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M-Shaped Genioplasty: A New Surgical Technique for Sagittal and Vertical Chin Augmentation: Three Case Reports

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Several surgical techniques are available for correcting and giving harmony to the lower third of the face. In this respect, some well-known techniques seek to correct the shape and size of the chin using different kinds of chin implants or osteotomies in an effort to move it and change its spatial location, thus determining a new facial contour.

For alloplastic techniques, silicone implants have been used in a supra- or subperiosteal location for improving the projection and profile of the lower third of the face.[1] Also, high-density porous polyethylene implants (Medpore; Porex Surgical Inc, Irvine, CA) have been used, with 100- to 300-μm pores that would permit a fibrous growth inside of it, thus increasing their fixation.[2]

The complications described in this technique include infection, extrusion, dehiscence, inappropriate volume, displacement, capsular contraction, retraction of the lower lip, and bone resorption.[1]

Genioplasty is a versatile surgical technique that allows one to modify the natural anatomy of the chin in all 3 spatial directions. It was first described in the 1940s by Hofer, who referred to it as an "anterior horizontal osteotomy of the mandible."[1] It has multiple indications, mainly of functional and esthetic types.[1,3] The principal complications associated with this technique include the damage to the mental nerve, inadequate consolidation, nonunion, asymmetry, and irregularities.[1] Cases of pulp necrosis of the lower anterior teeth after screw fixation have also been reported.[4]

Genioplasty is the second most frequent osteotomy currently performed on facial bones.[1] The usual approach is intraoral, requiring a labial vestibular incision as far as the first premolar zone,[3] uncovering the anterior mandibular area with both mental nerves on sight.[1] The osteotomy design must permit the mobilization of the distal segment in any of the 3 directions of space (anteroposterior, mediolateral, or vertical), depending on whether the purpose is to correct a vertical, horizontal, or sagittal deficit or excess.

Thus, for vertical deficit cases, several investigators have proposed placing some type of interpositional graft between the fragments, fixing them through osteosynthesis.[3,5]

The aim of the present report is to show a new genioplasty design that permits one to pull the chin forward and down without the need to use an interpositional bone graft or alloplastic elements, achieving optimal results for each specific case.

Technical Description

An M-shaped osteotomy design is proposed for genioplasty that will permit one to increase the vertical dimension of the chin and to advance it in the sagittal plane. This osteotomy design is based on the displacement of 2 bone fragments on the slope of an inclined plane with an anteroinferior direction. The back edge of the osteotomy must be as horizontal as possible under the mental foramen to achieve continuity of the basilar edge (Figs 1–3). The degree of inclination for this slope will be determined according to the extent of the vertical (axis Y) and sagittal (axis X) displacement wanted for a given case. There-

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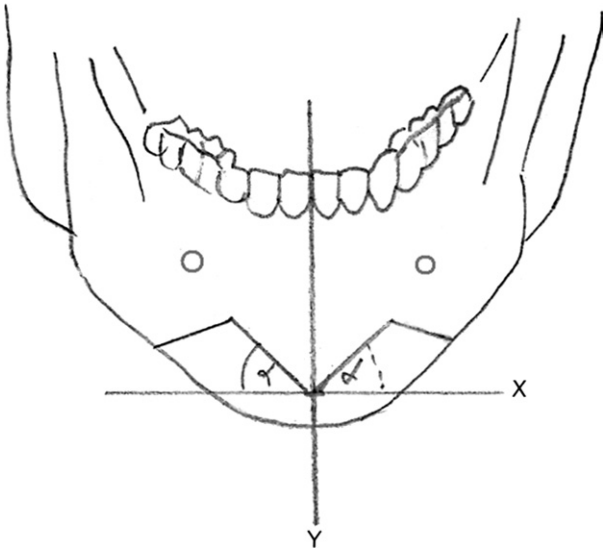

FIGURE 1. Osteotomy design from front view.

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fore, Tan α = Y/X, were Tan α is the tangent of the angle of the slope (inclination) measured in the sexagesimal system; Y is the extent of vertical displacement, and X is the extent of sagittal displacement (both expressed in millimeters) ().

It can be clinically applied, considering the basilar edge as the horizontal (axis X) and the imaginary perpendicular line from the pogonion representing the vertical (axis Y). Then, dividing it into 2 equal parts, a 45° angle can be determined, and, dividing it again into 2 equal parts, it becomes up to a 22.5° angle, and so forth. The idea is to come as close as possible to 1 of these angles.

Case Reports

The first case was a 17-year-old patient with a Class II skeletal microgenia and a vertical deficit of the left mandibular ramus and lower third of the face. She was considered a candidate for orthognathic surgery with Le Fort I osteotomy to decant the maxilla, bilateral advancement sagittal split osteotomy, and forward and down genioplasty (M-shaped genioplasty).

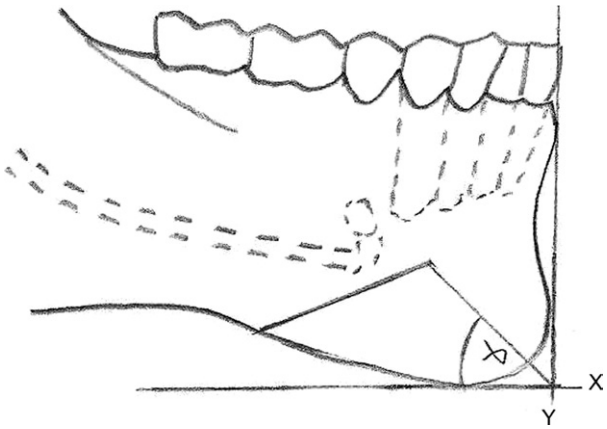

FIGURE 2. Osteotomy design from side view. X axis represents sagittal plane and Y axis, vertical plane.

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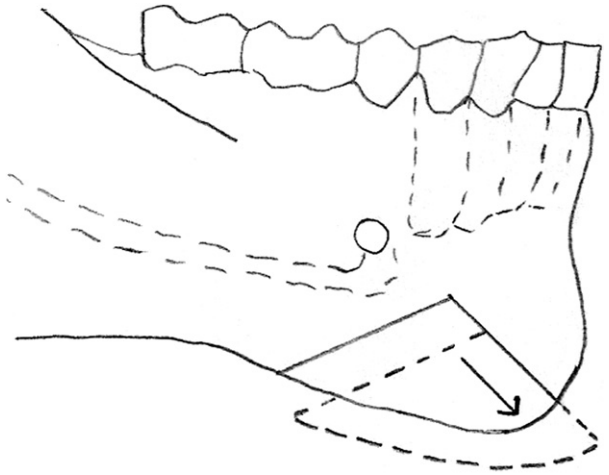

FIGURE 3. Displacement of distal fragment in anteroposterior direction.

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For this case, an 8-mm advancement and 6-mm descent was planned. In determining the amount of the slope required for this purpose, a 36.9° angle (tan α = 6/8) was obtained.

The osteotomy was designed at the intraoperative phase to comply with this angle (Figs 4–9).

The second case was of an 18-year-old patient with microgenia, who underwent M-shaped genioplasty and rhinoplasty (Figs 10, 11).

The third case was of a 26-year-old patient with dental and skeletal Class II, who underwent Le Fort I osteotomy with counterclockwise, bilateral advancement sagittal split, M-shaped genioplasty, and rhinoplasty (Figs 12, 13).

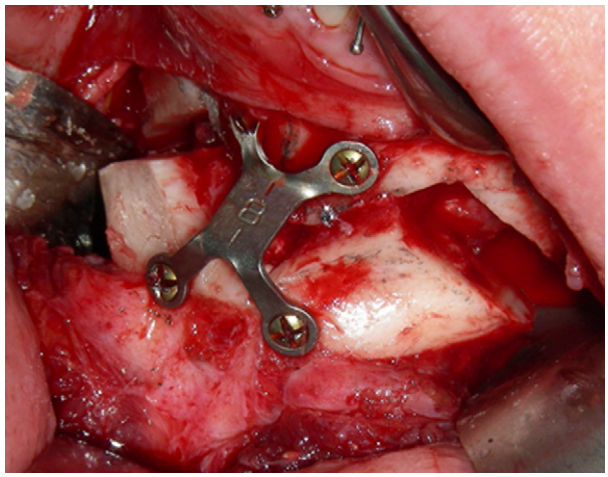

FIGURE 4. Patient 1, intraoperative view of fixation with chin advancement and descent.

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FIGURE 5. Patient 1, before surgery, front view.

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FIGURE 6. Patient 1, after surgery, front view, at 14 months of follow-up.

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Discussion

The chin size and projection is critical in determining facial balance and harmony.[6] A disproportion in the lower segment of the face, in both directions of space, will result in significant facial imbalance and disharmony.[7]

Multiple techniques are available for correcting this imbalance. It was in the mid-20th century that Hofer described the anterior sliding osteotomy, which was later modified by Trauner and Obwegeser.[1,6,8] However, in subsequent years, Brown and Millard introduced silicone implants and new biomaterials de-

FIGURE 7. Patient 1, before surgery, side view.

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FIGURE 8. Patient 1, after surgery, side view, at 14 months of follow-up.

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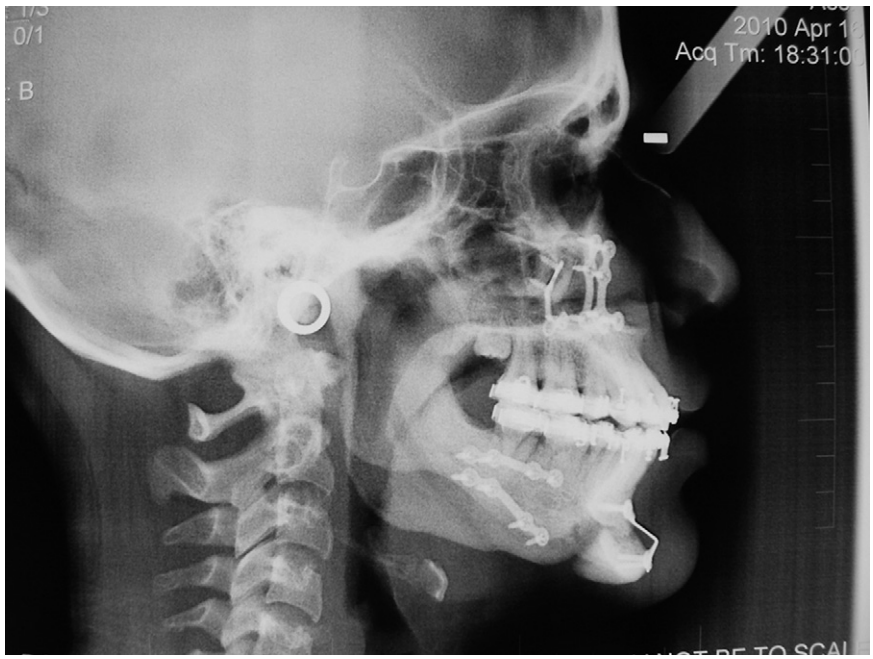

FIGURE 9. Patient 1, lateral teleradiography, 15 months after surgery.

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signed to increase the chin volume without using any osteotomies.[2,6,7] Silicone implants (Silastic; Michigan Medical Corporation, Santa Barbara, CA) have shown good esthetic results, although they have not been stable enough over time owing to their micromovement and possible displacement. In addition, increased osteoclastic activity below the implants has been observed that has resulted in underlying bone resorption when placed in the subperiostic position.[1,6,8]

Porous biomaterials composed of carbon and covalent bonds (Medpore) have proved stable over time

FIGURE 10. Patient 2, before surgery, side view.

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FIGURE 11. Patient 2, after surgery, side view, at 20 months of follow-up.

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FIGURE 12. Patient 3, before surgery, side view.

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FIGURE 13. Patient 3, after surgery, side view, at 10 months of follow-up.

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without any major adverse tissue reactions.[6] This is because their pores permit a fibrous growth inside them, reducing micro-displacements, and the incoming macrophages reduce the infection rates.[2,6] Similarly, Mersilene (Ethicon, Somerville, NJ), a nonabsorbable polyester fibrin mesh used for closing abdominal wall hernias, has shown good results and low infection (0.8%) and displacement (1.5%) rates; however, it has a high cost.[6,7]

Although biomaterials have provided good esthetic results, it is clear they have been indicated precisely for those cases of mild retrogenia in which the required chin projection is lower (≤3 mm) or when no asymmetry is present.[8] For moderate or severe cases requiring greater chin projection, osteotomy is more versatile and has produced better results.[1,2,4]

The horizontal sliding genioplasty indicated for cases of moderate retrogenia enables up to 14-mm advancement in the anteroposterior plane.[4] The desired amount of displacement will depend on the length of the cut and contact surface of the fracture planes.[3] In cases of severe retrogenia (displacement >14 mm), a staggered genioplasty can be performed, using 2 or 3 parallel osteotomies, fixing the intermediate segment to the proximal segment and the distal segment to the intermediate one and thus gaining up to 20 mm in advancement.[3,6] In contrast, in cases with sagittal excess, the distal segment is usually moved backward, with the subsequent excess of adjacent soft tissues.[3,6]

In 1974, Michelet described the "Tenonmortaise Génioplastie" technique, which seeks to pull the chin up and forward using a quadrangular spike in the proximal segment that fits into a cavity of similar shape and size in the distal segment, pivoting at the transverse axis.[9]

To reduce the vertical excess of the chin, 2 parallel osteotomies are usually performed, eliminating the intermediate segment, and fixing the distal segment to the proximal one.[3,5,6] To center the chin in the presence of lateral asymmetry, centering genioplasty is possible using an osteotomy with an asymmetric wedge in a vertical or horizontal direction.[6]

Another comparative advantage of the chin sliding osteotomy versus implants is the volumetric change of the upper airway when displacing the genioglossus and geniohyoid muscles, thus changing the position of the tongue base.[6,10,11] Advancement genioplasty is a part of the treatment protocols for slight to moderate obstructive sleep apnea syndrome, with a high level of success (63%).[7,8] Likewise, as it has been seen, a percentage of patients who are candidates for advancement genioplasty for esthetic reasons appear to have, to a greater or lesser degree, some narrowing of the upper airway, with osteotomy providing a greater advantage over alloplastic and bioplastic procedures in these cases.[6,11]

To increase the vertical dimension of the chin, a horizontal osteotomy has been proposed by placing a rigid material (hydroxyapatite blocks) or some interpositional bone graft (interposition genioplasty), generally taken from the iliac crest, and fixing the distal

segment to the proximal segment in a conventional fashion.[3,4,6,9]

This new genioplasty (M-shaped genioplasty) makes it possible to increase the vertical dimension, as well as the mental sagittal projection, without placing a graft or interposition material. Also, by determining the angle for the path for the osteotomy, it is possible to individualize the design pursuant to the desired effect in each particular case.

Also, the cost of placing a graft is reduced, together with the complications that can occur at the donor and recipient sites. The hazards inherent to horizontal genioplasty remain but so do its benefits to the airway and facial esthetic.

Three M-shaped genioplasties have been performed with this new design, achieving optimal esthetic, functional, and stable results over time. No complications have been registered in any of the 3 patients at a follow-up period of 15, 20, and 10 months.

M-shaped genioplasty allows one to properly correct the vertical and sagittal deficiencies of the chin, avoiding the need for grafting or the use of interposition materials. A simple geometric calculation allows one to mobilize the chin in a vertical and sagittal direction, according to the needs of each patient.

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