Midface Skeletal Enhancement

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KEYWORDS

• Alloplastic malar augmentation • Midface surgery • Midface augmentation • Cheek augmentation • Cheek implants

KEY POINTS

- Alloplastic malar augmentation provides a permanent yet reversible form of midfacial rejuvenation that can be tailored to patients' anatomy.
- Malar deformities can be categorized into types I, II, and III, depending on the presence of bony malar hypoplasia, submalar soft tissue volume loss/ptosis, or both, respectively.
- Choosing the correct implant design is essential in achieving ideal malar augmentation. A combination of malar, submalar, and malar-submalar implant shapes are available.
- The surgeon should thoroughly inspect the face for the presence of any significant preexisting facial asymmetries before determining the type and size of implant to be used.
- The transoral surgical approach allows for rapid and precise placement of malar implants. Implant stabilization in the immediate postoperative period is necessary to minimize the possibility of implant displacement.

A video of midface skeletal enhancement accompanies this article at http://www.facialplastic.theclinics.com/

INTRODUCTION

The malar region may be considered the most important facial region imparting a youthful countenance to the human visage. The combination of the underlying bony support, adipose tissue, and mimetic musculature generates a dynamic dimension to the face that is essential for the beauty of human expression and facial balance. Such a delicate arrangement is prone to deformation because of the ever-present forces of aging, gravity, solar radiation, and bodyweight fluctuations. Over time, even a full malar pad becomes ptotic and atrophic, leading to the withered appearance characteristic of senescence. The presence of additional congenital malar bony deficiency accentuates such aging changes and may even act to accelerate them.

Presently, the modern facial aesthetic surgeon has an available surgical and nonsurgical arsenal that is unmatched compared with any other period in the history of our field. According to the American Society of Plastic Surgeons, as of 2013, hyaluronic acid augmentation of the face has risen to become the second most commonly performed nonsurgical procedure in the United States, behind only botulinum toxin, with nearly 2 million procedures performed yearly.[1] Such rapid growth

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and widespread use have been fueled by a need to create a more balanced, fuller, and, therefore, youthful facial harmony via augmentation of the cheeks. Despite this, injectable midface augmentation has shown limitations with durability, permissibility of large-volume augmentation, and correction of bony malar deficiency without imparting an adynamic or bloated-face appearance. Alloplastic augmentation provides a durable yet reversible form of malar augmentation that lends itself well to a significant proportion of patients seeking midfacial volume enhancement. This article describes the intrinsic details inherent to alloplastic midfacial augmentation, with procedural details describing the most commonly used surgical technique in current use.

TREATMENT GOALS AND PLANNED OUTCOMES

The primary goal of alloplastic midface augmentation is to attain a permanent volumetric enhancement of one or more components of the malar region, with a secondary endeavor to achieve an improved degree of facial symmetry. Anatomically, the *malar eminence* is the most protuberant bony prominence of the midface and represents the body of the zygomatic bone, which can be easily palpated on physical examination. The presence of bony hypoplasia imparts a certain degree of *flatness* to the human face that can be easily identified and should be carefully noted preoperatively. Measuring the bizygomatic distance on a frontal view can aid in the identification of malar hypoplasia, as that value typically exceeds the bigonial distance by 25% to 30% in patients with aesthetically balanced faces (**Fig. 1**).[2]

A second distinct region of the midface, the *submalar triangle*, is defined as the region bordered superiorly by the malar eminence, medially by the nasofacial fold, and laterally by the masseter muscle. This region is essential to consider before cheek augmentation, as this region's apparent fullness primarily depends on its soft tissue content, in particular the malar fat pad. During the process of natural aging or in those affected by lipodystrophy of the midface, the submalar triangle undergoes significant volume loss secondary to adipose tissue atrophy and/or midfacial soft tissue ptosis. The presence of significant submalar volume loss indicates the need for a cheek implant design that specifically augments this region.[3]

Patients seeking malar augmentation have previously undergone multiple rounds of cheek volume enhancement via injection with one of the currently available temporary fillers. Often, these individuals prefer the convenience and cost-effectiveness of a one-time procedure for long-lasting augmentation. Surgically, the placement of a solid implant directly on a hypoplastic bony malar region also yields a more natural result that easily achieves a high degree of aesthetic enhancement. Despite these truths, the aesthetic facial surgeon should consider a multitude of patient and implant features before recommending this procedure to cosmetic patients.

Fig. 1. Relationship between bizygomatic and malar distances. A ratio of 1.25:1.0 traditionally exists between these two distances but is often closer to 1:1 in individuals with malar hypoplasia or prominent gonial angles.

PREOPERATIVE PLANNING AND PREPARATION

Implant Design

The extent of the midfacial augmentation as it relates to implant shape and size largely depends on the physical examination findings and the apparent degree of bony and soft tissue deficiencies of the malar region. As originally described by Binder,[4] 3 types of midface deformity can exist, which are classified into types I, II, and III (**Fig. 2**). Individuals with a type I deformity

Fig. 2. Binder classification of midface deformities. Type I patients demonstrate mostly malar bony hypoplasia with otherwise normal submalar soft tissue pad. Individuals with type II cheeks have normal bony eminences but loss of submalar soft tissue volume caused by aging-related volume loss and ptosis or primary adipose tissue loss from lipodystrophy. Type III patients have a combination of bony hypoplasia and submalar soft tissue volume loss. (*From* Silver W, Soares D. Facial contouring with implants. In: Sclafani A, editor. Facial plastic and reconstructive surgery. In: Sataloff R, editor. Sataloff's comprehensive textbook of otolaryngology. Philadelphia: JP Brothers Medical Publishers; 2014. p. 15; with permission.)

display a certain degree of malar bony hypoplasia but otherwise have relatively normal midfacial soft tissue volumes. Type I patients benefit from the insertion of a *malar*-type implant (**Fig. 3**). Patients with a type II deformity, the most commonly encountered form, have normally projecting malar bony eminences but demonstrate considerable midfacial soft tissue loss caused by fat atrophy and/or malar ptosis, often secondary to the aging process. These patients require the insertion of a *submalar*-type implant, which specifically augments the submalar triangle (see **Fig. 3**). Finally, those with a type III midface deformity have a combination of both malar bony hypoplasia and soft tissue loss or ptosis. Type III individuals benefit most from a combined *malar-submalar*–type implant (see **Fig. 3**). Once the ideal implant design is chosen, the surgeon should next determine which implant material to use.

Implant Material

Although the ideal implant material is yet to be discovered, the few that do exist currently have well-established track records of safety and durability in addition to the necessary mechanical qualities for aesthetic facial augmentation. A variety of different implant materials are available for malar augmentation, each with their own specific benefits and disadvantages.[5,6]

Silicone implants (Implantech, Ventura, CA) are composed of vulcanized dimethylsiloxane polymer, which yields a pliable rubber that is nonporous and easily adapted for facial contouring. Silicone rubber implants are remarkably resistant to enzymatic breakdown and autoclaving, lack significant tissue immunogenicity, and are well tolerated by robustly vascularized recipient tissues. Because of their nonporous nature, silicone

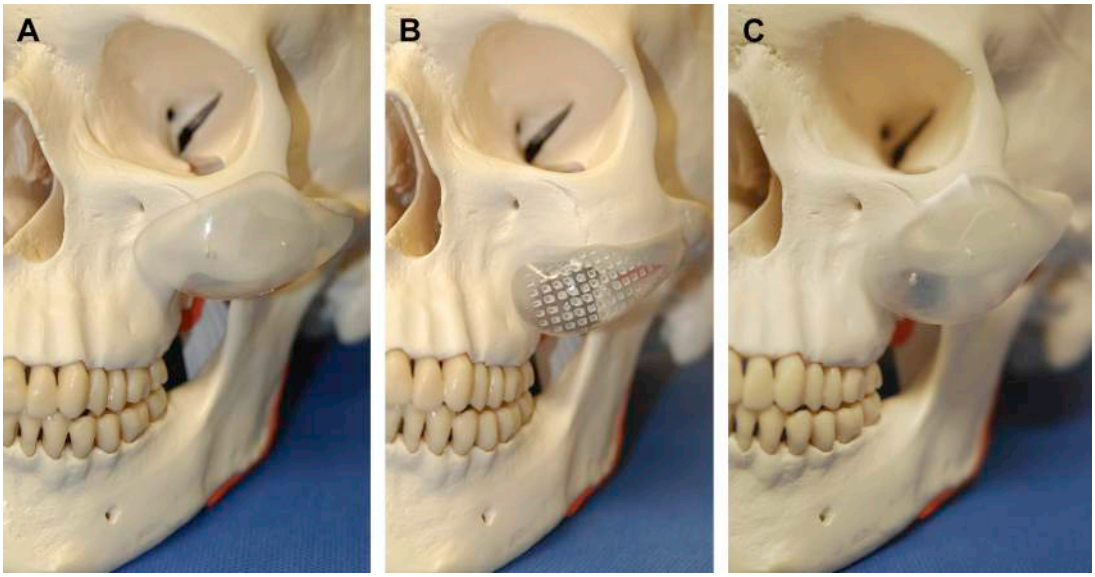

Fig. 3. Types of preformed malar implants. (*A*) Malar. (*B*) Submalar. (*C*) Combined malar-submalar. (*From* Silver W, Soares D. Facial contouring with implants. In: Sclafani A, editor. Facial plastic and reconstructive surgery. In: Sataloff R, editor. Sataloff's comprehensive textbook of otolaryngology. Philadelphia: JP Brothers Medical Publishers; 2014. p. 15; with permission.)

rubber implants do not allow for tissue ingrowth and, thus, incite a significant degree of capsular formation that actually aids in implant stabilization. However, the lack of any tissue ingrowth can mean that the implant may be easily displaced in the immediate postoperative period, if it is not sufficiently stabilized, before capsule formation has occurred, and may also be prone to deformation over time due to tissue contraction. Fortunately, when applied against the firm midfacial bony structure of the maxillary and zygomatic bones, it provides a relatively stable augmentation without significant implant deformation or displacement after healing has occurred.

The microporous expanded polytetrafluoroethylene implant material (ePTFE; *Gore-tex*, W.L. Gore and Associates, Flagstaff, AZ) is a versatile option available for malar augmentation. With pore sizes in the range of 10 to 30 μm, ePTFE implants allow for a small amount of tissue ingrowth that helps to stabilize the implant without creating the often difficult task of implant removal, should the need arise, that is often seen with macroporous implant materials. ePTFE is also easily accepted by well-vascularized facial tissues and also does not display any degree of tissue toxicity or immunogenicity.

Macroporous alloplastic implants, such as high-density polyethylene (Medpor, Porex Surgical Inc, College Park, GA), are characterized by pore sizes of 125 to 250 μm and, thus, allow for a large degree of tissue ingrowth. This feature results in rapid implant stabilization and may even reduce the incidence of implant infection secondary to improved vascularization of the implant–soft tissue interface. However, once tissue ingrowth has occurred, implant removal may be laborious and could require the excision of a cuff of normal recipient tissue along with the implant.

Preoperative Patient Preparation

Patients wishing to undergo alloplastic malar augmentation should be well informed of the intrinsic risks and benefits of the procedure, including the risk of complications relating to implant insertion, such as infection, extrusion, displacement, deformation, and motor and sensory nerve injury, as well as the risks of the desired level of anesthesia. In addition, patients should be screened for any active or prior history of immunosuppression, connective tissue disorders, coagulopathy, facial trauma, and implanted facial hardware, among others, before being deemed fit for the procedure. In addition, patients should also be inquired regarding any recent injections of permanent or temporary fillers (especially high volume), as these may interfere with the ability to proceed with surgery or achieve an ideal result. Standard preoperative photography should be obtained as with any other facial cosmetic procedure. Finally, preexisting facial asymmetries

should be noted before surgery and discussed thoroughly with patients. Often, preexisting facial asymmetries will be augmented if the surgeon does not recognize and address this problem intraoperatively. Placing implants of different sizes, or performing custom implant carving, will help correct any significant malar imbalance.

PATIENT POSITIONING

Patients are placed in a sitting position for the preoperative marking to ensure that an unnatural gravity vector does not distort all landmarks and delineated areas to be augmented. Patients are placed in a supine position for the actual surgical procedure.

PROCEDURAL APPROACH

Preoperative Marking

Before surgical malar augmentation, the malar region should be outlined with patients in a sitting position to facilitate symmetric placement of the malar implants (Video 1). Tracing the location of the inferior orbital rim and the infraorbital foramina will also aid in avoiding injury to nearby structures. Constructing Silver's malar prominence triangle (**Fig. 4**) will assist with all of those tasks. The size and shape of the implant should also be delineated on the skin to help prevent the creation of an excessively large pocket, which can predispose to implant displacement postoperatively. The infraorbital neurovascular bundle and foramina should be located and marked, serving as the medial-most extent of the dissection. Superiorly, tissue dissection should not proceed beyond the inferior orbital rim, as this could lead to a lower-lid contour deformity secondary to superior displacement of the implant.

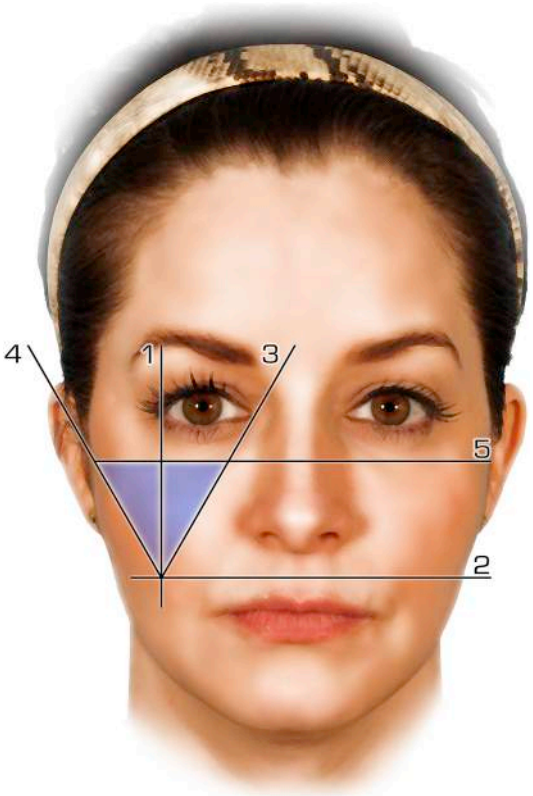

Fig. 4. Constructing Silver's malar prominence triangle. A vertical line is drawn intersecting the lateral canthus (1). A line perpendicular to (1) is drawn midway between the subnasale and upper lip vermillion border. Next, a line (3) is drawn from the medial canthus to the intersection point between (1) and (2). Line (3) is then reflected over (1), creating line (4). Lastly, the Frankfort horizontal line is drawn (5). The triangle is delineated by lines (3), (4), and (5). (*From* Silver W, Soares D. Facial contouring with implants. In: Sclafani A, editor. Facial plastic and reconstructive surgery. In: Sataloff R, editor. Sataloff's comprehensive textbook of otolaryngology. Philadelphia: JP Brothers Medical Publishers; 2014. p. 14; with permission.)

Surgical technique

This surgical procedure can be easily performed under either local anesthetic with or without sedation or general inhaled anesthesia. Appropriate regional nerve blockade is achieved via infiltration of 1% lidocaine with 1:100,000 epinephrine targeting the infraorbital and superior alveolar nerves. Appropriate antibiotic prophylaxis is provided 30 minutes before the incision with either intravenous cefazolin or clindamycin. Patients are then draped in the usual sterile fashion, and the skin is prepped with povidone-iodine (Betadine) solution. Next, a small incision is made with a No. 15 blade adjacent to the canine fossa, leaving at least 1.5 cm of gingival mucosa for later incisional closure. The tissue dissection is carried all the way down to the maxillary bone with monopolar electrocautery; the periosteum is subsequently incised; subperiosteal dissection is then carefully undertaken with an elevator. It is important to always keep the location of the infraorbital nerve and inferior orbital rim under palpation as one creates the subperiosteal pocket. The surgeon should aim to create a pocket that is only slightly larger than the implant itself but also ensure that it is in the correct configuration.

Placement of the alloplastic malar implant should be preceded by immersion of the implant within an antibiotic solution (such as 300 mg/15 mL clindamycin solution) in order to counteract the bacterial contamination that is inherent to the transoral route. If a porous material is to be

inserted, it is wise to pressure load the material with the antibiotic solution before insertion. The implant is then guided into position with a silk suture, twice-puncturing the implant at its superior-lateral corner that is then fed through the transoral incision, aimed at the superior-lateral apex of the implant pocket, driven by a Stamey needle (CS Surgical INC, Slidell, LA) toward its exit in the temporal scalp. A stab incision is made in the scalp region overlying the needle tip, and the silk suture ends are retrieved and tied over an antibiotic-impregnated bolster for short-term implant stabilization. The intraoral incision is then closed in a 2-layered fashion with 3–0 chromic gut sutures for the muscle and mucosal layers.

POTENTIAL COMPLICATIONS AND MANAGEMENT OF THEM

Implant Displacement

Postoperative complications following malar augmentation are rare and tend to concern, for the most part, implant malposition or postoperative asymmetry. Malposition is easily prevented when good surgical technique is used; the surgeon should avoid creating an excessively large implant pocket and stabilize the implant in position with transcutaneous sutures or other fixation methods. Fortunately, given the thickness of the malar soft tissue envelope, minor implant displacements are inconsequential from an aesthetic point of view. The development of postoperative facial asymmetry is often caused by asymmetric edema and tends to resolve as the edematous phase clears over 3 to 4 weeks. The surgeon should always carefully evaluate the face before surgery to determine if significant malar asymmetry exists. Inserting implants of different sizes, or performing custom implant carving, can help correct preexisting facial asymmetries. Should a significant difference in malar contour persist even after resolution of the edematous phase, the surgeon should strongly consider surgical revision.

Infection

Infection following malar augmentation is fortunately very rare because of the robust vascular supply of the region. However, the need for a transoral route of placement renders the risk of contamination ever-present. In the rare event of implant infection following silicone implant placement, cultures should be obtained and directed antibiotic therapy instituted immediately. If a porous implant has been inserted, then immediate removal should be sought, followed by irrigation and appropriate culture-directed antibiotic therapy. At least 6 to 8 weeks should be allowed to pass before contemplating implant reinsertion.

Nerve Injury

Motor and sensory nerve injuries are also extremely rare but possible. Awareness of the location of the infraorbital nerve and ensuring that a subperiosteal dissection is maintained will help avoid injury to the infraorbital and facial nerves, respectively. Often, even following significant neuropraxia or neurotmesis, midfacial sensory function will return. Motor nerve injury is also likely to recover because of the presence of significant redundancy of innervation in the area; the exception, of course, would be the frontal nerve, which is at risk of injury as it courses along over the zygomatic arch. Subperiosteal dissection is essential in helping to avoid injury to this very functional and aesthetic motor nerve branch.

POSTPROCEDURAL CARE

Prophylactic antibiotic coverage is provided to patients for the subsequent 5 postoperative days. The bolster and stabilizing sutures are removed on postoperative day number 3. Because of the subperiosteal dissection, patients may expect a moderate amount of facial swelling for 2 to 3 weeks after the procedure. The addition of a short course of oral steroids is often prescribed to help reduce the severity of the postoperative edema. Standard photographs are obtained at 3, 6, and 12 months following the procedure.

REHABILITATION AND RECOVERY

Alloplastic augmentation of the midface does not result in any degree of temporary physical disability; however, patients are advised to avoid any heavy lifting or exercise for the first 1 week following surgery. A certain degree of social downtime is expected to allow for most of the edema to resolve; but this is quite patient specific and, therefore, variable. Approximately 80% of patients will have complete resolution of facial edema within 3 to 4 weeks.[7] Early steroid therapy postoperatively should be considered to aid in minimizing the degree of the edematous response. A soft diet is recommended for the first 5 to 7 days to avoid incisional abrasion, as well as excessive cheek motion caused by chewing, in order to limit any chances of implant displacement.

OUTCOMES

Figs. 5 and **6** display examples of preoperative and postoperative facial views in patients having

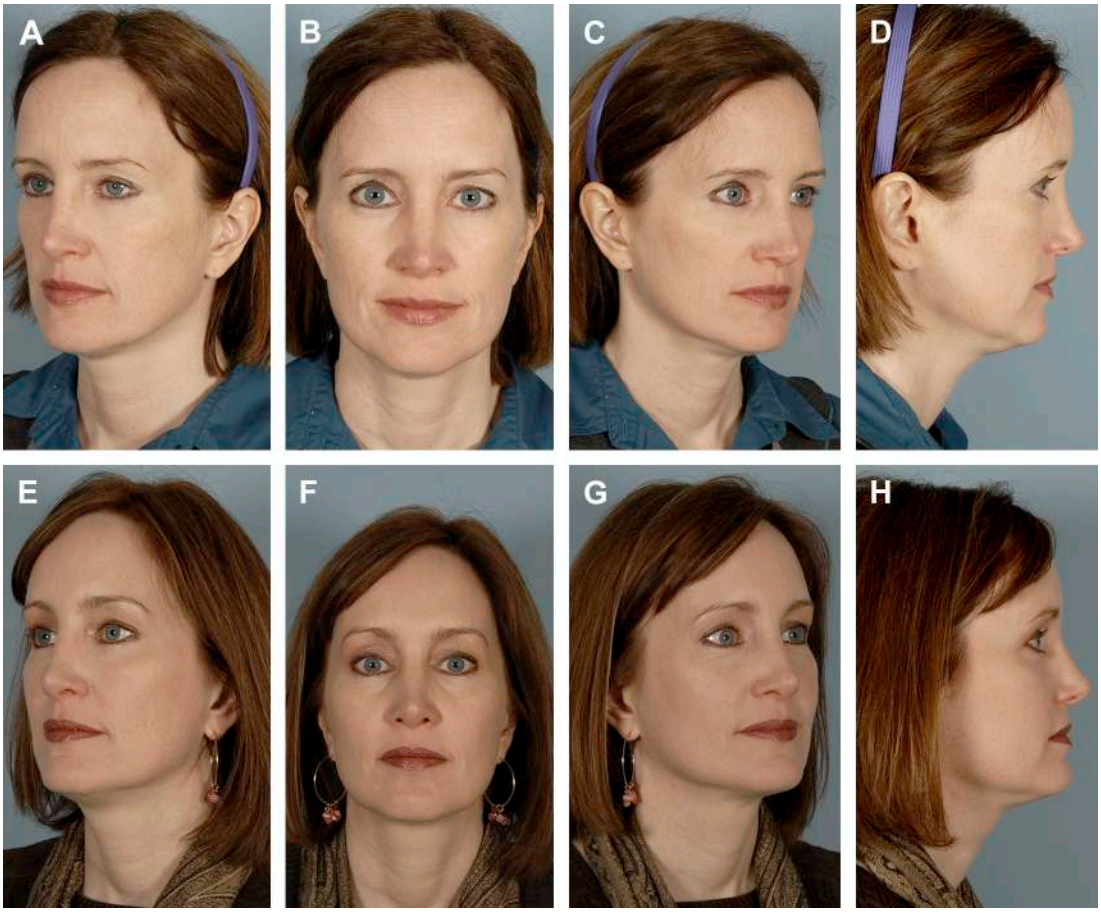

Fig. 5. Preoperative and postoperative photographs following malar augmentation. (*A–D*) Preoperative photographs displaying a patient with type I midface deformity. (*E–H*) Postoperative photographs 3 months following cheek augmentation with malar implants and endoscopic brow lift. (*From* Silver W, Soares D. Facial contouring with implants. In: Sclafani A, editor. Facial plastic and reconstructive surgery. In: Sataloff R, editor. Sataloff's comprehensive textbook of otolaryngology. Philadelphia: JP Brothers Medical Publishers; 2014. p. 17; with permission.)

undergone malar augmentation. Preoperatively, the patient shown in **Fig. 5** demonstrated a type I facial deformity and, therefore, underwent augmentation with a malar-type facial implant. The patient displayed in **Fig. 6** displayed a type II facial deformity preoperatively, characteristic of the aging face with loss and ptosis of submalar tissue. Malar augmentation in conjunction with rhytidectomy yielded a more youthful facial shape postoperatively.

CLINICAL RESULTS IN THE LITERATURE AND EVIDENCE

The wide applicability of alloplastic implants for use within the facial regions demonstrates their suitability for correction of facial volume, contour, and symmetry losses. The gradual dissipation of midfacial volume is a well-known phenomenon resulting from facial aging and is often associated with other classic aging-related changes, such as the development of the jowl, excess neck skin laxity and banding, and the deepening of the nasolabial and labiomental folds. Therefore, the modern aesthetic facial surgeon will often recommend the simultaneous coupling of midfacial alloplastic augmentation with cervicofacial rhytidectomy, periorbital rejuvenating surgery, and other procedures. Hopping and colleagues[7] reviewed 100 cases of rhytidectomy with alloplastic midface augmentation and compared it with 200 isolated rhytidectomies, finding no significant increase in procedure complications or morbidity with the addition of alloplastic malar implant placement to rhytidectomy.

Fig. 6. Preoperative and postoperative photographs following malar augmentation and rhytidectomy. (*A–D*) Preoperative photographs displaying a patient with a type II midface deformity. (*E–H*) Postoperative photographs 17 months following cheek augmentation with submalar implants, cervicofacial rhytidectomy, and fractional carbon dioxide laser skin resurfacing. (*From* Silver W, Soares D. Facial contouring with implants. In: Sclafani A, editor. Facial plastic and reconstructive surgery. In: Sataloff R, editor. Sataloff's comprehensive textbook of otolaryngology. Philadelphia: JP Brothers Medical Publishers; 2014. p. 18; with permission.)

The use of alloplastic implants within the face has seen a variety of complications occur, such as infection, extrusion, and displacement or distortion, depending on recipient site, adequacy of soft tissue coverage, and chosen implant material. Overall, the incidences of implant infection, extrusion, and displacement within the malar region have been quoted at 2.4%, less than 0.5%, and 2.3%, respectively, with a rate of implant removal of 4.2%.[6] The thickness of midfacial tissue coverage for malar implants placed subperiosteally ensures that implant exposure and extrusion are extremely rare events. In addition, the placement of the implants against the maxillary bone helps to prevent the occurrence of implant distortion. The risk of implant displacement is minimized by the placement of fixation sutures, with different transcutaneous methods available.[4]

SUMMARY

Malar augmentation with alloplastic implants continues to serve as a reliable method of achieving a permanent yet reversible form of midfacial volume enhancement and rejuvenation. The procedure allows for placement of different implant shapes to correct different types of malar deformities. The insertion of malar implants provides the necessary volume to correct underlying congenital asymmetries, malar hypoplasia, or soft tissue volume loss and ptosis inherent to the aging process. In addition, the procedure is easily performed in the outpatient setting with minimal anesthesia and short downtime and can be coupled with other surgical procedures, such as rhytidectomy, without increased morbidity. Surgeons should offer this type of augmentation to patients seeking a permanent answer to midfacial

volume loss and aging in lieu of repeated injections with soft tissue fillers.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.fsc.2015.01.004.

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