

Matthew Johnson

Overview

The mandible is an important aesthetic feature in Western society. The mandible is not a structure in isolation, but has a significant impact on facial shape, nasal projection, occlusion, and neck aesthetics. A well-defined jawline and appropriate chin proportion provide the patient with balance and harmony in the lower face. Genioplasty and mentoplasty are methods for changing the size and shape of the mandibular symphysis. This can be recontouring the chin by burring away bone, placement of an implant, multiple osteotomies and repositioning of bone, or some combination of these. The goals of chin augmentation are to attain harmony of the lower face, appropriate facial height, aesthetic contour, and balance with the nose.

Definitions

- Genioplasty—recontouring or repositioning of the bony chin with burring or osteotomy, movement, and fixation
- Mentoplasty—augmentation and contouring of the chin with implant materials

M. Johnson, M.D. (✉)
Department of Surgery, Division of Otolaryngology –
Department of Head and Neck Surgery, Southern Illinois
University, Springfield, IL, USA
e-mail: Mjohnson81@siu.edu

- Retrognathia—the position of one of the jaws retrudes behind the normal position, often associated with class II malocclusion; may be the result of underdeveloped ramus but normal body
- Micrognathia—hypoplastic mandible, ramus, and body are underdeveloped, often associated with class II malocclusion
- Microgenia and Retrogenia—normal mandible with underdeveloped chin, retruded and deficient by palpation, may have class I occlusion
- Prognathia—the position of one of the jaws protrudes forward beyond a normal position
 - Mesognathic, straight profile, normal chin
 - Prognathism, large mandible

Anatomy

Arterial supply (external carotid system)

Maxillary artery → inferior alveolar artery → mental artery exits the mental foramen as the terminal branch providing blood supply to the anterior chin.

Facial artery → submental artery below the inferior border of the mandible; it travels superficial to the mylohyoid muscle supplying the submental region and inferior chin.

Facial artery → inferior labial artery above the inferior border of the mandible; this provides

blood supply to the lower lip. It has anastomotic connections with the superior labial artery.

Venous Outflow

Veins (inferior labial vein, submental vein) accompany the arterial blood supply and return to the facial vein, which in turn drains into the internal jugular vein.

Mental vein returns to inferior alveolar vein and drains into the pterygoid plexus. This eventually drains into the maxillary vein, which merges with the superficial temporal vein to form the retromandibular vein.

Innervations

Inferior alveolar nerve (branch of V3, trigeminal) divides into incisive and mental nerves; mental nerve exits the mental foramen and provides sensation to cutaneous lower lip and chin. The nerve runs below the tooth roots and exits at the level of the second premolar. The most medial location of the nerve as it travels through the mandible is at the external oblique ridge (area of the vertical section of a sagittal split osteotomy).

Marginal mandibular branch of facial nerve, CN VII supplies motor innervations to the muscles of the chin and lower lip.

Muscles

Mentalis muscle—originates from incisive fossa on the anterior mandible and inserts into soft tissues and skin of chin. Contraction raises the central chin and lower lip; protrudes lip, innervated by mandibular branch CN VII.

Transversus menti—lateral lower lip and chin musculature; considered to be superficial fibers of depressor anguli oris; muscle located laterally along chin, originates from mandibular oblique line and platysma; it inserts into orbicularis oris and risorius. Innervated by mandibular branch CN VII.

Platysma muscle—extends up from the neck over the inferior border of the mandible extending up onto the chin region, originates in skin of lower neck, and inserts into mandible and skin of the lower face.

Geniohyoid—originates from inferior mental spine on posterior surface of the symphysis and inserts into superior border of hyoid body, depresses mandible and elevates hyoid bone, innervated by C1.

Mylohyoid—originates on the lingual surface of mandible and inserts onto the superior border of the hyoid bone; it supports and raises the floor of mouth, innervated by CN V.

Physical Exam

The surgeon should begin any assessment by asking the patient to identify their concerns, especially concerns about symmetry, projection, and height of the lower face.

The physical exam should include evaluation of the occlusion, chin, labiomental crease, hyoid position, nose, lips, and facial proportions. Standard photography is critical.

Occlusion

Prior to committed evaluation of chin size and position, dental occlusion should be evaluated and occlusal class established. When assessing occlusion, observe for significant variation between the patient's centric occlusion and centric relation; occlusion should be assessed in centric relation with the condyle seated in the temporomandibular joint in the most superior position. Overbite is overlapping of the maxillary incisors in relation to the mandibular incisors. Normal overbite is around 3–5 mm or 25–30 % the height of the mandibular incisor. Overjet describes the horizontal (anterior–posterior) extent that the maxillary incisors projects beyond the mandibular incisors.

Angle's Classification (1899) Fig. 23.1

1. Class I is orthognathic, neutroclusion
 - (a) First molars contact normally; maxillary molar mesiobuccal cusp sits in mandibular molar buccal groove
2. Class II is retrognathic, distocclusion
 - (a) First mandibular molar is displaced posteriorly with respect to the first maxillary molar (cusp sits anteriorly to the groove). Maxillary canine is anterior to embrasure formed by mandibular first bicuspid and canine
3. Class III is prognathic, mesioclusion
 - (a) First mandibular molar is displaced anteriorly with respect to the first maxillary molar (cusp sits posteriorly to the groove)

Patients with malocclusion often have abnormal profile and an irregular chin position. Receding chin may be associated with class II; protruding chin may be related to class III occlusion. **Patients who have malocclusion should be evaluated and offered orthognathic surgery prior to consideration of genioplasty or mentoplasty.** Patients who do not want orthognathic surgery may be considered candidates for genioplasty or mentoplasty.

Chin

Chin abnormalities occur in 3 dimensions; therefore, assessment must include all three planes: vertical plane (frontal and lateral views), transverse plane (frontal view), and anteroposterior plane (lateral view). Most deformities occur in the anteroposterior plane Figs. 23.2 and 23.3 assessment and facial divisions.

There are multiple methods for assessing the horizontal projection of the chin:

- A vertical line perpendicular to the Frankfurt horizontal line dropped through the subnasale has consistent relationship with the upper and lower lip vermillion and the pogonion. Upper lip vermillion = 0 mm; Lower lip vermillion = -2 mm; soft tissue pogonion = -4 mm (Fig. 23.4).
- Steiner—line is placed tangential to the anterior projection of the upper and lower lip; the pogonion should be tangential to this line as well (Fig. 23.5).
- Ricketts—Line is placed tangent to the tip of the nose and pogonion; the upper lip is ~4 mm behind this line and the lower lip ~2 mm behind (Fig. 23.5).
- Burstone—a line is placed between the subnasale and pogonion; the upper lip extends ~3.5 mm beyond this line and the lower lip ~2.2 mm beyond this line (Fig. 23.5).

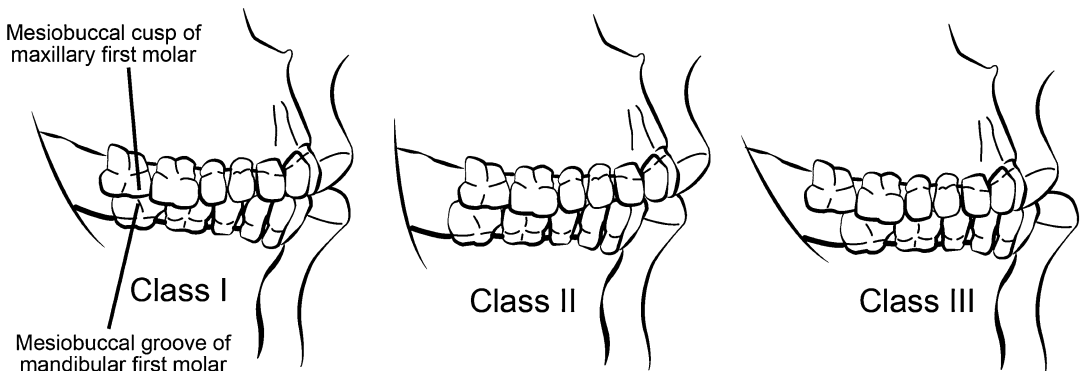


Fig. 23.1 Occlusal classes

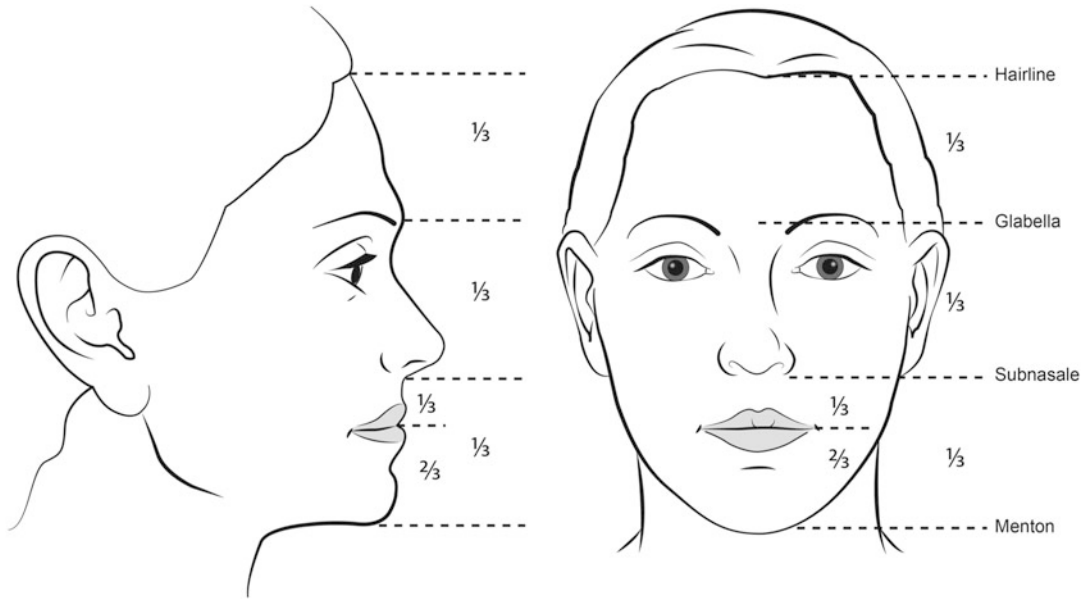
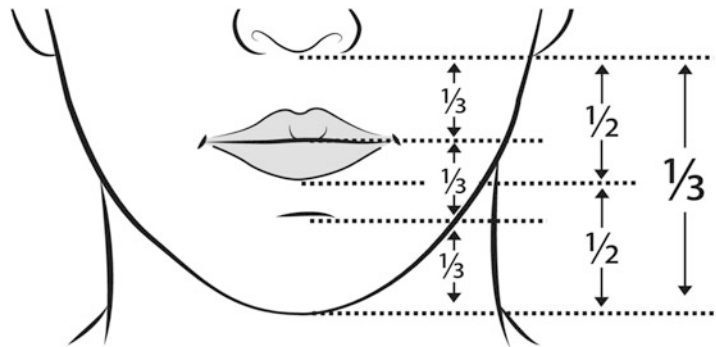


Fig. 23.2 Horizontal thirds of the face in anterior and lateral views

Fig. 23.3 Horizontal divisions of the lower third on anterior view



- Chin should ideally touch or be just behind a line from nasion perpendicular to the Frankfort line (also called the facial plane), tangent to the pogonion
- Alternatively, chin should approach line from the anterior lower lip perpendicular to the Frankfort line
- Another method is to draw an oblique line from the anterior aspects of the upper and lower lips, the chin should be at this line; the pogonion is tangent to the line

Methods of vertical analysis

- Golden Proportion
 - the ratio of upper lip to lower lip and chin equals 1:1.618; put another way, the upper lip is ~62 % the height of the lower lip and chin
- A simpler method is to approximate as the subnasale to stomion as equal to ~1/3 of the lower third of the face and stomion to menton is 2/3 of the lower third of the face

Fig. 23.4 Chin position.

Left, a line is dropped perpendicular to the Frankfort horizontal line through the subnasale where pogonion is ~4 mm behind line. *Right*, oblique line touching most anterior projection of upper and lower lips should lie in tangent to pogonion

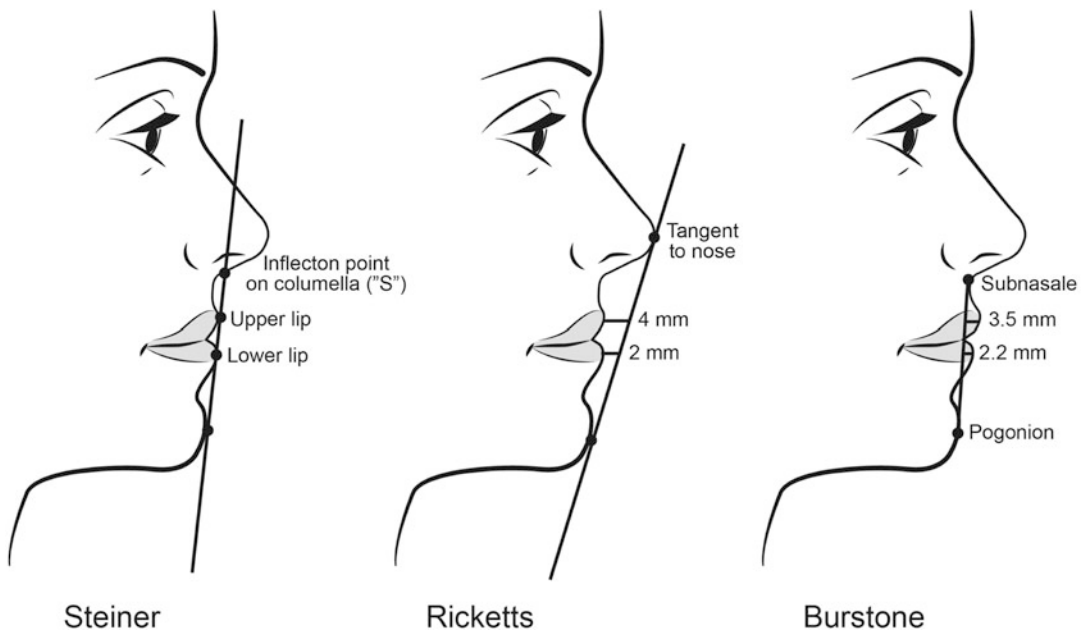
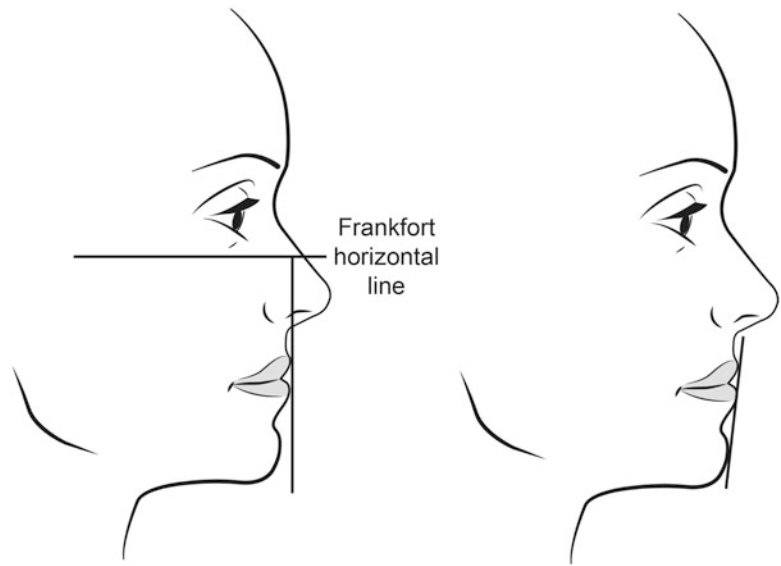


Fig. 23.5 Chin position. Steiner, Ricketts, and Burstone methods

- Powell and Humphreys method for ideal vertical facial-height dimensions
 - Lower third (subnasale to menton) should be 57 % of the lower two thirds (nasion to subnasale); therefore, the middle third should be 43 % of the lower two thirds.
 - Glabella to subnasale distance should equal the distance from subnasale to the menton

Recessive chin has three associated anatomic abnormalities:

- (a) Recessive procumbent lower lip
- (b) Deep labiomenal fold
- (c) Diminished to normal lower facial height

Labiomenal fold

The depth of the labiomenal fold should be carefully evaluated. Advancement and/or shortening of the mandibular symphysis results in deepening the labiomenal crease. Vertical lengthening results in effacement of the labiomenal crease. Therefore, patients with long lower faces and deep creases should be cautioned about mentoplasty. These patients are often better served with orthognathic surgery.

Lip

The ideal lip relationship is one in which the upper lip projection is 2 mm beyond the lower lip, and the lower lip projection is 2 mm beyond the chin. The position of the lower lip determines the degree of chin augmentation needed. Advancement beyond the lower lip leaves the patient with a distracting, artificial appearance; therefore, undercorrection is always preferred to overcorrection.

Nose

There is a balance relationship between the nose and chin. The size of one will influence the perceived appearance of the other. Nasal projection is the degree at which the nasal tip extends from the plane of the face. Pogonion projection normally extends to a vertical line dropped from the nasion through the lower lip (as mentioned above). The perception of nasal projection can be altered by adjusting chin position. Increased nasal projection would make the pogonion appear more posterior. Conversely, moving the pogonion anteriorly can reduce the perceived nasal projection.

Neck

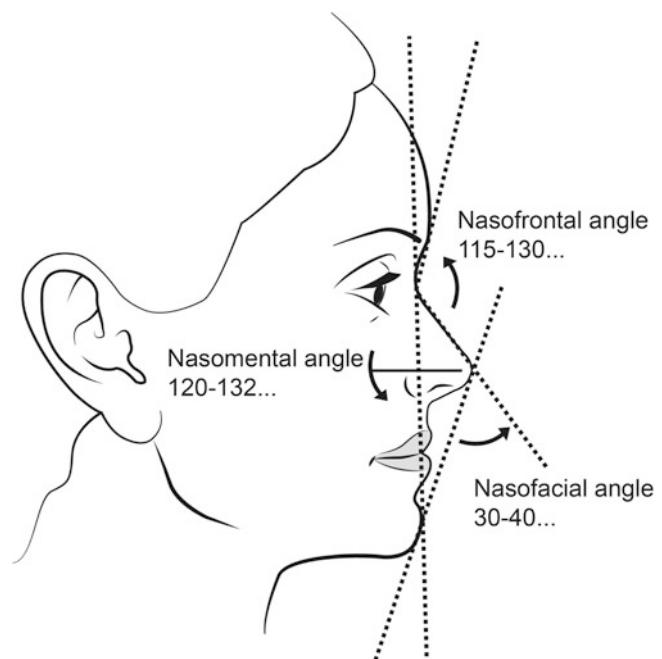
Neck anatomy can vary from skin excess only at the mildest. At the severe end, there may be a low and anterior hyoid, little to no chin projection, excess skin, and significant subcutaneous or subplatysmal fat. Evaluation includes hyoid position and the submental transition.

Mentocervical angle

- Ideal angle is 105–120° with head in Frankfurt horizontal plane

Powell and Humphrey's triangle (Fig. 23.6).

Fig. 23.6 Nasofrontal angle (defined by glabella-to-nasion line intersecting with nasion-to-tip line), nasofacial angle (defined by glabella-to-pogonion line intersecting with nasion-to-tip line), and nasomental angle (defined by nasion-to-tip line intersecting with tip-to-pogonion line) provide the boundaries of the aesthetic triangle of Powell and Humphreys



- Line from nasal tip to pogonion (“E” line) intersecting with a line from the cervical point (the innermost point between the submental area and neck) with the menton
- Should be 80–95°

Imaging: Lateral Cephalogram

Cephalometric assessment of maxillary and mandibular position assists in relating the position of the chin to that of the upper and lower jaws, and thus, occlusion. These should be obtained when patients are undergoing sliding genioplasty. Lateral cephalograms are taken with the patient facing the right.

Cephalometric Points: Fig. 23.7

- (n) nasion, most anterior point on fronto-nasal suture
- (s) sella, midpoint of sella turcica

- (a) point A: subspinale, position of deepest concavity on anterior profile of maxilla
- (b) pint b: supramentale, the most posterior point (position of deepest concavity on anterior profile of mandibular symphysis) in the outer contour of the mandibular alveolar process
- (Me) menton, the lowest most point on the mandible
- (Pg) pogonion, the most anterior point on the bony chin in the midline
- (Gn) gnathion, a point between the most anterior (Pg) and the most inferior (Me) on the chin
- (Go) Gonion, the midpoint at the angle of the mandible, the most posterior inferior point on angle of mandible

Common Reference Angles Fig. 23.8

- S-N-A: sella to nasion to subspinale angle: anteroposterior position of maxilla, 81° (+/–3), and mean of 82.
- S-N-B: sella to nasion to supramentale angle: anteroposterior position of maxilla, 79° (+/–3), mean of 80°

Fig. 23.7 Cephalogram points. Point A—subspinale or most concave point on maxilla, ANS— anterior nasal spine, Ar—articulare, Point B (not shown)—supramentale or most concave point on mandible, Cd—condyion (alternatively denoted Co), Gn—gnathion, Go—Gonion, Id—inferior prosthion Me—menton, N—nasion, Or—orbitale, P—porion, Pg—pogonion, PNS—posterior nasal spine, Pr—prosthion, S—Sellion

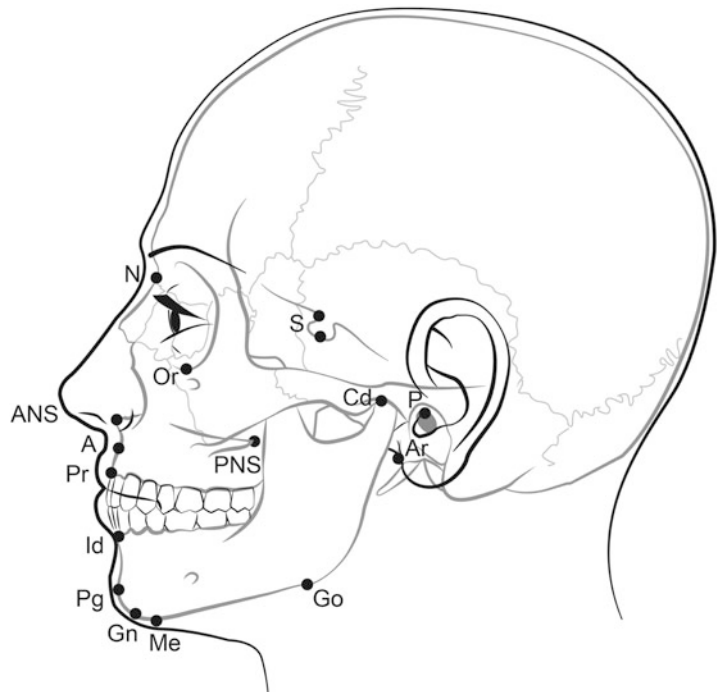
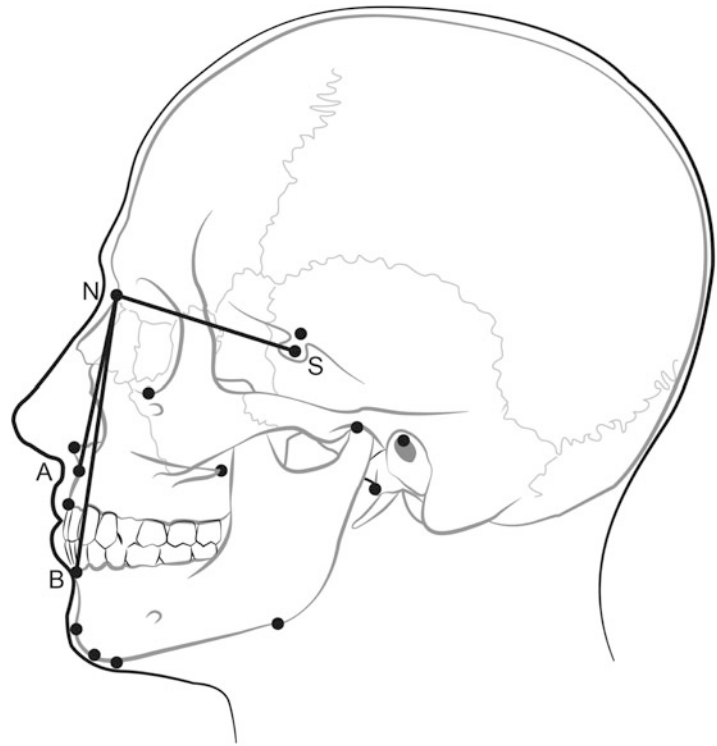


Fig. 23.8 Lateral cephalogram angles. SNA and SNB



- These angles provide information regarding the lateral relationship between the anterior skull base, maxilla, and mandible.
- A-N-B: difference between SNA and SNB
 - If greater than 4° , skeletal class II malocclusion
 - If greater than 4° and SNA is greater than normal, class II malocclusion is due to maxillary protrusion
 - If greater than 4° and SNA is less than normal, mandibular retrognathia is probable Fig. 23.9.

submental liposuction, correction of platysma banding, etc. The main disadvantage of this approach is committing the patient to a facial scar.

Transoral, vestibular incision—mucosal incision made inside the lower lip. The mentalis muscle is traversed and divided with deep dissection toward the bone. Incisions should extend laterally to the canine/cuspid region on both sides. Subperiosteal elevation is performed exposing the symphysis region but are maintained at the inferior border of the mandible. It is important to expose the mental foramen bilaterally in the region between the first and second premolar, at the level of the origin of the mentalis muscle. The foramen is located at the approximate vertical midpoint of the mandibular height. In the edentulous patient, the nerve may be located more superficially resulting from alveolar recession. The surgeon must ensure accurate reapproximation of the mentalis muscle to prevent lower lip malposition, dysfunction, and chin ptosis (witch's chin deformity).

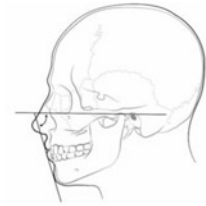
Surgery

Mentoplasty and genioplasty can be performed through an external or intraoral approach.

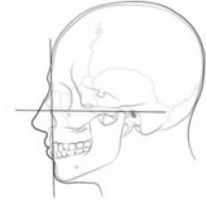
Submental—incision is placed just behind the submental crease. Dissection to the mandible enables subperiosteal placement of the implant without disturbing the mentalis. This approach also offers the surgeon the ability to perform adjunct neck procedures, for example,

Fig. 23.9 Assessment of chin position on lateral cephalogram

Merrifield's Z-angle
 Formed by a line from soft tissue chin (Po) tangent to most procumbent lip
 Z-angle should be 80 +/- 5 degrees



Gonzales-Ulloa-Steven's
 Line perpendicular to Frankfurt horizontal line passing through soft tissue nasion
 Chin should be tangent to this line



Ricketts law of lip relationships
 Line from tip of nose to chin
 Aesthetically pleasing profiles have upper lip 4mm behind and lower lip 2 mm behind



Holdeqay's H-line and H-angle
 Line tangent to the chin and upper lip that forms an angle with a line between the nasion and basion of 7-9 degrees



Zimmer's aesthetic plane
 Line from anterior nasal spine to Down's "B" point
 Nose, lips, and chin are almost identical in thickness to this plane
 Nose ratio of 5:1 to any other soft tissue structure



Reidel's plane
 Lips and chin generally fall on a straight line



Steiner's aesthetic plane
 Plane from middle of columella, midway between curve of upper lip and nasal tip
 Lips should fall on this line



Table 23.1 Alloplastic Implants

Implants	Advantages	Disadvantages
Silastic (most commonly used)	Essentially inert Firm Easily sculpted	Rare foreign body reaction and rejection Infection risk Bone resorption below implant Extrusion when superficial
Polytetrafluoroethylene (Gore-Tex)	Perforated implant Pore size 10–30 μm Some soft tissue ingrowth Less tendency for migration	Some tissue ingrowth
Polyethylene (Medpore)	Firmer implant Pore size 125–250 μm More extensive fibrous ingrowth	More soft tissue adherence Difficult to remove
Supramid (organopolymer related to nylon and Dacron)	Stable, reliable Infiltrated by host tissues Slightly more resistant to infection	Extrusion after infection Foreign body response Possible resorption Does not give firm support
Proplast (highly porous Teflon polymer and vitreous carbon fibers)	Tissue reactivity and ingrowth Firm Easy to shape	Less resistant to infection and extrusion

Mentoplasty

Alloplastic implants remain a popular technique for the correction of **mild–moderate microgenia and a shallow labiomentral fold**. This can be performed under local anesthesia as an office procedure or in the outpatient surgery setting. The surgical approach is often via the submental route; however, they may be placed via an intraoral approach.

Alloplastic implants can accomplish augmentation of the mandible and chin primarily in an **anteroposterior dimension**. It is important to ensure symmetric placement of implant in vertical plane and horizontal midline. Placement is usually performed subperiosteally, but supraperiosteal placement has been described. The implant is secured into position with sutures or screws (Table 23.1).

Disadvantages to mentoplasty include the inability to correct for asymmetries, vertical excess, the potential for infection/extrusion, and deepening of the labiomentral crease. In addition, porous implants can be difficult to remove and revise due to tissue ingrowth and capsule formation.

Genioplasty

Osseous genioplasty is the second most commonly performed osteotomy of the facial

skeleton for both reconstructive and aesthetic reasons (osteotomies in rhinoplasty being the first). While most agree alloplastic implantation is technically easier to perform with a low complication rate, osseous genioplasty remains a more versatile procedure, able to address deformities in all three dimensions.

The horizontal osteotomy is placed 4 mm below the mental foramen. If no vertical change is desired, the osteotomy is made parallel to the occlusal plane. This gives an anterior–posterior movement only. The osteotomy is carried as far posteriorly as possible to ensure a natural look with adequate skeletal volume advancement. Failure to complete the osteotomy at the lingual cortex may result in a mandibular fracture, nerve injury, irregular inferior mandibular border, and/or altered aesthetics. The upper limit of bony advancement is 8–10 mm; greater than this amount requires either stair-step osteotomies or release of muscular attachments. When advancing the chin, a horizontal movement up to 8 mm showing the **ratio of correlation from bone to soft tissue movements is roughly 1 to 0.9** (range of 1:0.6 to 1:1 in the literature).

Vertical changes can be achieved by angled osteotomies, interposition grafting, and wedge resections. Vertical augmentation of lower face height can be performed with an interposition

graft of autologous grafting material. Means of performing vertical reduction include wedge ostectomy of mandibular bone utilizing two parallel horizontal osteotomies. This is easiest when removed from the central segment. Unfortunately, reduction genioplasty is not as predictable as advancement genioplasty. The ratio of bone to soft tissue movement is typically 0.5 to 1.

Stabilization of the bony segment can be performed by various techniques including unicortical or bicortical wires, adaptation plates, prebent chin plates, lag screws, and absorbable plate materials.

The major disadvantage of this approach is the potential for unnatural bony contours, step-off deformities, or notching.

Distraction Genioplasty

Primarily useful when soft tissue envelope is tight making concern for restricted movement and high chance of relapse (i.e., Treacher-Collins syndrome and Nager syndrome) where class 1 occlusion is present. These maneuvers may improve upper aerodigestive tract caliber when facial sling advancement is combined with the distraction and brings the hyoid forward. Gradual lengthening allows the muscle and soft tissue to compensate mechanically followed by biologic creep during the active and consolidation phases.

Post-operative Care and Recovery

Pressure dressings are placed and used for 3–5 days postoperatively to minimize the formation of hematoma and assist with soft tissue reattachment after degloving. Patients are generally placed on a 1-week course of antibiotics postoperatively. Patients are followed for varying periods of time from 3 months to 1 year.

Complications

Complications are generally minor and can be avoided by appropriate patient selection and technical execution. The surgeon must take care

to avoid specific complications such as an infection, undesirable aesthetic outcome, tooth injury, nerve damage, and mandible fracture. Meticulous attention to sterile technique can minimize the majority of surgical infections and includes minimal handling of the implant, appropriate antibiotic coverage, appropriate oral hygiene, etc. Nerve damage can be avoided by intimate knowledge of the anatomy and attention to detail. Fortunately, the majority of neurosensory disturbances is temporary secondary to neuropraxia. If nerve transection occurs, immediate repair is indicated.

Undesirable aesthetic outcomes can be the result of a number of issues including soft tissue changes, asymmetries, malposition, or overcorrection. Chin ptosis results from inferior redistribution of the soft tissues of the chin. This leaves the appearance of redundancy of submental skin, flattening of the labiomental fold, excessive lower tooth display, and lip incompetence when severe. The cause is typically inadequate or failure of periosteal resuspension and mentalis closure and corrected with suspension. Preexisting or undiagnosed asymmetry may become more apparent after repositioning. Careful examination preoperatively and pointing out this to the patient is important, as postoperatively, the blame may be placed on the surgeon. Maintaining orientation intraoperatively with markings and measurements and immediate and careful inspection after placement of implants or movement minimizes the risk of iatrogenic asymmetry. Malposition can occur due to capsular contraction and movement; therefore, care is taken to fix the implant to the mandible. Overcorrection can be corrected by burring down excess bone or replacing the implant. Revision surgery should not be undertaken earlier than 6 months postoperatively.

Tooth injury can result from damage to the tooth roots or devitalized teeth from compromised pulpal blood flow. Therefore, it is recommended that osteotomies be placed 5 mm below tooth roots.

Mandibular complications can include non-union, malunion, avascular necrosis of mobilized

segments, bony resorption under the implant, and fractures. To minimize risk of necrosis, maintenance of a wide soft tissue pedicle with attached periosteum is important. Care is also taken to only expose the amount of bone necessary for augmentation. Bone deposition and osseous remodeling occurs in a somewhat consistent and predictable pattern. There is approximately ~10 % resorption rate of bone that is moved. Bony resorption with mentoplasty occurs under the implant with mean resorption volumes reported as 1.3 mm. The majority of the time this is of little cosmetic concern but, in cases of severe resorption, implant removal is recommended. Mandible fracture can occur with osseous genioplasty and is most commonly caused by an incomplete osteotomy through buccal and lingual cortices. The fracture occurs during the mobilization of the inferior segment and often extends through body, angle, or ramus.

This is managed by completion of the osteotomy, followed by open or closed reduction fracture management

Questions

- A patient interested in chin augmentation has class II occlusion and a retruded chin; this most fits with:
 - Retrogenia
 - Microgenia
 - Micrognathia
 - Prognathia
- Postoperatively, a patient who underwent genioplasty has lower lip incompetence and incisor show. This is prevented by:
 - Watertight closure
 - Limiting osseous advancement of < or = 10 mm
 - Resuspending the mentalis muscle in the midline
 - Preservation of the lateral mental neurovascular bundles
- In osseous genioplasty, the relationship between bone movement and soft tissue change is best represented as:
 - 1:0.5
 - 1:0.9
 - 1:1
 - 1:0.3
- Recessive chin is most often associated with all of the following EXCEPT:
 - Horizontal midline shift
 - Recessive procumbent lower lip
 - Deep labiomental fold
 - Diminished to normal lower facial height
- Preoperative evaluation of a patient for chin surgery. What radiographic study do you order?
 - Anteroposterior skull radiograph
 - Lateral cephalogram
 - Orthopantomograph
 - No radiologic tests are necessary
- A woman has a long chin and blunted labiomental fold. What is the best method to improve the aesthetics of her chin?
 - Mentoplasty with silastic implant and wafer
 - Sliding osseous genioplasty
 - Recontouring of the mentum by burring down
 - Acute-angle osteotomy genioplasty
- The relationship of the pogonion to the facial plane as dropped from the Frankfurt plane:
 - It is located at or just behind the facial plane
 - It is located 2–4 mm behind the facial plane
 - It is located 2–4 mm beyond the facial plane
 - It participates in the determination of the facial plane

Answers: 1. (c), 2. (c), 3. (b), 4. (a), 5. (b), 6. (d), 7. (a)

Recommended Reading

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