different implants for each side or shims that can be carved from a silicone block that are sutured to the posterior surface of the implant to increase the projection of a particular segment.

Implant Fixation

Once position has been established, it is usually necessary to secure the implant. This can be accomplished by a number of different methods. Internal suture fixation relies on the presence of an adjacent stable segment of periosteum or tendinous structure on which to anchor the implant. Stainless steel or titanium screws can also be used. There are two methods of external fixation used to stabilize midfacial implants. The indirect lateral suspension technique uses 2-0 Ethilon sutures 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. The direct method of external fixation is often used in patients with gross asymmetry or when submalar or combined implants are used. In these situations, the direct external method of fixation prevents slippage in the immediate postoperative period. With this method, the implants are positioned to correspond directly with marks on the skin that coincide with the two most medial fenestrations of the implant. Symmetrical placement of both implants is assisted by measuring the distance from the midline to both right and left medial markings (Fig. 25–15A). Then the implants are 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 suture with 1-in. straight needles 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 allowed to exit at the respective external markings (Fig. 25–15B). The implant, following the needles, is guided into the pocket. The implant is then secured in place by tying the sutures over bolsters composed of two cotton rolls (Fig. 25–15C).

Subciliary (Lower Blepharoplasty) Approach

It is more difficult to introduce a large implant through a subciliary approach. However, this is the preferred approach for the insertion of the tear trough implant. In malar augmentation only, when zone 1 or 2 requires a smaller malar implant to achieve high-arch cheek bones, then the blepharoplasty approach may be adequate. The advantages of the subciliary approach are the lack of oral contamination and the soft tissue support inferiorly, which reduces the chances for implant descent. However, this technique can also precipitate an ectropion in the presence of a weak tarsus.

Transconjunctival Approach

The transconjunctival approach has been used for insertion of midfacial implants but may also require disinsertion of the lateral canthal tendon. This necessitates secondary resuspension canthoplasty with the attendant risk of lower eyelid assymmetry.

Rhytidectomy Approach

The malar space may be safely entered through zone 1 of the malar region. Penetration of the subcutaneous musculoaponeurotic system (SMAS) is made medial to the zygomatic eminence and then bluntly carried down to bone. There are no significant facial nerve branches in this area. The malar pocket is then created primarily by retrograde dissection. However, insertion of an implant by this approach can introduce technical difficulties during SMAS dissection and elevation and provides limited access for extended implant positioning.

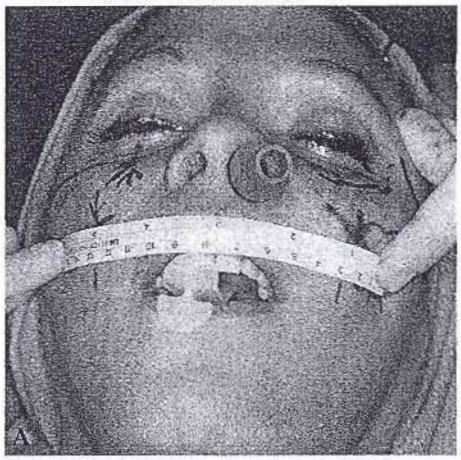
Zygomatic/Temporal and Coronal Approaches

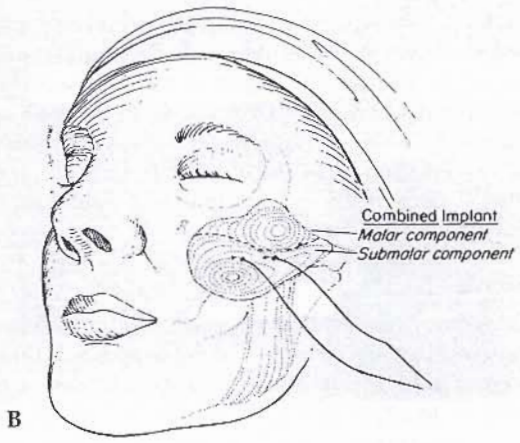
The cranial facial techniques for subperiosteal facelifts provide ready access to the malar zygomatic region. However, endoscopic approaches for the most part provide reduced exposure or the required visualization necessary for regional augmentation with larger implants.

COMPLICATIONS

Complications of implantation 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.[36] However, in most of the complications listed, very few are due solely to the implant material itself. It is extremely difficult to separate the surgical technique from the surrounding circumstances of the individual operation as well as from individual patient risk factors not associated with the implant.

Extrusion should not occur if the technical rules 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 to a large enough degree 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 overlay this area. The course of the mental nerve is anatomically directed superiorly into the lower





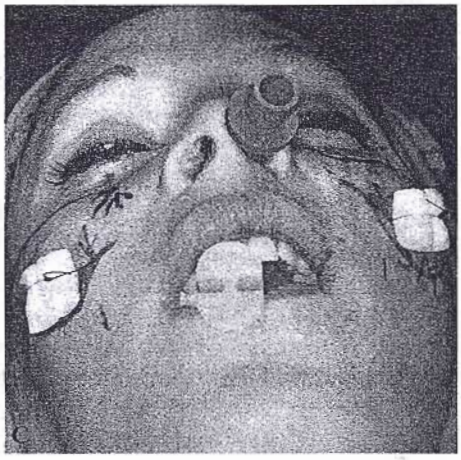


Figure 25–15 **(A)** Symmetrical placement is assisted by measuring the distance from the midline to both the right and left marks. A second mark is then placed on the skin, which corresponds to the second, adjacent fenestration which determines the superior–inferior orientation of the lateral portion 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. [Figure illustrates the two components (malar and submalar) that form the combined implant.] **(C)** The implant is stabilized by tying of the suture directly over an external bolster (composed 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. *Fac Plast Surg Clin North Am* 1993;1:231–255. With permission.)

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 numbers of cases.[37] If encroachment on the nerve by the implant is detected due to misplacement or malrotation, then repositioning of the implant below the nerve should be done as early as possible.

The temporal branch of the facial nerve passes posterior to the midaspect 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 with 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, swelling, and, consequently, the postoperative complications related to fluid accumulation within the pocket (Fig. 25–16).

Bone resorption is more commonly found in mandibular augmentation than in other alloplastic implant procedures. Findings of bone erosion following chin implantation were reported in 1960. However, since these early reports, there have been no clinical reports of significance after surveying large populations of surgeons.[37] 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.

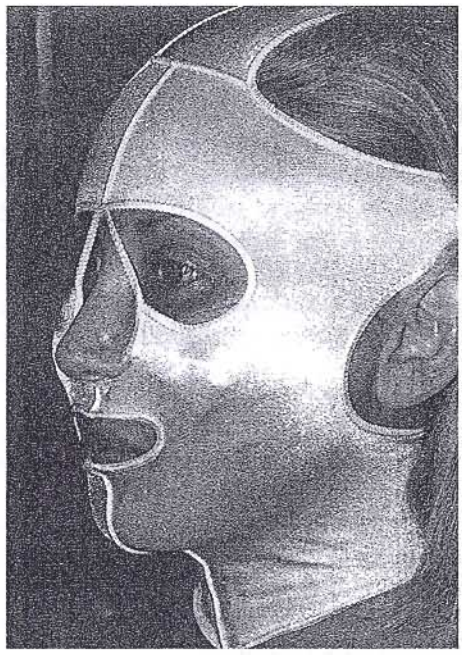


Figure 25–16 The immediate application of some pressure over the entire midface by using a full-face compression garment has been found to considerably reduce the risk of hematoma, seroma, and swelling.

DISCUSSION

Understanding the principals of zonal anatomy, observing the types of external facial forms, and paying careful attention to basic techniques result in greater predictability in facial contouring. Critical analysis of the patient's face and precise and focused communication between surgeon and patient lead to optimal patient satisfaction. Many different types of facial implants are available with which the surgeon can create a variety of contours to fulfill most needs. Reconstructing more complex contour defects can be accomplished by using three-dimensional computer imaging and CAD/CAM technology to manufacture custom implants.[25] A recent increase in the number of HIV-positive patients taking protease inhibitors has necessitated the use of this technique to effectively treat this cosmetically disabling condition.

CONCLUSION

Facial implant procedures provide the patient with significant change in his or her facial appearance, and the rewards to the patient in terms of producing increased harmony and proportion to the face are unlimited. Although challenging, few procedures can provide the major rewards that facial contouring procedures can offer.

REFERENCES

1. Carr A, Samaras K, Burton S, et al. A syndrome of peripheral lipodystrophy, hyperlipidaemia and insulin resistance in patients receiving HIV protease inhibitors. *AIDS* 1998;12(7):F51.
2. Kotler DP, Rosenbaum K, Wang J, Pierson RN. Studies of body composition and fat distribution in HIV-infected and control subjects. *J Acq Immune Defic Hum Retrovirol* 1999;20(3):229.
3. Anderson JM, Miller KM. Biomaterial biocompatibility and the macrophage. *Biomaterials* 1984;5:5.
4. Ziats NP, Miller KM, Anderson JM. In vitro and in vivo interactions of cells with biomaterials. *Biomaterials* 1988;9:5.
5. Gabriel SE, O'Fallon WM, Kurland LT, et al. Risk of connective-tissue diseases and other disorders after breast implantation. *N Engl J Med* 1994;330:1697.
6. Park AJ, Black RJ, Sarhadi NS, et al. Silicone gel-filled breast implants and connective tissue diseases. *Plast Reconst Surg* 1998;101:261.
7. Park JB, Lakes RS (eds). Polymeric materials. In: *Biomaterials: an introduction*. New York: Plenum Press, 1994:164.
8. Soyer T, Lempier M, Cooper P, et al. A new venous prosthesis. *Surgery* 1972;72:864.
9. McCauley CE. A seven-year follow-up of expanded polytetraflouroethylene in femoropopliteal by-pass grafts. *Ann Plast Surg* 1984;199:37.
10. Brown BI, Neel HB III, Kern EB. Implants of Supramid, Proplast, Plasti-pore, and Silastic. *Arch Otolarngol Head Neck Surg* 1979;105:605.
11. Alexander H. Calcium-based ceramics and composites in bone reconstruction. *CRC Crit Rev Biocompat* 1987;4:43.
12. Salyer KE, Hall CD. Porous hydroxyapatite as an onlay bone graft substitute in maxillofacial surgery. *Plast Reconstr Surg* 1989;84:236.
13. Rodriquez A, Vacanti CA. Characteristics of cartilage engineered from human pediatric auricular cartilage. *Plast Reconstr Surg* 1999;103:1111.
14. Langer R, Vacanti J. Tissue engineering: biomedical applications. *Tissue Eng* 1996;1:151.
15. Romm S. Art, love and facial beauty. *Clin Plast Surg* 1987; 14:579.
16. Broadbent TR, Mathews VI. Artistic relationships in surface anatomy of the face. Application to reconstructive surgery. *Plast Reconstr Surg* 1957;20:1.
17. Blitzer A, Binder WJ, Aviv JE, et al. The management of hyperfunctional facial lines with botulinum toxin: a collaborative study of 210 injection sites in 162 patients. *Arch Otolaryngol Head Neck Surg* 1997;123:389–392.
18. Gonzolez-Ulloa M, Stevens EF. Senility of the face. Basic study to understand its causes and effects. *Plast Reconstr Surg* 1965;36:239.

19. Mittelman H. The anatomy of the aging mandible and its importance to facelift surgery. *Fac Plast Surg Clin North Am* 1994;2:301.
20. Binder W. Submalar augmentation: an alternative to face lift surgery. *Arch Otolaryngol* 1989;115:797.
21. Belinfante LS, Mitchell DL. Use of alloplastic material in the canine fossa–zygomatic area to improve facial esthetics. *J Oral Surg* 1977;35:121.
22. Binder W. Submalar augmentation: a procedure to enhance rhytidectomy. *Ann Plast Surg* 1990;24:200.
23. Binder W, Schoenrock L (eds). Facial contouring and alloplastic implants. *Fac Plast Surg Clin North Am* 1994;2.
24. Cao Y, Vacanti JP, Paige KT, et al. Transplantation of chondrocytes utilizing a polymer–cell construct to produce tissue engineered cartilage in the shape of a human ear. *Plast Reconstr Surg* 1997;100:297–304.
25. Terino EO. Alloplastic facial contouring by zonal principles of skeletal anatomy. *Clin Plast Surg* 1992;19:487.
26. Binder WJ. A comprehensive approach for aesthetic contouring of the midface in rhytidectomy. *Fac Plast Surg Clin North Am* 1993;1:231–255.
27. Flowers RS. Cosmetic blepharoplasty, state of the art. In: *Advances in Plastic and Reconstructive Surgery*. Vol. 8. Chicago: Mosby–Year Book, 1992:31.
28. Flowers RS. Tear trough implants for correction of tear trough deformity. *Clin Plast Surg* 1993;20:403.
29. Tobias GW, Binder WJ. The submalar triangle: its anatomy and clinical significance. *Fac Plast Surg Clin North Am* 1994;2:255.
30. Binder WJ, Kaye A. Reconstruction of posttraumatic and congenital facial deformities with 3-D computer assisted custom-designed implants. *Plast Reconstr Surg* 1994;94:775.
31. Hoenig JA, Shorr N, Shorr J. The suborbicularis oculi fat in aesthetic and reconstructive surgery. *Int Ophthalmol Clin* 1997;37(3):179.
32. Moelleken B. The superficial subciliary cheek lift: a technique for rejuvenating the infraorbital region and nasojugal groove—a clinical series of 71 patients. *Plast Reconstr Surg* 1999;104:1863.
33. Schoenrock LD, Chernoff WG. Subcutaneous implantation of GoreTex for facial reconstruction. *Otolaryngol Clin North Am* 1995;28(2):325.
34. Schultz RC. Reconstruction of facial deformities with alloplastic material. *Ann Plast Surg* 1981;7:434.
35. Gorney M, Harries T. The preoperative and postoperative consideration of natural facial asymmetry. *Plast Reconstr Surg* 1974;54:187.
36. Courtiss E. Complications in aesthetic malar augmentation—discussion. *Plast Reconstr Surg* 1983;71:648.
37. Terino EO. Complications of chin and malar augmentation. In: Peck G (ed). *Complications and Problems in Aesthetic Plastic Surgery*. New York: Gower Medical Publishers, 1991.