

Original Investigation

A Simplified, Reliable Approach for Advancement Genioplasty

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IMPORTANCE Advancement genioplasty is a versatile procedure able to address both functional and cosmetic issues. It is commonly performed by oral surgeons and less so by facial plastic and plastic surgeons, presumably because of its inherent risks.

OBJECTIVES To present our technique for advancement genioplasty and our aesthetic and functional outcomes.

DESIGN, SETTING, AND PARTICIPANTS A retrospective review was conducted of the medical records of 126 patients who had undergone advancement genioplasty with our modified technique in a private practice setting from September 1997, through September 2014. Our analysis was performed between January and March 2015.

MAIN OUTCOMES AND MEASURES Description of technique and evaluation of complication rates, improvement in sleep apnea symptoms, and patient satisfaction.

RESULTS The 126 patients had a mean age of 39.8 years. There were 81 male and 45 female patients. The overall complication rate was 6.3% (8 of the 126 patients). Complications included plate extrusion in 2 patients, infection in 2 patients, mental nerve injury in 3 patients, and tooth root injury in 1 patient. Patients were satisfied with the aesthetic result of the procedure, which also produced an improvement in obstructive sleep apnea in 82 of 89 (92%) patients with sleep apnea.

CONCLUSIONS AND RELEVANCE Advancement genioplasty is a valuable tool that can address both functional and aesthetic issues. The technique presented here allows safe, reliable, and effective execution of the procedure.

LEVEL OF EVIDENCE 3.

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Advancement genioplasty, compared with alloplastic implantation, can provide both functional and aesthetic benefits for the patient.¹⁻⁵ Yet, despite numerous modifications and progress in advancement genioplasty,⁶⁻¹¹ facial plastic and plastic surgeons, unlike oral maxillofacial surgeons, seldom use this technique.^{12,13} Much of the present literature about advancement genioplasty is found in oral surgery journals. It is likely that facial plastic surgeons' comfort and familiarity with alloplastic implants contributes to their more widespread use of these implants than of advancement genioplasty.

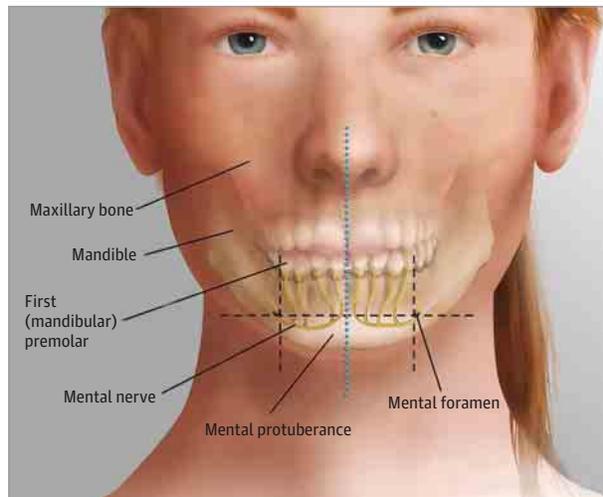
Although an alloplastic chin implant is faster and easier to perform than an advancement genioplasty, it can produce complications, including infection, chronic inflammation, extrusion, variable bone resorption, capsular contraction, displacement, and chin ptosis.^{3,14} Some have reported that advancement genioplasty allows for the correction of more complicated deformities, provides greater patient satisfaction, permits heightened predictability, and provides greater stability than alloplas-

tic implantation.^{3,5,13} We believe that advancement genioplasty is a valuable tool for the facial plastic surgeon in offering both aesthetic and functional benefits for the patient. In the present study, we describe a safe, reliable, and effective method for the osteotomy performed in advancement genioplasty and our results using this technique during the past 17 years.

Methods

The John Peter Smith Hospital Institutional Review Board approved this retrospective study of medical records of patients who had undergone advancement genioplasty. Patients were included in the review if they underwent an advancement genioplasty from September 1997 to September 2014, using the technique described below. Patient medical records were reviewed between January and March 2015. Patient demographic data, indications for advancement genioplasty, and

Figure 1. Markings for Osteotomies



Markings depict the boundaries for the saw cut. The lateral boundary is marked by a vertical line drawn through the mental foramen. The horizontal boundary is a line marked inferior to the tooth roots. The midline is marked. Reproduced with permission from Alexandra B. Hernandez of Gory Details Illustration.

follow-up information were collected. Patients were also surveyed postoperatively to assess their overall satisfaction with the procedure.

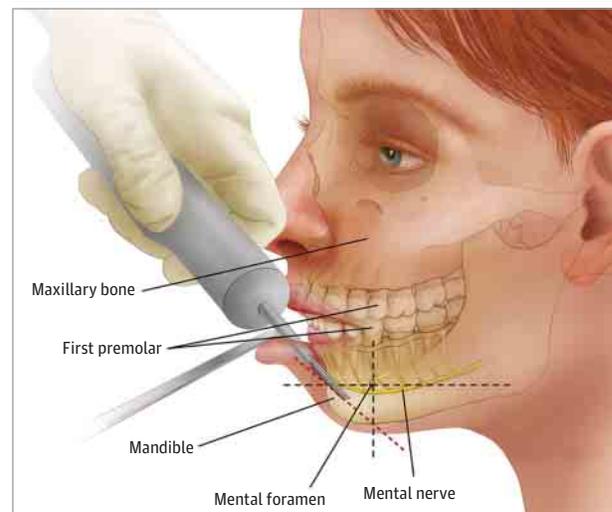
Surgical Technique

An incision is made near the gingivobuccal sulcus, leaving at least a 1-cm cuff of tissue to allow easy closure after the procedure, and is carried through the mentalis muscle onto the bone. Dissection is done in a subperiosteal plane laterally on both sides to identify the mental foramen and neurovascular bundle. The mentalis muscle should remain attached to the anterior aspect of the mandible to preserve blood supply to the distal segments of the mandible, to prevent chin ptosis, and to allow the advancement of underlying musculature.¹⁵

The lateral and inferior boundary of the osteotomy is the intersection of a vertical line drawn through the mental foramen as it crosses the inferior border of the mandible, with the superior boundary of the osteotomy located below the tooth roots. The midline is marked between the incisors to ensure proper alignment during plating (Figure 1). A reciprocating handsaw is used for the osteotomy. The osteotomy should be angled from the superior boundary down toward the marks of the inferior boundary to help preserve the mental nerves and tooth roots and prevent a large step-off, allowing a more gradual and natural final appearance of the jaw and chin (Figure 2). It should be noted that the mental nerve canal runs slightly inferior to the foramen,⁷ creating the risk of scything the nerve if a bone is cut too close to the foramen.

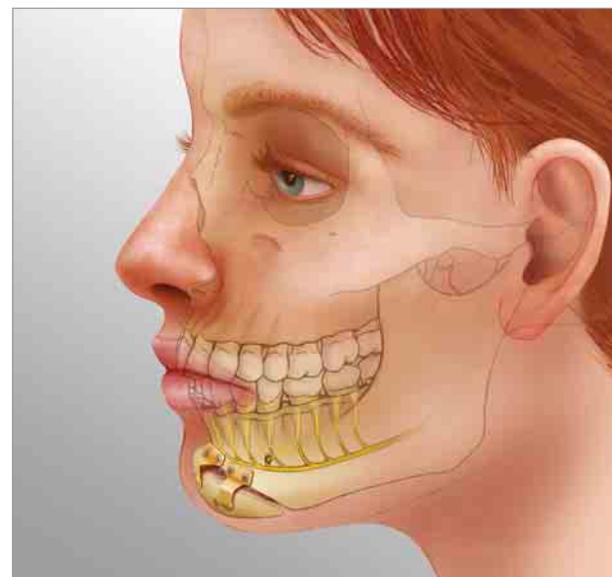
The distal segment of the mandible is advanced anteriorly as appropriate while ensuring that the bone of the distal-most inferior segment of the mandible and the distal body of the mandible continue to overlap. Two step plates are then applied with monocortical screws to rigidly fix the segments (Figure 3). It should be ascertained that the chin projection is appropriate. The surgical wound is then irrigated, the mentalis

Figure 2. Angulation of Osteotomy



Angulation of the saw cut based on the boundaries decreases the risk of injury to the mental nerve. Reproduced with permission from Alexandra B. Hernandez of Gory Details Illustration.

Figure 3. Advancement and Fixation of the Mandible Segment



The advancement segment maintains contact with the mandible and is secured using 2 step plates. Reproduced with permission from Alexandra B. Hernandez of Gory Details Illustration.

muscle reapproximated, and the incision closed. Postoperative care includes a soft diet, application of a jaw bra, oral rinsing with a Peridex mouthwash, and oral clindamycin hydrochloride at 300 mg every 6 hours for 7 days.

Results

A retrospective review of the senior author's (Y.D.) patients who were treated with advancement genioplasty from Sep-

tember 1997, through September 2014 yielded 126 cases. Of these, 81 cases involved male and 45 involved female patients, with a mean (SD) age of 39.8 (14.39) years (range, 14-67 years). Indications for treatment included microgenia, base-of-tongue obstruction on Müllers maneuver, and intolerance to continuous positive airway pressure. Eighty-nine of the patients underwent advancement genioplasty for obstructive sleep apnea (OSA), of whom 64 (71.9%) no longer required continuous positive airway pressure, 18 (20.2%) were able to better tolerate continuous positive airway pressure after the procedure, and 7 (7.9%) did not improve. The 37 remaining patients underwent advancement genioplasty for cosmetic purposes (with a concurrent neck-lift in 17 patients, concurrent rhinoplasty in 15, and no other procedure in 5). The mean (SD) operative time, defined as the time from initial incision to closure of incision, was 51 (7.84) minutes (range, 38-61 minutes).

The review identified 8 complications (6.3%). Plate extrusion occurred in 2 patients (1.6%), which was closed in 1 patient with suture in the clinic; the other patient required an exchange of hardware. Two patients (1.6%) developed cellulitis along the surgical site that resolved with antibiotic treatment. Three patients (2.4%) experienced hypoesthesia along the distribution of the mental nerve. These 3 patients had a full recovery, with the longest time to resolution being 11 months. There was 1 dental root fracture in a patient with a history of a root canal procedure.

Aesthetic outcomes were assessed with a patient satisfaction survey (where 1 indicates extremely satisfied; 2, very satisfied; 3, somewhat satisfied; 4, somewhat dissatisfied; 5, very dissatisfied; and 6, extremely dissatisfied) at follow-up. The mean score was 1.4 (range, 1-3).

Discussion

In 1942, Hofer¹⁶ first described advancement genioplasty through an external approach, followed in the late 1950s by descriptions of an intraoral approach by Trauner and Obwegeser¹⁷ and Converse and Wood-Smith.¹⁸ The development in the 1980s of rigid fixation techniques for the distal segment of the mandible allowed better stabilization of the advanced segment, first with pins and rods and currently with screws and plates. Manipulation of the sliding segment now allows for correction in the horizontal, vertical, and transverse dimensions, making this technique versatile enough to address a multitude of chin abnormalities.^{3,13,19} Indeed, various authors recommend osseous genioplasty because of its versatility, predictability, stability, and low complication rates.^{5,15,20-23}

Despite the benefits of advancement genioplasty, many facial plastic and plastic surgeons use alloplastic implants for augmentation genioplasty because it generally requires less operative time and is easier to accomplish. Although the complication rates are low for modern implants, those complications that do occur tend to be more severe and require a prolonged treatment course. For this reason, Li and Cheney²⁴ advocated the use of sliding genioplasty in

the treatment of failed chin implants in the setting of infection and/or extrusion. When an infected implant does not resolve with antibiotics alone, the implant is usually removed and a secondary procedure is required 3 to 6 months later to replace the implant. Because this method requires a second procedure, however, Li and Cheney recommended an immediate sliding genioplasty at the time of implant removal. They found that this protocol eliminated the need for a second surgery and produced an excellent immediate result. Furthermore, Strauss and Abubaker¹³ found that osseous genioplasty yielded more predictable soft-tissue changes than did alloplastic implants. Gui et al,²⁰ in a large retrospective study comparing sliding genioplasty with a Medpor chin implant, found that both techniques produced similar patient satisfaction but that sliding genioplasty was more versatile in correcting abnormalities in all 3 dimensions. Chang et al³ also preferred the sliding genioplasty technique because it allowed for the correction of a greater range of abnormalities. They found high surgeon and patient satisfaction scores for this procedure and that operative times for experienced surgeons were as short as 15 minutes, results were stable, and neurologic complication was infrequent and transient.

Another factor contributing to the widespread use of alloplastic implants among facial plastic and plastic surgeons may be the difference in training for their use by these professionals compared with that for oral surgeons. A study by Fan et al¹² evaluated the comfort level of practicing plastic surgeons with common craniofacial techniques. Among the techniques examined, osseous genioplasty was considered a key procedure that should be taught during residency. However, Fan et al found that, despite exposure to osseous genioplasty in residency and in fellowship, practicing plastic surgeons did not feel comfortable with the procedure. In comparison, oral surgeons are significantly more comfortable and experienced in performing osteotomies, as evidenced by the many publications in the oral surgery literature addressing such techniques. This disparity in training undoubtedly resulted in the increased use of alloplastic implants by surgeons not trained in oral surgery.

In addition to aesthetic improvements with sliding genioplasty, it can also be used to alleviate OSA either in isolation or in combination with other procedures. Henderl et al²⁵ found that genioplasty combined with uvulopalatopharyngoplasty improved the respiratory disturbance index for 86% of patients with moderate obstructive sleep apnea. Kezirian and Goldberg²⁶ found in their literature review that genioglossal advancement alleviated OSA in 67% of patients with severe OSA. Santos et al²⁷ also found an improvement in scores on the apnea-hypopnea index with advancement genioplasty alone and recommended it as a treatment for OSA secondary to hypopharyngeal obstruction. In our study, 89 patients underwent advancement genioplasty for OSA, and 92% (82 of 89) experienced an improvement in symptoms postoperatively. It should be stressed that the success of advancement genioplasty for OSA relies on capturing the genioglossus, geniohyoid, mylohyoid, and digastric muscles in the advancing segment of the mandible. The

superior bone cut should be made 5 mm or more below the tooth roots to prevent the devitalizing of teeth; however, some patients may have a genial tubercle above the level of this cut and can therefore have worse-than-average outcomes.²⁸

We developed the technique described here on the basis of the many benefits of advancement genioplasty. Our technique is simple in that the boundaries of the bone cuts are easily visualized because they are anatomic landmarks, reducing the guesswork involved in the locations at which to end the bone cuts. Our results are reliable and the complication rates with our technique are low. Indeed, Gui et al,²⁰ who were experienced in the procedure, found that osseous genioplasty yielded no malunions or nonunions in their 500-patient cohort. Because permanent mental nerve injury is of great concern as a complication of the procedure, it is important to use a technique that consistently avoids trauma to the nerve. Ousterhout⁷ found that no permanent nerve injuries occurred if the osteotomies in the procedure were made 6 mm inferior to the mental foramen. The 6-mm distance was based on prior studies showing that the mental nerve canal was located no more than 5.5 mm inferior to the mental foramen. Hwang et al,²⁹ in an analysis of the path of the mental nerve in the mandible in 80 cadavers, found that the most common location of the mental foramen was inferior to the second premolar and halfway between the alveolar process and the inferior border of the mandible. The path of the mental nerve is on average 4.5 mm inferior to the mental foramen and loops 5 mm anterior to the foramen before making a U-turn and exiting the foramen itself. It is, therefore, possible for an osteotomy that is too high or is not sufficiently oblique to transect or injure the mental nerve. Our present technique simplifies

the procedure for advancement genioplasty by taking the osteotomy to the inferior border of the mandible at the mental foramen, resulting in a more oblique cut that is well below the mental foramen. Indeed, the incidence of transient mental nerve injury in our study was only 2.4% compared with its 9% to 100% incidence³⁰ in some reports.

A variety of techniques exist for sliding genioplasty, and all appear to produce a positive effect both aesthetically and functionally. However, although the results of the procedure are generally well received and complication rates are low, the individual surgeon should find a method that works best in that surgeon's hands for minimizing complications and maximizing benefit. Our technique has yielded highly satisfactory results from a functional and aesthetic standpoint, with low complication rates. A limitation of our study is that we lack objective measures of preoperative and postoperative results with our technique, and it was not a randomized prospective study.

Conclusions

Advancement genioplasty is a safe and effective means of improving chin projection for both cosmetic and functional purposes. Facial plastic surgeons prefer alloplastic implants to improve chin projection because it is easier to perform, but it incurs the risk of infection, bone erosion, and extrusion. Despite the advantages of advancement genioplasty, however, most facial plastic and plastic surgeons shy away from it because of lack of comfort and training in its performance. The technique outlined above permits advancement genioplasty to be accomplished in a safe, reliable, and effective manner with low complication rates.

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Invited Commentary

Osteotomy vs Augmentation Genioplasty Which Is Best?

Daniel J. Meara, MD, DMD

Patients seeking improved lower facial esthetics through genioplasty are often confronted with the options of bony advancement osteotomy vs implant augmentation. The choice of one of these options vs the other is often based on surgical experience and training rather

than evidence-based data.¹ Implant surgery is less invasive and reversible but carries the risks of underlying bony resorption and hardware infection.²⁻⁵ Osteotomy is more versatile and long lasting and can provide functional improvements, if the genial tubercles are involved in the design, but is more invasive and technically more challenging.^{6,7} Chan and Ducic suggest that advancement genioplasty should be more readily used because of the potential functional benefits that accompany its esthetic changes.⁸ They report it to be a safe, reliable, and effective method that is reproducible by all surgeons, regardless of whether trained in otolaryngology, plastic surgery, or oral and maxillofacial surgery.

Oral and maxillofacial surgeons tend to perform bony advancement osteoplasty on the basis of their surgical training, which includes significant bony procedures, such as orthognathic surgery and facial fracture reconstruction. As a result, most oral and maxillofacial surgeons find the procedure relatively simple and often perform it in the office setting but consider implant augmentation when a

less invasive approach is preferred. Plastic surgeons and otolaryngologists-facial plastics surgeons are more familiar with soft-tissue surgery and seemingly prefer implant augmentation. This raises the key question: What is the best surgery for patients? A literature search does little to answer this question and only reinforces the risks or benefits of each technique. Thus, a clinically relevant prospective study is needed to assess patient outcomes and the preferred method of genioplasty. Until this is done, the surgeon must continue to perform the surgery best suited to each individual patient on the basis of patient need rather than historical training methods.

Addressing this issue, Chan and Ducic present their modified technique, performed on 126 patients during 17 years, in which the osteotomy design is based on intersecting lines with the mental foramen as the key landmark. This creates a predictable surgical procedure for the novice and expert alike, minimizing the allure of alloplastic augmentation. It should be noted, however, that the osteotomy design done in the procedure raises the concerns of possible notching of the inferior border and shortening of the lower third of the face. A pure advancement genioplasty avoids an acute-angle osteotomy and extends posteriorly toward the first molars to alleviate these concerns. However, the point of the article is clear in that advancement genioplasty is more versatile, with less long-term risk than alloplastic augmentation, and should be used more routinely by all surgeons.



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