Chapter 34: Facial Implants

Nabil S. Fuleihan, Richard C. Webster, Richard C. Smith

Autogenous tissue has always been considered the best implantation material. However, there are situations in which autogenous tissues are not available or will not give a good result. Implantation of autogenous tissue for major contouring is associated with morbidity from the donor site, prolongation of the surgery, and a possibility of absorption if the tissue is not vascularized. Insufficient amounts of autogenous material and difficulties in contouring of grafts may necessitate the use of alloplastic material for facial augmentation.

Among the first alloplastic materials used successfully were certain nonreactive metals including stainless steel, tantalum, and Vitallium. Since heat-cured acrylics were introduced and commonly used for contouring of the forehead and different areas of the skull during World War II, multiple plastic polymers have been used for facial contouring, including cold-curing methylmethacrylate, polyvinyl alcohol, polyisobutylene, polyvinyl chloride, polytetrafluoroethylene, polyethylene, tricalcium phosphate (bioabsorbable ceramic), dimethylpolysiloxane (O'Quinn and Thomas, 1986; Schultz, 1980), polyamide, and polyethylene terephthalate.

Scales (1953) defined the properties of an ideal implant as follows:

1. Not physically modified by soft tissue.

2. Not capable of inciting an inflammatory or foreign body reaction.

3. Not capable of producing a state of allergy or hypersensitivity.

4. Chemically inert.

5. Noncarcinogenic.

6. Capable of resisting strain.

7. Capable of fabrication in the form desired.

8. Capable of sterilization.

The quality of tissues surrounding implants plays an important role in decreasing the rejection site. The ideal host bed is one that is covered by well-vascularized thick skin and subcutaneous tissue that is not subjected to the stresses of trauma or motion.

Chemical Composition

The chemical composition of an implant predicts its compliance to the ideal properties required for its use in soft tissue contouring. Also, the chemical composition of an implanted material determines its biocompatibility, which is a term used to describe "the state of affairs in which a material exists within a physiologic environment without either the material adversely and significantly affecting the body, or the environment of the body adversely affecting the material" (Williams, 1981a).

Biocompatibility is monitored by testing the tissue reactions, which are categorized as localized or systemic. The localized tissue reaction is the response of the adjacent tissue to the implant and its biodegradable products. The systemic reaction is due to a response to biodegradable substances or molecules that may migrate throughout the body, potentially resulting in immunologic, carcinogenic, or metabolic effects. Toxicity is the term used to describe the response to these effects. Toxicity of implants is usually caused by biodegradation or oxidation of implant material, resulting in the release of potentially bioactive substances (Hayes, 1982). The degree of localized inflammatory reaction induced by the implant is an indirect reflection of its degree of toxicity (Hurley, 1983). This is usually histologically assessed by the numbers of macrophages and giant cells adjacent to the implant.

Because "all of the common implant metals corrode at some finite rate in the human body" (Sutow and Pollack, 1981), the ultimate success of the implant may depend on the potential reaction to these corrosion products. The interaction of implanted material with the immune system is an important aspect of the toxicity. This reaction depends on the size of the implants used and the degree of corrosion and biodegradation induced. The usual reaction associated with biomaterials is a T-cell-mediated response that may be systemic and not easily recognized (Holmes, 1990).

Hueper (1965) and Oppenheimer et al (1952) report the formation of cancer in cancer-prone laboratory animals in conjunction with many implant materials. Malignant tumors have been reported in patients with implants, but a cause-and-effect relationship between alloplastic implants and cancer development has never been proven in humans. The number of persons living with different synthetic materials implanted is increasing every day (Harris, 1961). The subject of metal implant-related carcinogenicity has also been studied. Of the 13 cases of cancer associated with a metal implant reported in humans, four have been reported in association with trauma devices made from cobalt-chromium alloy. However, a direct association between the metal implants and malignant changes have been difficult to establish. In consideration of the 120 million devices implanted during the 60-year history of contemporary orthopedic procedures, "the number of reported cases of sarcoma is so minute that no surgeon or patient would feel undue concern on this account" (Hamblen and Carter, 1984).

Metals

Biocompatibility of metals depends on their resistance to corrosion, as well as local and systemic tissue reactions to corrosion products. Hoar and Mears (1966) reported that cobalt-chromium alloys should be relatively stable in the body. Vitallium, titanium, and stainless steel corrode at some finite rate in the human body (Sutow and Pollack, 1981). The minimal localized reaction found indicated that these implants are extremely well-tolerated by bony and periosteal tissues. Corrosion is controlled by the formation of an oxide film. Both titanium and chromium naturally form an oxide film, making them useful as alloys because of improved corrosion resistance. Corrosion products of stainless steel have also been associated with local tissue changes and potential systemic effects that can be carcinogenic (Hueper, 1952), metabolic (Underwood, 1971; Williams, 1973), immunologic (Foussereau and Laugier, 1966), and bacteriologic (Weinberg, 1974). Osteointegrated implants produce a minimal tissue reaction that decreases the development of a fibrous layer around the implanted material, allowing a direct structural and functional connection between bone and the implant.

Systemically, there is transport of the metal ions around the body, resulting in accumulation in certain organs, but the levels were not thought to be unduly high; and indeed, the changes in ion concentrations were described as minimal (Williams, 1981b).

The use of metals has been limited to skeletal applications (Figs. 34-1 to 34-3). Since the introduction of stainless steel in the 1920s, raw materials have been developed that will decrease the corrosive reaction around the implanted material (Table 34-1). Vitallium, formed mainly from cobalt and chromium, was introduced later in the 1920s. This material demonstrated an increased corrosion resistance. Titanium implants are most widely used today because of their light weight, strength, and resistance to corrosion. They were shown to be less corrosive than both Vitallium and stainless steel (Holt et al, 1986; Luckey and Kubli, 1983).

Polymers

Whereas metallic implants have been used for skeletal fixation and bony augmentation, polymers have been used for soft tissue augmentation and contouring. The number of polymers used for this purpose has progressively increased over the past decade.

A polymer is an aggregate of atoms usually based on carbon and linked together to form chains by a process called polymerization (Ashley et al, 1967). Molecular weight depends on the number of repeating units. With increases in the degree of polymerization and cross-linking between polymer units, there is transformation of the polymer from a liquid to a more viscous state and finally to a solid form. The composition, molecular weight, and degree of cross-linking have a profound effect on the properties of the polymer and its biocompatibility.

Polymers implanted in subcutaneous tissue produce an inflammatory reaction that results in the deposition of connective tissue around the implant. A fibrous capsule ultimately surrounds the implant. Liquid polymers such as dimethylsiloxane produce multiple small capsules that will

surround the material injected, resulting in a honeycomb appearance.

The most commonly used polymers for soft tissue contouring of the face are poly(dimethylsiloxane), poly(amide), poly(methylmethacrylate), poly(ethylene), poly(ethyleneterphthalate), and poly(tetrafluoroethylene carbon) (Fig. 34-4).

Poly(dimethylsiloxane)

The silicone polymers are the most widely used implants for facial contouring. They are composed of long chains of dimethylsiloxane units based on the element silicon, which is among the most abundant elements on earth. The element silicon is naturally present in human tissue as a component of mucopolysaccharides and may contribute to connective tissue structure by bridging or linking polysaccharides to protein (Petersdorf et al, 1983).

Siloxane is an acronym derived from si(licon), ox(ygen), and (meth)ane. The viscosity of the dimethylsiloxane polymers depends on the degree of polymerization (Rees et al, 1967). Cross-linking is used to produce a rubber or gel. Silicone polymers have been used in different forms for facial contouring. Medical-grade injectable silicone with a viscosity of 200 to 350 centistokes is a clear, oily, colorless, and odorless material with a high degree of chemical stability, allowing prolonged storage at room temperature and repeated steam autoclaving. Animal experiments have shown that following intradermal, subcutaneous, intramuscular, and intraperitoneal injections there was an early migration of polymorphonuclear leukocytes to the area followed by a local and mild round-cell reaction that subsided within 6 months. With time, the silicone became encapsulated by the animal's own collagen. After massive subcutaneous doses of silicone were injected into rats, droplets or vacuoles were present in the reticuloendothelial system (Ashley et al, 1967; Rees et al, 1970).

Injectable silicone, introduced for restoration of facial contour in patients with hemifacial atrophy (Rees and Ashley, 1966), was also used for correction of certain depressed scars, glabella frown lines, malar and melolabial grooves, and certain postrhinoplastic deformities (Webster et al, 1984, 1986). The use of injectable silicone was recently addressed by the US Food and Drug Administration (FDA). The FDA does *not* approve of this use of this material.

Liquid silicone is widely employed by the medical industry to coat certain suture materials and as an internal lubricant in some disposable syringes (Selmanowitz and Orentreich, 1977).

When silicone rubber (Silastic) is implanted, a fibrous capsule is formed. This capsule does not adhere to the implant. Gradual deterioration of the silicone rubber can occur (Frisch and Langley, 1985), producing some postoperative failure. When silicone implants are used in joints, a giant-cell reaction can be seen locally in connective tissue and synovium with no focal necrosis (Swanson et al, 1985). Preformed silicone implants are used for augmentation of different areas of the face including malar, submalar, nose, chin, and mandible regions. The use of silicon rubber in nasal augmentation has been associated with a high extrusion rate, especially when used in revision rhinoplasty cases, usually because of the necrosis of overlying skin. However, huge

numbers of Asiatic patients have had successful primary nasal augmentations with silicone dorsal implants.

Poly(tetrafluoroethylene carbon)

Proplast is a highly porous material prepared from Teflon (a fluorocarbon polymer) and carbon fibers, giving it a black color. This type of material is given the name Proplast I to differentiate from Proplast II, which is white in color and formed of an aluminum oxide-coated Teflon. This chemical composition results in an unusual chemical stability. The space between the cross-linked polymer particles provides a porosity that permits tissue ingrowth, resulting in increased stability of the implant (Holmes, 1990). The size of the pores is usually between 200 and 500 microm. The pore volume of Proplast implant material constitutes 70% to 90% of the total volume (Kent and Misiek, 1991).

Proplast I is easily shaped or carved with a knife or scissors. Proplast II is firmer and more difficult to carve. Proplast has a low rejection rate. In an experimental study by Kasperbauer et al (1983), Proplast was implanted in 17 rabbit ears. Although the black color of the implant was clearly visible beneath the skin a 1 year, only one partial implant exposure without obvious reaction was noted. A marked granulomatous reaction with many histiocytes and giant cells occurred within the implant. A similar reaction was present when Proplast was implanted in the subcutaneous tissue of the face of a rabbit.

Although tissue ingrowth provides a dependable fixation with a decreased chance of extrusion, it makes removal of these implants more difficult than is the case with solid Silastic implants. The porosity allows loading the implant with antibiotic solution at the time of the surgery. Proplast has been associated with less bone resorption than found with other firm implants (Silver, 1983). When implanted adjacent to osseous surfaces, Proplast I and Proplast II cause the formation of osteoid tissue with or without a fibrous tissue zone between the outer surface of the implant and the osseous tissue (Homsy and Anderson, 1976).

Silver (1983) used Proplast to augment several different sites about the face and stressed strict guidelines for a successful implantation. Although this implant material is stable at temperatures greater than 392 °F, it should be sterilized with a slow wet-steam autoclave at 250 °F for 30 minutes. Steam autoclaving should not be performed more than three times on the same material. Proplast should be impregnated with an antibiotic saline solution (600 mg lincomycin (Lincocin) / 30 Ml saline) at the time of implantation. Infusion of the Proplast with antibiotic material does not seem to affect tissue ingrowth. It is advisable to carve the material before the surgical procedure and handle it with powder-free gloves.

Proplast has been used successfully for facial contouring procedures including chin augmentation, nasal dorsal augmentation, and correction of traumatic prominence loss and frontal bone defects. The manufacturer states that Proplast is not indicated as an implant (1) by itself in weight-bearing or articulating bony surfaces where compressive loading is likely (temporomandibular joint (TMJ)), (2) over sinus cavities, (3) where there is insufficient

underlying bone or soft tissue to prevent collapse in the event of external pressure, (4) in patients with systemic disorders that may compromise tissue ingrowth or normal wound healing, (5) in recent areas of infection, (6) in patients with phobia for implant material, or (7) in gas or cold sterilization (Kent and Misiek, 1991).

Poly(ethylene)

These polymers consist of a large number of ethylene units linked together to form a highly branched micromolecule. Three types of polyethylenes are available. The low-density polyethylenes have approximately 10 to 30 branches per 1000 carbon atoms. This branching results in low yield strength and lower stiffness (Holmes, 1990). The high-density polyethylene is a substantially linear molecule with minimal branching and with higher density, tensile strength, and stiffness. The ultra high-molecular weight polyethylene, with molecular weight of approximately 4 million, is a component of total hip prostheses. The composition allows weight bearing. Low-density polyethylenes may be formed into porous sponge implants for reconstruction of non-load bearing areas. Total ossicular replacement prostheses (TORP) and partial ossicular replacement prostheses (PORP) are polyethylene implants used for middle ear reconstruction. The implant becomes embedded in a connective tissue network with no chronic or acute inflammation. However, these implants have not proved to be ideal for middle ear reconstruction because of a high incidence of extrusion.

High-density polyethylene (HDPE) is frequently used in facial reconstruction. Different forms of HDPE are available to the facial plastic surgeon. Among these are Porecron (Effner GmbH, Berlin, Federal Republic of Germany), Medpore (Porex, Fairburn, GA), and Plastipore (Richards Manufacturing Company, Memphis, TN) (Berghaus et al, 1984; Bikhazi and Van Antwerp, 1991). Porecron is a porous HDPE with a pore size of approximately 150 microm, permitting ingrowth of connective tissue that is supplied by capillary vessels.

Canine studies using porous, high-density polyethylene have demonstrated tissue ingrowth of osteoprogenitor mesenchyme within the first week. A few bone spicules within a soft tissue matrix were present in the second week. Bone trabeculae with an active osteoblastic front were formed by the fourth week. Mature bone ingrowth into the surface of the pore was documented at the end of 1 year (Bikhazi and Van Antwerp, 1991; Sauer et al, 1974). Proplast does not allow such bony ingrowth, possibly because Proplast pores do not have a sufficiently large diameter. Polyethylene implants retain their shape and do not undergo resorption after implantation. Proplast, on the other hand, gradually fragments, and parts of the synthetic material appear in medullary spaces (Berghaus et al, 1984). Long-term studies with Proplast used in chin and zygomatic maxillary augmentations revealed an overall loss of bone and soft tissue thickness of approximately 57% (Kent et al, 1981). In the case of HPDE, limited studies have demonstrated evidence of soft tissue loss without bony resorption (Bikhazi and Van Antwerp, 1991).

Poly(amide)

Polyamide, known generically as nylon, was among the first commercial polymers introduced ni the 1930s. Where nylon is implanted, hydrolysis of some of the 15 amide groups occurs with time. This is a reversal of the polymerization reaction and results in loss of approximately 25% of the tensile strength of nylon sutures (Holes, 1990). After implantation, a moderate foreign-body reaction is seen, which is slowly replaced by the ingrowth of fibrous tissue (Dickinson and Joguss, 1972). Stucker et al (1982) introduced the "auto-alloplast" concept to polyamide mesh (Supramid) implantation. The material is implanted in a secure area for a period of 6 weeks and then harvested and reimplanted in the area that needs augmentation. This process has decreased the extrusion rate.

Brown et al (1979) have shown that Supramid strands appear to disintegrate at 6 to 12 months in the rabbit face and ear.

Poly(ethylene terephthalate)

Polyethylene terephthalate (PET) polyester fibers are used as woven or knitted fabric configurations in implant applications. Mersilene mesh is a PET product. It is knitted in such a way that it can be rolled, folded, or molded into any shape. This design allows an ingrowth of fibrous tissue. The mesh is available in sheets that are 0.25 mm thick. Colton and Beekhuis (1991) reported the use of Mersilene mesh for facial augmentation in 113 cases with a 4- to 5-year follow-up. The infection rate was around 7%. Removal of the implant after fibrous ingrowth has taken place is difficult, because the lack of capsulation around the implant makes it difficult to know whether complete removal was achieved. Polyethylene terephthalate (Dacron) has been used as a vascular replacement material. Dacron mesh (Osteo Mesh, Xomed, Inc, Gainesville, FL) has been successfully used for reconstruction of craniofacial and mandibular defects.

Poly(methylmethacrylate)

The use of acrylic in reconstruction of cranial defects was started by Zander during World War II (Penhale, 1945). The medical-grade acrylic resin has two components; a powder of small polymethylmethacrylate spheres and beads 10 to 30 microm in diameter to which benzoyl peroxide has been added and a liquid monomer in which the amino accelerator has been dissolved. The monomer polymerizes and links together the preexisting polymer. The polymerization reaction is exothermic with maximal temperatures reaching 120 °C. After mixing, a moldable dough is formed that cures in about 10 minutes. The reaction of the host to implantable acrylic may include toxicity, hypersensitivity, and systemic effects. Although uncommon, these reactions may be due to the exothermic reaction of polymerization or to the direct toxicity of the monomer. However, polymethylmethacrylate has demonstrated a high tissue compatibility.

Hydroxyapatite

Calcium hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$) is formed of crystals that have a similar composition to the inorganic components of osseous and dental tissues. This allows the implant to become an integral part of bony tissue. The material is composed of 39.9% Ca, 18.5% OP, and 3.5% OH with a Ca/P ratio of 1.67 (Jaffe, 1972). These crystals are fused together at temperatures of 1100 °C to 1300 °C by a process called "sintering" (Rao and Boehm, 1974; Rejda et al, 1977). Depending on the conditions of the sintering process and composition, a range of degree of porosity and mechanical properties is achieved. In thin, porous, or dense forms, hydroxyapatites (HA) can serve as permanent bone implants with no tendency to resorption in vivo (Jaicho, 1981). HA implants are, on the other hand, quite brittle and have a relatively low tensile strength, which does not allow them to withstand bending or torsional forces.

The main advantage of HA implants is their ability to become directly integrated into bony tissue. HA implants have been shown to stimulate osteogenesis when placed against bone (Grower et al, 1978), but implantation of HA in soft tissue did not result in bone formation (Boyne et al, 1978). HA has had wide application in the augmentation of the facial skeleton, including augmentation of the alveolar ridge, orbital floor reconstruction, and spacers for orthognathic and craniofacial procedures (Cullum et al, 1988). Salyer and Hall (1989) compared the use of hydroxyapatite and autogenous bone grafts as onlays for facial augmentation. Their 3-year study shows that "porous hydroxyapatite as an onlay has a greater potential for movement than bone, and it may not become totally adherent for 4 months". This problem necessitated suture fixation of the hydroxyapatite. The hydroxyapatite became incorporated with 20% to 30% bone ingrowth and appeared to become fully established and stable by between 12 and 16 months. Because of soft tissue thinning over hydroxyapatite onlays and the potential for late exposure, the authors recommend limiting the use of this material to maxillary and malar augmentation, thereby "avoiding potential reaction problems with mandibular and temporal positioning or when used in the forehead and lateral orbital regions".

Clinical Applications

Forehead

Bony defects of the forehead may be caused by a congenital anomaly, traumatic loss of the frontal bone, resection of the frontal bone, or frontal sinusitis with loss of anterior or posterior table caused by osteomyelitis.

The choice of an implant material for forehead reconstruction is highly individualized. The location of the frontal sinus, degree of pneumatization, relation of the mucosa to the current defect, and history of previous infection should be considered and carefully analyzed before attempting to reconstruct a forehead defect. Separation of the mucosal lining from the site of reconstruction is an essential part of the surgical planning. Insertion of bone grafts or implants into a bed containing mucosal elements predisposes to infection (Fig. 34-5).

If the defect to be reconstructed includes the posterior table of the frontal sinus, it is preferred to removal all mucosal elements using a burr and a microscope. Attempts are usually made to plug the frontonasal duct with bone chips, muscle, or fascial grafts. Fat obliteration is usually helpful in maintaining the separation from the nasal cavity. If the size of the defect is small, not allowing good visualization of all portions of the sinuses, an osteoplastic, anterior flap to open the entire wall should be performed.

When the defect to be reconstructed involves the anterior table only, obliteration of the frontal sinus and plugging of the frontonasal duct is not usually necessary. In these cases it is best to maintain the patency of the duct and reconstruct the defect with an onlay bone graft (Marchac, 1990).

Merville et al (1982) recommended a two-stage procedure in patients with histories of extensive infection and loss of frontal bone: (1) removal of all sinus elements and isolation of the nasal cavity, with iliac cancellous bone grafts used to reconstruct the supraorbital area; and (2) later reconstruction of the frontal bone with irradiated bank bone graft.

The use of autogenous bone grafts has been associated with a significant incidence of resorption and subsequent recurrence of the defect. According to Marchac (1990), "alloplastic materials are considered for an overlay on a deformed bone and for cranial vault cranioplasties in carefully selected cases".

Munro and Guyron (1981) believe that "there is no place for alloplastic materials". Their first choice is autogenous bone. They state that alloplastic material is contraindicated if the defect is adjacent to or involves the nose or paranasal sinuses, if there is a history of infection, and in cases where there is deficient soft tissue coverage. Acrylic (methylmethacrylate) is the most commonly used alloplastic material by neurosurgeons. Berghaus et al (1984) used Porecron, a porous polyethylene implant, for certain forehead reconstruction. This material is porous with a pore size of approximately 150 microm, allowing ingrowth of fibrous tissue.

Malar and submalar area

The contours of the malar and submalar region dominate the middle third of the face. Surgeons who deal with facial contouring realize the importance of these defining elements of the middle third of the face. This definition is usually a balance between the dimensions of the zygoma, malar eminence, and overlying soft tissue. Perhaps the most important feature of the cheek is the malar highlight, noted on the skull as a long triangle with its base corresponding to the zygomaticomaxillary suture (Tolleth, 1987). The transition from the zygomatic to the maxillary bony components is acute. This transition is not reflected on the outside facial contour because of the thick soft tissue coverage in the central portion of the face. During the aging process, subcutaneous atrophy predisposes to grooving of the central portion because of lack of adequate bony support. Terino (1991) discusses the use of a "zonal anatomy" when planning a malar augmentation. A careful examination of the bony structure of the middle third of the face shows that it is divided into two areas: (1) the malar and zygomatic complex, consisting of the

area between the zygomaticomaxillary suture line and the zygomaticotemporal suture line; and (2) the infraorbital complex, consisting of the space between the medial and lateral buttresses.

Terino uses the term *malar space,* which he divides into five architectural and functional zones: zone 3 corresponds to the area of the cheek medial to the perpendicular line drawn at the level of the infraorbital foramen; zone 4 corresponds to the posterior third of the zygomatic arch; zone 1 corresponds to the major surface of the malar bone, including the first third of the zygomatic arch; zone 2 represents the middle third of the zygomatic arch; and zone 5 represents the submalar region.

Augmentation in zone 3 is rarely needed unless the patient has a posttraumatic deformity. Zone 4 is a dangerous zone because of the proximity of the frontal branch of the facial nerve and the capsule of the temporomandibular joint. Zone 2 augmentation increases the width of the upper third of the face. Zone 1 augmentation increases the projection of the malar eminence area (Fig. 34-6). Extension of the augmentation to involve zone 5 or the "submalar" zone results in a fuller cheek in the inferior projection.

The method of placing an implant in the cheek region depends on the deformity to be corrected. A careful analysis of implant shapes and the contour of the cheek region as well as the patient's expectations needs to be addressed. Different types of implants have been introduced. The choice of an implant depends on the deformity to be corrected as well as the cheek contour that is desired. The presence of deep malar grooving or midfacial depression necessitates the use of an implant type that will address this deformity since augmentation of the malar eminence area only might result in exaggeration of the deformity (Fig. 34-7).

By using submalar augmentation as stressed by Binder (1989), the appearance of hollowing in the midface is improved. We prefer the placement of these implants in a more posterolateral position to decrease the prominence of the cheek mound since the area of maximal projection in the central portion of the cheek is posterolateral to the cheek mound area.

Different surgical approaches are used for insertion of cheek implants. In our practice we most often use the intraoral approach. Occasionally we use the transconjunctival or blepharoplasty approach for the correction of cheek asymmetries caused by facial fractures associated with floor-of-orbit injuries. We rarely use the rhytidectomy approach because of the increased possibility of injury to facial nerve branches.

Chin implants

Establishing a balanced profile between the nose and chin improves facial harmony. A well-defined inferior border of the chin, with a smooth contour between the parasymphysis and body of the mandible, is an essential part of chin augmentation. This requires the use of implants that provide increased projection not only in the symphysis and parasymphyseal areas but also in the anteroinferior third of the body of the mandible.

The size of the implant is determined with the patient's face positioned so that Frankfort's plane is horizontal. The patient is asked to close the mouth until the teeth are in their most comfortable occlusion and the lips are gently touching each other. The most practical guide for judging the amount of anteroposterior projection desired is the number of millimeters of implant material required to move the retruding chin pad forward until it sits just behind a vertical line dropped from the vermilion border of the lower lip. Obviously, sex, height, and the general facial features play important roles in the judgment. In females the chin profile is put 2 to 4 mm posterior to the vertical dropped from the vermilion border (Webster et al, 1970).

Once the anteroposterior dimension has been selected, the patient is evaluated from the front. A decision is then made as to how far laterally the implant must go to allow a gradual blending of the augmented chin into the cheeks. The mental foramen is usually located 27 mm or more from the midline. If the implant is to extend over 25 mm, the implant is carved to sit along the inferior border of the mandible and inferior to the mental foramen.

The incision for introduction of the implants may be made intraorally or externally at the junction of the chin and submental regions. The external incision rarely needs to be longer than 15 to 20 mm. Intraoral incisions are usually made on the posterior surface of the lip 4 mm from the inferior labial fornix.

We commonly use the external or submental approach. After exposure of periosteum anteriorly, vertical incisions are made through periosteum 10 to 18 mm from the midline (Fig. 34-8). With the surgeon using direct vision, an elevator lifts the periosteum lateral to the incisions along the inferior border of the mandible, avoiding the mental nerve. The size of the subperiosteal pockets created depends on the dimensions of the implants. After placement of the implants in the created pockets, they are fixed to the periosteum in the midline using a permanent long-lasting suture. The central portions of the implants rest anterior to the periosteum, and the lateral portions rest deep to it. We believe that insertion of the central portion of the implant anterior to periosteum might decrease the rate of bone erosion (Fig. 34-9). Preformed implants can be inserted in a similar fashion into pockets prepared as described. The more flexible ones can be folded through the same incisions in such a way as to slip between the roof above and the shelf below and deep to the periosteum laterally. We find carving to be a simple procedure that allows precise tailoring of the implant to the aesthetic need (Figs. 34-10 and 34-11). Gel implants have been associated with distortion and asymmetry secondary to capsular contractures (Fig. 34-12).

Nasal implants

The use of alloplastic material for nasal augmentation is popular in the Far East and Japan (Adams, 1987). Different shapes of Silastic implants have been used to provide dorsal and tip projections. Such alloplastic materials are associated with complications such as extrusion, displacement, and infection, particularly when used under scarred tissues as in revisions or when used as "pushers" or projectors of the tip. We prefer the use of autogenous cartilage or bone grafts for augmentation of the nasal dorsum and tip, especially in revisional rhinoplasties.