Management and Avoidance of Complications in Chin Augmentation

Jeremy B. White, MD; and Craig R. Dufresne, MD, FACS

Abstract
Chin augmentation is an extremely rewarding cosmetic operation, particularly when performed as an adjunct to rhinoplasty and rhytidectomy. There has been much debate regarding the ideal surgical approach and whether implant placement or osseous genioplasty is the superior operation. Regardless of the technique, all surgery carries an inherent risk for complications, and it is the surgeon’s responsibility to learn which techniques will work best in his or her hands for each patient. Certain complications can be almost unavoidable, but a solid foundation in anatomy and a review of the existing literature can help minimize the risk of certain problems while providing an improved understanding of how to recognize and manage them when they occur. The authors present a comprehensive review of genioplasty and chin implant complications, how they might be avoided, and management methods if they occur.

Keywords
chin augmentation, facial surgery, genioplasty, chin implant, complications, cosmetic

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Chin augmentation is extremely rewarding, particularly when performed as an adjunct to rhinoplasty and rhytidectomy. In the literature, there remains debate over the best surgical approach—specifically, whether implant placement or osseous genioplasty is the superior operation. Regardless of technique, all surgeries carry a risk of complications, and surgeons performing cosmetic chin augmentation should familiarize themselves with the options to learn what will work best for each patient.

Appropriate patient selection is the first step in avoiding complications and dissatisfied patients. This begins with a thorough medical history and physical exam, with emphasis on the patient’s dental occlusion. If there is a significant occlusion abnormality, the necessity of maxillary or mandibular shifts should be evaluated before performing aesthetic chin surgery. Patients who have dental problems and a small chin may be served better by mandibular advancement alone or in combination with a chin augmentation technique. Once the patient is established as a good medical candidate, it is equally important to assess his or her motivations and expectations for the surgery. Obviously, if the patient is relying on surgery to get a new job or boyfriend/girlfriend, the surgeon should reconsider performing this procedure. Even if the aesthetic outcome is better than expected, the surgery may be viewed as a failure by the patient if his or her end goal is not accomplished.

After medical and motivational factors have been considered, if the decision has been made to proceed with chin augmentation, the patient should be counseled thoroughly regarding the surgical risks. Complications from genioplasty can largely be grouped into the following categories: soft tissue, nerve, muscle, bone or tooth, and technical errors (Table 1). Certain complications can be almost unavoidable, but having a solid foundation in anatomy and reviewing the existing literature can help minimize the risk of problems while providing an improved understanding of how to recognize and manage them when they occur.

As with any cosmetic surgery, smoking increases the risk of complications, so patients should discontinue the use of tobacco prior to surgery. Patients should be counseled on the importance of good oral hygiene, as well as the avoidance of aspirin and nonsteroidal anti-inflammatory drugs (NSAIDs) for at least 10 days prior to surgery. The use of antibiotics for prophylaxis is not supported in the literature and may even increase the risk of complications.

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use of nicotine products at least three weeks preoperatively to minimize any additional impact on healing. Anticoagulant medications such as aspirin, warfarin, and vitamin E should be discontinued at least 10 days before surgery (with permission from the patient’s primary care physician) to lower the risk of hematoma.

SOFT TISSUE COMPLICATIONS

In chin augmentation, hematomas are rare and usually easily treated by needle aspiration. Scar formation can occur with an external approach, but this is usually well hidden if the incisions are placed appropriately in a submental crease. When an intraoral approach is utilized, overgranulation of the buccal wound may occur; this can be treated with local cautery. Wound dehiscence can occur with any approach, so the wound should be monitored closely for evidence of infection. When the dehiscence is small, both external and intraoral wounds generally heal well in the absence of infection.

Infection is an additional concern. It has been reported to occur in approximately 5% to 7% of chin implant procedures but certainly can also occur after osseous genioplasty.1

Cases of infection may range from cervical cellulitis to abscess or draining fistula (Figure 1). This is usually due to contamination of the wound with either oral or skin flora, but rare cases have been reported in which fluid collections developed in the chin many years after the procedure. One rare case of delayed abscess formation was due to retained nasal mucosa in implanted cartilage, which led to the formation of a mucous retention cyst. These complications can also result from a nearby infection contaminating an alloplastic implant.2 Although use of the nasal dorsum as a chin augmentation graft after harvest from simultaneous rhinoplasty is infrequently employed currently, the technique was originally described by Aufricht and was quite popular in the midtwentieth century.3

When infections arise without a fluid collection or abscess, early high-dose antibiotics may salvage the implant. However, many implants ultimately require removal with pocket irrigation and loose reapproximation of the wound. In a review of Mersilene mesh implants, the infection rate was 2.5%, with 70% of patients requiring subsequent implant removal.4 A separate review demonstrated an implant infection rate of only 0.8%. Neither study showed a difference in infection rates based on surgical approach.5 In certain cases of infection, the implant may begin to extrude, necessitating immediate implant removal and antibiotics. This is particularly likely in cases of late abscess with an associated alloplastic implant because of extensive bacterial colonization of the implant. If a late abscess does occur, the implant should be removed. In our experience, porous implants are more difficult to salvage and so require more frequent removal than nonporous alternatives (eg, Silastic, Dow Corning Corp., Midland, Michigan). Once the decision to remove the implant has been made, the surgeon and patient must decide together whether to abort reaugmentation, place a new implant after a course of antibiotics, or perform simultaneous sliding genioplasty.6

Capsular contracture (CC) around an implant can lead to a very unnatural, poorly-contoured appearance to the chin (Figure 2). CC is more likely with Silastic implants than with porous polyethylene implants, probably because the latter are integrated with soft tissue ingrowth.7 However, this incorporation also makes porous implant removal more difficult. CC can cause the skin to bunch or

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**Table 1. Potential Genioplasty Complications**

<table>
<thead>
<tr>
<th>Soft tissue</th>
<th>Muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematoma</td>
<td>Chin ptosis</td>
</tr>
<tr>
<td>Scar</td>
<td>Mentalis muscle dysfunction</td>
</tr>
<tr>
<td>Buccal overgranulation</td>
<td>Lower lip retraction</td>
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<tr>
<td>Wound dehiscence</td>
<td></td>
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<tr>
<td>Cellulitis</td>
<td>Bone/tooth</td>
</tr>
<tr>
<td>Abscess (early/late)</td>
<td>Tooth root damage</td>
</tr>
<tr>
<td>Draining fistula</td>
<td>Mandibular bone resorption</td>
</tr>
<tr>
<td>Capsular contracture</td>
<td></td>
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<tr>
<td>Skin bunching/dimpling</td>
<td>Technical</td>
</tr>
<tr>
<td>Skin necrosis</td>
<td>Implant malposition</td>
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<tr>
<td></td>
<td>Underaugmentation/overaugmentation</td>
</tr>
<tr>
<td>Nerve</td>
<td></td>
</tr>
<tr>
<td>Chin hypoesthesia/dysesthesia</td>
<td></td>
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</tbody>
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**Figure 1.** This 19-year-old woman presented with a draining fistula 18 months after sustaining trauma to her polytetrafluoroethylene (Proplast; Vitek, Inc., Houston, TX) implant.
dimple, particularly if the patient’s skin is thin or if the plane of dissection was supraperiosteal. This deformity is extremely difficult to correct and often requires a capsulotomy with placement of a larger implant. A thin skin envelope can also lead to implant palpability once the initial swelling has subsided. This issue has been addressed successfully with fat grafting to the area. Skin necrosis is rare but can occur if there is dissection and implant placement within the soft tissues (as opposed to directly on the bone or periosteum).

**NERVE DAMAGE**

In osseous genioplasty, as with any surgery that involves osteotomies or screws in the mandible, the location of the tooth roots must be considered to avoid tooth damage, discoloration, pain, infection, and cysts (Figure 3). This concern is particularly important in adolescent patients, since mandibular growth is incomplete until the late teens or early twenties, and the tooth roots may be close to the mandibular canal. If tooth devitalization occurs, a root canal procedure will likely be necessary. This complication may be avoided by keeping mandibular entry approximately two crown lengths inferior to the exposed tooth.

Other anatomic hazards in this area include the inferior alveolar nerve and the mental nerve, which usually exits below the bicuspid tooth but can also be found below the cuspid or between the two premolars. To minimize the risk of paresthesia, the surgeon must remember that the inferior alveolar nerve begins inferior to the mental foramen and loops anterior to it. In one study of Korean cadavers,
the inferior distance between the mental foramen and inferior alveolar nerve was measured at an average of 4.5 mm, with a maximum distance of 8.4 mm.9 With this in mind, the osteotomy should be placed at least 4 mm below the mental foramen in very small mandibles and perhaps even below 6 mm in less hypoplastic cases.10 Unfortunately, it is inevitable that some sensory innervation to the incisor teeth, lower chin, or inferior border of the mandible will be damaged with an osteotomy. This occurs because additional nerve fibers from the lingual and mylohyoid nerves enter at the inferior portion of the mandible to form a plexus in the genial segment. Ultimately, the patient may acquire some degree of temporary postoperative hypoesthesia or dysesthesia of the chin, which occurs in 3.4% to 12% of cases.11-13 These risks should be discussed preoperatively with the patient.

Lower lip numbness can also occur with implant placement due to stretch, compression, or severing of the mental nerve. This problem usually resolves spontaneously, but if improvement is not noted by two or three weeks postoperatively, the implant should be removed, and the lower flange should be either moved inferiorly or trimmed at its superior border to allow more space for the nerve. This complication may become permanent if not addressed within a two-month window.14

**CHIN PTOSIS AND MENTALIS MUSCLE DYSFUNCTION**

In closing the incision, special care should be taken to reapproximate the mentalis muscle, which elevates and compresses the chin against the anterior mandible and indirectly raises the lower lip. Failure to do so can lead to chin ptosis (Figure 4), lip ptosis, drooling, and an increase in lower teeth show. Cases of lower lip retraction and incisor show may be particularly difficult to correct, as they require sufficient mobilization of the lip and repositioning/suspension with screws.15 Some surgeons have found that chin padlifting techniques yield disappointing results. Less severe ptosis may be corrected by excising submental soft tissue through an elliptical submental incision.16 Osseous genioplasty is an alternative for patients with chin ptosis and lack of projection; surgeons can place a chin implant and de-epithelialize a 1.5- × 3-cm submental area while advancing the more posterior tissue over the de-epithelialized area.17,18

If asymmetric ptosis is present, botulinum toxin A can be injected on the unaffected side to lend temporary symmetry as muscle function recovers. Botulinum toxin has also been shown to be helpful in treating muscle spasm due to intraoperative traction on the mentalis muscle (Figure 5) or skin dimpling that can result after chin implant removal. This dimpling is often due to bunching of the soft tissue and mentalis muscle, which contracts into a mass and appears most unsightly during a smile. While surgical attempts at reattaching this muscle to its natural origin on the anterior face of the mandibular body are successful at managing chin ptosis, this technique does not specifically address mentalis muscle dysfunction, which is better treated with botulinum toxin injections. As can be expected, the effect only lasts approximately four months, and repeat treatments are necessary to sustain the result.19
Figure 5. This 55-year-old woman presented after osseous genioplasty, having developed facial spasms months after the procedure. These spasms improved with botulinum toxin injections. The patient is shown on frontal (A) and lateral (B) views.

Figure 6. Panorex scan demonstrating bony nonunion after osseous genioplasty. This patient presented with a palpable step-off on the left mandible. Bone putty was placed in the defect, and the resulting contour was smoother.

**BONE COMPLICATIONS**

Although unusual, mandible fracture and bony nonunion (Figure 6) have been reported after osteotomies for osseous genioplasty. Rare cases of hardware failure after osseous genioplasty require refixation of the bony segments (Figure 7).

One of the most frequently discussed bone-related issues after chin augmentation is potential mandibular bone resorption (Figure 8). Although it is rarely a large-enough change to be recognized aesthetically, one study showed that resorption with a chin implant can occur at a rate as fast as 0.1 mm per month. This would be particularly harmful if the implant had been placed high on the mandibular body, thereby predisposing the patient to erosion into a tooth root, which can cause pain and other dental problems. In a retrospective cephalometric analysis of mandibular bone after Silastic implant placement in 85 patients, Friedland et al demonstrated bone resorption in more than half these patients. Despite this, none exhibited significant aesthetic changes on their soft tissue profiles. Moreover, bone loss appeared to be more prominent when the implant was placed over alveolar bone, as opposed to the hard bone of the lower mandible. Bone resorption may also be associated with larger implant size. A later study that measured bone loss retrospectively over at least 19 months showed that Proplast I and II implants (Vitek, Inc., Houston, TX) ranged from 0 to 3.3 mm, compared to porous block hydroxyapatite implants, which did not demonstrate any resorption. Note that the latter implant is technically more difficult to insert.

There are multiple theories regarding the cause of resorption, including pressure of the implant against bone, devascularization of the bone from a subperiosteal pocket, and micromotion of the implant within its pocket against the bone. The question of the amount of pressure that should be allowed between an implant and the mandible stems from the fact that bone is constantly remodeling in response to mechanical stress. An animal study was conducted to evaluate supraperiosteally- and subperiosteally-placed Silastic implants at different pressures, and it noted a trend toward less bone resorption in the setting of higher pressure, with a P value of .09. The data did not reach statistical significance, likely due to the small sample size, four-month study duration, and dislodgement of three maximum-pressure implants. This study also reinforced the irrelevance of implant location with respect to the periosteum, as shown in a previous animal study that found no difference among four types of rigid implants in varied periosteal planes at six and 18 months. This lack of difference may be due to erosion of the implant through the periosteum over time if placed in a supraperiosteal plane. Despite this similarity in results, preserving vascular supply to the bone appears to be more important in the case of osseous genioplasty. In a study of 29 patients, 14 had osseous genioplasty with retained lingual soft tissue, and the remainder had completely detached genial segments; as such, the former group had significantly fewer infections (P < .05) and less bone resorption (P < .01).
Another pressure-related theory stems from a review of patients who sustained significant mandibular resorption after silicone implant augmentation, despite the appropriate position of these implants. Lower labial incompetence, leading to lower lip strain and mentalis hyperfunction, was determined to be the shared factor among these patients. The overactive mentalis muscle was likely applying additional pressure to the rigid implant, squeezing it against the bone and causing erosion. With this experience in mind, it would be prudent to consider maintaining radiographs and conducting long-term follow-up with this population, particularly for younger patients who will continue to sustain this mandible stress over many years.

Last, the theory of micromotion causing resorption may be supported by the previously-mentioned animal study by Pearson and Sherris. It is possible that the minimally-pressurized implants had the most significant micromotion during the healing process, thereby leading to bone erosion. A precise pocket and implant design that allow for excellent contact between the anterior surface of the mandible and the abutting implant may help to prevent micromotion. Rigid fixation with screws/sutures or choosing a porous polyethylene implant, which allows tissue ingrowth and fixation to the surrounding tissues, may also assist in this endeavor. Overall, in the setting of bone resorption, one must consider removing the alloplastic implant. The implant may then be replaced with a smaller one to reduce the soft tissue sequelae of an empty soft tissue pocket, or the surgeon may convert to osseous genioplasty.

**IMPLANT MALPOSITION**

Implant malposition typically occurs when the implant is too low on the chin (Figure 9) or when it migrates superior to the pogonion. In a review of 62 patients who had undergone chin augmentation, 8% of implants had moved superiorly. This problem may occur more frequently after a procedure performed with an intraoral approach, and it can be remedied by replacing the implant via a submental approach, securing it in place with sutures or screws. Care must be taken to reattach the mentalis muscle to avoid a drooping “witch’s chin” deformity.

Asymmetry may also occur, where one flange of the implant is not in proper contact with the mandible.
Ideally, this problem should be preempted by recognizing the asymmetry intraoperatively and electing to perform osseous genioplasty. Otherwise, an alternative is to use an adaptable implant with two halves that can be inserted and contoured separately. This implant can mimic the inclination of the patient’s mandibular body halves and allow for a better transition between the implant and mandible. When a single Silastic implant is placed, the device may spring forward slightly from the mandible and result in dead space. Webster et al. addressed this issue by making slits on the anterior surface of a Silastic implant to provide posterior bends in certain areas. In contrast, Mahler advocated cutting vertical posterior slits on the implant to maintain a smooth anterior implant profile while closing dead space with tissue growth into the slits.

**UNDERAUGMENTATION OR OVERAUGMENTATION**

Both underaugmentation (Figure 10) and overaugmentation are potential complications of aesthetic chin surgery, but overaugmentation tends to be more distressing to patients. Unintentional overaugmentation with an implant may occur if gaps are present between the anterior surface of the mandible and the abutting implant due to mandibular contour irregularities. This is a particular risk with a firm implant. In instances of this type of irregularity, the implant should be contoured and two-piece implants considered.

Overaugmentation more commonly occurs when the surgeon fails to recognize the thickness of the chin pad and the relationship of the pogonion with the lower lip and labiomental fold. Chin pad soft tissue thickness is often overlooked as a separate component. When the thickness is within the average range of 8 to 11 mm when palpated off the midline, the anterior surface of the implant should not project beyond the labial surface of normally-positioned lower incisors. An overly deep labiomental groove may result if this is not considered. When managing a patient who desires implant augmentation for projection but already has an overly high, deep, or blunted labiomental groove, the surgeon should make every effort to balance the patient’s anatomy, taking special care that the lower third of the face does not overpower the rest of the face. Facial harmony can be maintained by trimming down the vertical height of the implant. To avoid an overly deep labiomental fold in the setting of osseous genioplasty, one should...
consider placing a graft under the groove when osseous advancement over 10 mm is conducted.\textsuperscript{16}

Identification of “ideal” chin pogonion position can be determined in multiple ways. One method relies on a line drawn perpendicular to the Frankfort plane through the soft tissue of the subnasale. The subnasale and upper lip are tangent to this line, while the lower lip and pogonion are 2 and 4 mm posterior to it, respectively. Another popular method of projection assessment is the use of a vertical line tangent to the vermilion border of the lower lip. A masculine chin should lie on the tangent line, whereas a feminine chin should be just behind it. In a study on the range of norms in North American Caucasian faces, Farkas et al\textsuperscript{33} determined that, in reference to a vertical line tangent to the glabella, a line from the glabella to the pogonion is $-3^\circ \pm 3.4^\circ$ in men and $-4.1^\circ \pm 3.0^\circ$ in women.

Whichever assessment method is utilized, surgeons must recognize that there is still a significant subjective component to the ideals of patients and surgeons. Some postoperative disappointment may be avoided with the use of digital image-morphing programs, but it must be made clear to the patient that these are only tools for communication and not a promise of results. Perception mismatches between the surgeon and the patient may be most common with older patients who undergo simultaneous facial rejuvenation surgery, since they might have more psychological difficulty after surgery.\textsuperscript{34} They may view even an excellent result as a large change rather than the restoration of their youth.

**CONCLUSIONS**

Overall, chin augmentation procedures are safe and effective. Complications are rare and can often be avoided with comprehensive knowledge of regional anatomy and relative facial proportions. Most important, potential problems should be discussed thoroughly with patients preoperatively so that such problems are understood as risks rather than viewed as unanticipated complications.
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REFERENCES