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## Introduction

The chin is the inferior topographic limit of the face and thus play a pivotal role in the perception of facial proportions. Proper chin positioning and morphology is an essential component of overall facial harmony. Vertical deficiency or excess of the chin disrupts the balance of facial thirds. Horizontal deficiency or excess of the chin can result in a cosmetically displeasing facial profile. Genioplasty is a versatile procedure that can address functional and cosmetic concerns of the patient. In younger patients, this procedure is typically performed during rhinoplasty or orthognathic surgery to give harmonious balance to the face. In older patients, it is usually performed simultaneously with facial and neck rhytidectomy to give definition to the jaw line and to improve the pre-jowl sulcus. Osseous genioplasty can also increase the upper airway space by repositioning the genioglossus and geniohyoid muscles anteriorly and therefore may be a useful component in obstructive sleep apnea. Osseous genioplasty was first described by Trauner and Obwegesser in 1957 and has continued to be a vital component in the oral and maxillofacial surgeon's arsenal [1].

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## Anatomy

The chin encompasses a region of the face below the labial mental fold that includes both soft tissue and bone. The soft tissue portion includes the labial mental fold superiorly, the oral commissures laterally, and the submental cervical crease inferiorly. The bony portion of the chin includes the mandibular symphyseal and

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parasymphyseal region inferior to the root apices of the anterior teeth. The depressor angularis, depressor labi inferioris and mentalis attach to the anterior surface of the bony chin. Attached to the genial tubercle of the lingual surface of the chin are the tendinous attachments of the geniohyoid and genioglossus muscles. The anterior bellies of the digastric muscles are attached to the posterior portion of the inferior border of the symphysis.

The sensory innervation to the cutaneous chin, the lower lip, and the vestibular mucosa is derived from the mental nerve. It is a continuation of the inferior alveolar nerve and exits the mandible via the mental foramen located between the first and second mandibular premolars. As the nerve travels to the foramen, it takes on an upward trajectory that must be taken into consideration when planning the location and angle of a horizontal osteotomy. To avoid nerve injury, the osteotomy should be placed at least 5–7 mm caudal to the foramen and be executed at a caudal-oblique angle. The motor innervation to the muscles within the soft tissues of the chin occurs through the marginal mandibular and cervical branches of the facial nerve. Care must be taken to protect the soft tissue when making osteotomies to avoid direct facial nerve injury [2].

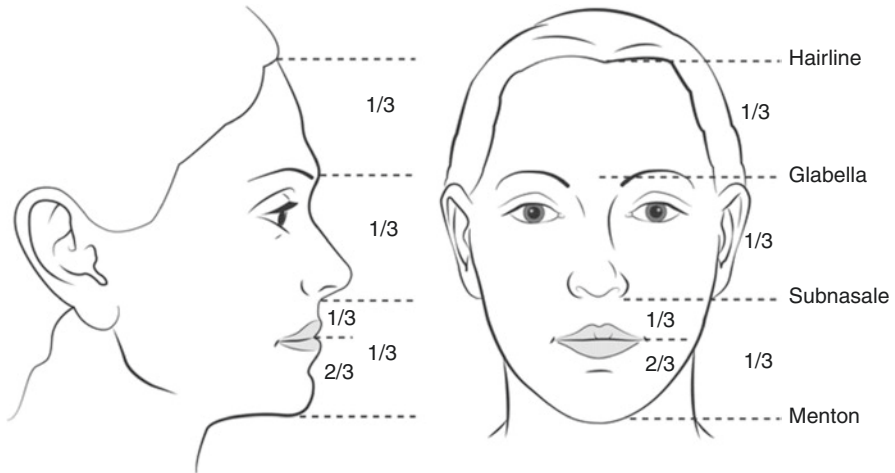
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## Preoperative Assessment

Evaluation of the chin in three dimensions is necessary for proper diagnosis and genioplasty treatment planning. From the frontal view, the chin and inferior border of the mandible should be well defined and provide separation of the lower third of the face from the neck. The midline of the chin should also be coincident with the facial midline with no significant deviation or asymmetry. The chin width should be in harmony with the bizygomatic and bigonial facial widths.

The chin's vertical dimension plays an important role in balancing vertical facial thirds. The middle third from glabella to subnasale and the lower third from subnasale to soft tissue menton should be approximately equal in males and females. The lower third can be further subdivided into the upper and lower lip, as seen in Fig. 24.1. The upper lip length should be approximately half the lower lip length, which is 40 mm ( $\pm 2$ ) in females and 44 mm ( $\pm 2$ ) in males. Excessive lower facial height may warrant a reduction osseous genioplasty. Deficiencies in vertical chin height may be improved with osseous genioplasty and an interpositional bone graft. Midline asymmetries and chin deviations may require a combination of osteotomy and grafting [2, 4].

Chin projection is an important aspect of the facial profile. A lateral cephalometric radiograph provides accurate image of the facial skeleton and the overlying soft tissues from which to judge profile esthetics when taken with the patient in their natural head position with the condyles seated in the fossa and with a normal freeway space between the teeth. For anteroposterior soft tissue analysis, a vertical line perpendicular to the floor can be drawn through subnasale to assess the relative prominence of the nose, lips, and chin. Ideally, soft tissue pogonion should be 3 mm



**Fig. 24.1** Division of facial thirds [3]

( $\pm 3$ ) behind this line, with the lips slightly anterior. Generally, a stronger chin is considered masculine, and a more retrusive chin is considered feminine. The bony chin position can be assessed with NB–pogonion and A–pogonion relationships to the lower incisor. The lower incisor tip and pogonion relationship to the NB line should be 2:1 to 1:1. These analyses assume that the maxilla and mandible are in the proper anterior–posterior relationship to one another and that the lower incisor inclination is normal [4].

It is important to assess other factors such as chin shape, depth of the labiomental fold, lower lip position, and mandibular position. Cultural differences should also be taken into consideration as a weak chin is generally considered more esthetic in Asian cultures whereas a stronger projection is generally desired in Western cultures.

With the advent of technology, virtual surgical planning is increasingly utilized for genioplasties. With virtual surgical planning, cutting guides, positioning guides, custom plates, and custom implants can be fabricated to ensure esthetic outcome and decrease surgical time [5]. This is especially helpful in genioplasties where there is significant asymmetry to be corrected.

## Osseous Genioplasty

Osseous genioplasty is more versatile than alloplastic implants in correcting three-dimensional chin position. It can be used to manage vertical and anteroposterior excess or deficiency and correct midline asymmetries. Osseous genioplasty is often performed in combination with orthognathic surgery, though careful assessment is needed as chin projection is influenced by rotation of the maxillomandibular complex.

## Anesthesia

Local anesthetic with a vasoconstrictor is recommended for anesthesia and hemostasis. Intravenous sedation can be administered in conjunction with local anesthesia for induction and maintenance of anesthesia during the surgery to increase patient comfort. The most frequently used agents include midazolam, ketamine, fentanyl, and propofol. Standard protocol for monitoring of sedation anesthesia should be strictly followed.

## Surgical Technique

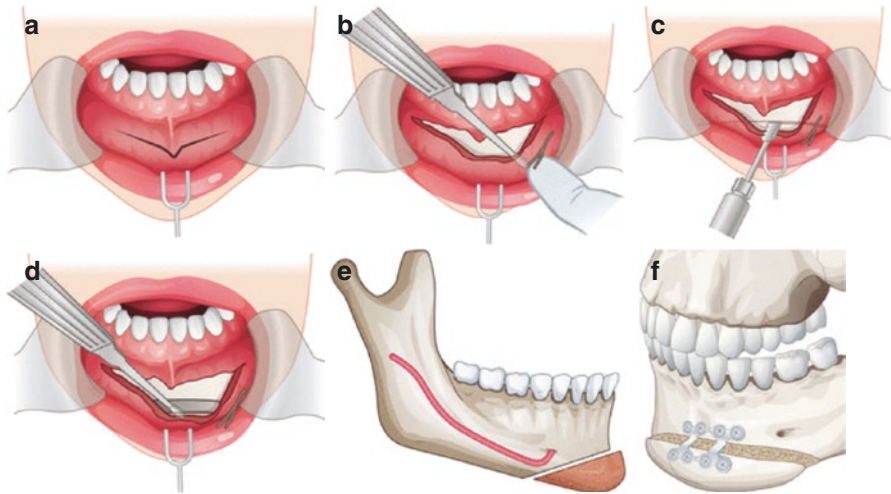
Local anesthesia is administered in mandibular blocks as well as infiltration into the submucosal tissue of the chin. The patient is then placed into maxillomandibular fixation with arch bars or maxillomandibular fixation screws to help stabilize the mandible during surgery.

An incision is made through the lip mucosa with 15 blade or electrocautery 3–10 mm below the mucogingival junction extending from canine to canine. Care should be taken not to extend the incision far laterally in either direction as this can damage the mental nerve as it exits the foramen. The mentalis muscle is then divided in an oblique angle so that an adequate cuff is left attached to periosteum for muscle resuspension on closure. The incision is then carried down to bone and subperiosteal dissection is performed with a #9 periosteal to fully expose the symphysis down to the inferior border. Subperiosteal dissection is then carried posteriorly into the premolar region, keeping the elevator along the inferior border. Excessive dissection along the inferior border should be avoided to preserve vascular supply to the advanced segment. A well vascularized pedicled segment is vital in postoperative healing and preventing long-term bone resorption. Dissection is then finally carried superiorly to identify and expose the mental nerve where it exits the foramen.

Using a thin fissure bur, the symphyseal midline is marked in a straight line across the intended osteotomy. To avoid injury to the mandibular teeth and mental nerve, the horizontal osteotomy should be at least 5 mm below the apices of the mandibular canines and 6 mm below the mental foramen. In advancement genioplasty, the osteotomy should extend posteriorly to the molar region in order to avoid excessive notching of the mandibular border.

The osteotomy is initiated posteriorly through both cortices of the inferior border. As the saw is advanced anteriorly, it should be gradually uprighted, reaching 90° at the midline. A finger on the operator's nondominant hand should be used to palpate the tip of the saw extraorally to ensure that both cortices are cut and to avoid over-insertion of the blade that can result in trauma to the mylohyoid and genioglossus muscles and excessive bleeding. The same osteotomy is carried out on the opposite side, with both osteotomies connecting at the midline. If the genial segment is not easily mobilized, the osteotomy should be rerun with the saw to ensure that both cortices have been fully cut. Forcing the segment to mobilize may result in irregular fracturing and sharp bony edges.

Bony fixation is then carried out with plates or positional screws depending on the surgeon's preference and the type of movement desired. Any osteotomy gaps should be grafted with autogenous or allogeneic bone. Please refer to Fig. 24.2 for surgical steps.



**Fig. 24.2** Surgical technique as viewed caudad to cephalad. (a) Surgical incision extending from canine to canine. (b) Subperiosteal dissection carried to the inferior border. (c) Osteotomy with a sagittal saw. (d) Mobilizing the genial segment. (e) Oblique osteotomy 6 mm below the mental foramen. (f) Rigid fixation [6]

The wound is then thoroughly irrigated and closed in two layers. The mentalis muscle is resuspended using vicryl sutures to maintain soft tissue contour and prevent chin ptosis. The mucosa is then closed in a continuous running fashion with chromic gut. A surface pressure dressing is placed to support the soft tissue envelope, minimize edema, and prevent hematoma formation [2, 7].

## Alloplastic Augmentation

Synthetic high-density porous polyethylene implants are common in facial augmentation and can be used in several anatomical areas such as the nose, cheek, or chin. Numerous companies manufacture products such as Medpor® and Gore-Tex® implants that can be used for alloplastic augmentation of the chin. Alloplast implants are limited to the correction of a vertical or transverse chin deficiency. A narrow chin or disruption of the jaw line with jowling may benefit from augmentation with an alloplastic implant to enhance chin projection and lateral jaw line contour. Implants offer several advantages, including ease of placement, shorter surgical time, and structural stability. They can be placed via a submental incision and are often placed in conjunction with other cosmetic procedures such as rhytidectomy, platysma plication, or neck liposuction [2]. One potential downside to alloplastic implants is an increase in infection rate, although the infection rates quoted in recent literature seem to be about equal to that of osseous genioplasty. This may be attributed to the development of better implant material. A recent study by Ferneini et al. shows that MedPor implants with larger pores of 100–300  $\mu\text{m}$  allows for a lower infection risk long term due to the ability for macrophages to infiltrate [8].

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## Complications

One potential complication of genioplasty is hematoma formation which can be devastating depending on the location. Anterior hematomas are often benign and can be treated with pressure dressing or needle evacuation. Expanding hematomas in the floor of the mouth can cause airway obstruction and result in an airway emergency. To prevent this complication, judicious hemostasis is warranted during surgery. A thorough preoperative history should also be taken to check for any coagulopathies and medications that can disrupt platelet function and hemostasis [9].

Inferior alveolar nerve injury is another potential intraoperative complication. This can occur if the nerve runs low in relation to the inferior border of the mandible and the situation is not appreciated preoperatively and adjusted for during surgery. Up to 50% of patients complain of temporary postoperative paresthesia or anesthesia due to edema or stretching from the retractors. Only about 3.5% of patients experience permanent neurosensory disturbances secondary to nerve injury. To minimize the risk of nerve transection, careful presurgical imaging should be done and the osteotomy should be at least 7 mm below the mental foramen. If the nerve is transected, a neuroorrhaphy procedure can be attempted [9, 10].

To avoid chin ptosis or a “witch’s chin” deformity, the surgeon should avoid excessive stripping of the mentalis muscle. Care should be taken to ensure adequate resuspension of the mentalis muscle when closing. In addition, appropriate chin dressing should be placed to provide additional support to the chin and to prevent hematoma formation [11].

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## Conclusion

Genioplasty, whether performed via osteotomy or allograft augmentation, can play a pivotal role in altering the profile esthetics of the face. When performed with diligent preoperative assessment, meticulous planning, and precise surgical execution, genioplasty can restore esthetic balance between the skeletal and soft tissue components of the lower face. Both allograft implant augmentation and osseous genioplasty can be performed in the office setting and should be an integral component in the armamentarium of an oral and maxillofacial surgeon.

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## References

1. Trauner R, Obwegeser H. The surgical correction of mandibular prognathism and retrognathia with consideration of genioplasty. I. Surgical procedures to correct mandibular prognathism and reshaping of the chin. *Oral Surg Oral Med Oral Pathol.* 1957;10:677–89.. contd
2. Guyuron B, Kinney BM. *Aesthetic plastic surgery video atlas e book.* New York, NY: Elsevier Health; 2011. p. 179–97.
3. Johnson M. Genioplasty. In: Wong BF, Arnold M, Boeckmann J, editors. *Facial plastic and reconstructive surgery.* Cham: Springer; 2016.
4. Posnick JC. *Orthognathic surgery: principles and practice.* New York, NY: Elsevier; 2014. p. 1564–678.

5. Costa PJC, Demétrio MS, Nogueira PTBC, Rodrigues LR, Júnior PDR. A new proposal for three-dimensional positioning of the chin using a single computer-aided design/computer-aided manufacturing surgical guide. *J Craniofac Surg.* 2018;29:1963–4.
6. Park S. The osseous genioplasty. In: Park S, editor. *Facial bone contouring surgery.* Singapore: Springer; 2018.
7. Kademani D, Tiwana P. *Atlas of oral and maxillofacial surgery: Elsevier Health Sciences;* 2015. p. 282–97.
8. Ferneini E, Halepas S. Antibiotic prophylaxis in facial implant surgery: review of the current literature. *Conn Med.* 2018;82:693–597.
9. Sood A, Caldemeyer C, Ferneini E. Complications of genioplasty. In: Ferneini E, Castiglioni C, Banki M, editors. *Complication in maxillofacial cosmetic surgery.* Cham: Springer; 2017.
10. Ousterhout DK. Sliding genioplasty, avoiding mental nerve injuries. *J Craniofac Surg.* 1996;7:297–8.
11. Richard O, Ferrara JJ, Cheynet F, Guyot L, Thierry G, Blanc JL. Complications of genioplasty. *Rev Stomatol Chir Maxillofac.* 2001;102:34–9.