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Asian facial recontouring surgery

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Abstract

Most East Asian women prefer a smaller and smoother facial contour. To meet this aesthetic preference, the concept and surgical techniques of modern facial bone contouring surgery have evolved. Initially, facial bone contouring surgery was limited to procedures like mandibular angle and malar reductions. However, contemporary Asian facial bone contouring surgery now places a stronger emphasis on addressing the entire facial profile from a three-dimensional perspective, a concept referred to as Profiloplasty. In this article, we review the evolution of surgical techniques in Asian facial bone contouring surgery and present its current surgical concepts, particularly focusing on the three-dimensional aspects.

Keywords: Asian, bone contouring, profiloplasty, mandibuloplasty, malarplasty, genioplasty

INTRODUCTION

In some Asian cultures, a preference for a relatively smaller facial appearance is observed as a commonly held beauty ideal, often associated with concepts of femininity and adherence to prevalent societal beauty norms[1,2]. Over the years, Asian facial bone contouring surgery has evolved significantly to cater to the preferences of Asian women. Historically, the aim of facial bone contouring surgery in Asia was primarily to achieve a more Westernized look by reducing the size of the cheekbones, jawline, and chin. However, in modern times, there is a stronger emphasis on achieving a natural and harmonious appearance that

enhances the individual's unique features.

Contemporary Asian facial bone contouring surgery aims to create facial balance while preserving ethnic identity. It involves modifying facial skeletons to recreate the ideal facial contour. While facial analysis has mostly been carried out in a two-dimensional framework, the actual face is a complex three-dimensional structure composed of multiple planes. Similarly, the assessment of surgical outcomes in aesthetic facial bone surgery usually occurs in a two-dimensional context. Considering the inherently three-dimensional nature of the facial contour, surgeons must possess the ability to analyze and evaluate the face in three dimensions [Figure 1]. Therefore, planning for aesthetic facial bone surgery should incorporate a comprehensive three-dimensional perspective. This entails not only reducing the malar and mandible bones but also achieving facial profile balance across all three dimensions. Procedures like malarplasty and mandibuloplasty impact all three dimensions simultaneously [Figure 2].

The purpose of this study is to review the evolution of surgical techniques in Asian facial bone contouring surgery and present the latest surgical concepts with a focus on three-dimensional perspectives.

EVOLUTION OF ASIAN FACIAL BONE CONTOURING SURGERY

Traditional facial bone contouring surgery has a well-established history, primarily concentrating on reducing the prominence of the mandibular angle and the malar region. The introduction of the concept of correcting a prominent mandible by resecting the masseter muscle by Gurney *et al.* marked a pivotal shift in mandibular contouring surgery. This shift aimed at achieving a sharper and more slender face from an Asian perspective[1]. Further advancements and refinements of techniques have been accomplished in Asian patients, as a prominent mandible and a wide face are more frequently identified and perceived as aesthetically unfavorable traits within this ethnicity. Baek *et al.* introduced the concept of the "prominent mandible angle" to describe the angular resection technique. Since then, numerous improvements in mandibular contouring surgery have been made[2]. Most importantly, the scope of the surgery has shifted from solely addressing the angle region to encompassing the management of the body and chin regions[3-5]. Park *et al.* suggested performing tubercle resection simultaneously with anguloplasty to maximize the frontal effect[5]. Other surgeons have introduced combined management techniques involving the chin, body, and angle, such as narrowing genioplasty, sequential mandibuloplasty, external sagittal ramus osteotomy, and long-curved osteotomy of the mandible[6-13]. This trend reflects a shift in focus for mandibular contouring, moving from primarily maximizing the frontal effect to effectively managing the three-dimensional impression of the facial profile.

Asian malarplasty, initially reported in 1983 by Onizuka and colleagues, is founded on the technique of underpositioning the osteotomized zygoma via an intraoral approach. Subsequently, Baek and Lee introduced a malar reduction technique involving *in situ* transposition osteoplasty or the process of extracting, contouring *ex vivo*, and then implanting the malar complex[14]. Satoh and Watanabe reported the outcomes of tripod osteotomy and simultaneous fronto-periorbital lifting through a coronal approach in Japanese patients[15]. Cho reported a malarplasty technique by repositioning it medially and superoposteriorly based on either bicoronal or intraoral incision[16]. He favored reduction malarplasty with intraoral and preauricular incision, which had the advantages of a short operative time and simple procedure. Regarding the malarplasty technique, various operative approaches have been developed, including coronal, temporal, intraoral, and preauricular incisions. Surgical methods are classified based on the presence of bone removal and the shape of the osteotomy. Bone removal can be achieved through shaving or osteotomy, such as I-shaped, L-shaped, or C-shaped osteotomies[17-20]. In the systematic literature review, I-shaped osteotomy and L-shaped osteotomy have been the most frequently used methods of

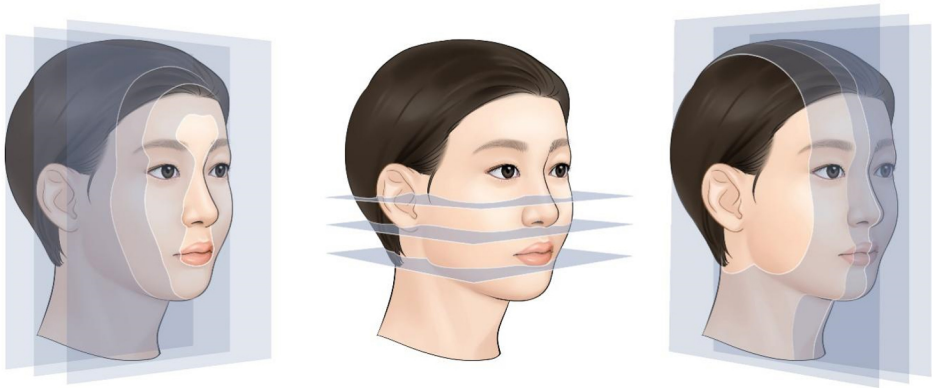

Figure 1. Three-dimensional perspectives in facial bone contouring surgery. Surgeons should assess the face in three-dimensional aspects based on multiple two-dimensional planes.

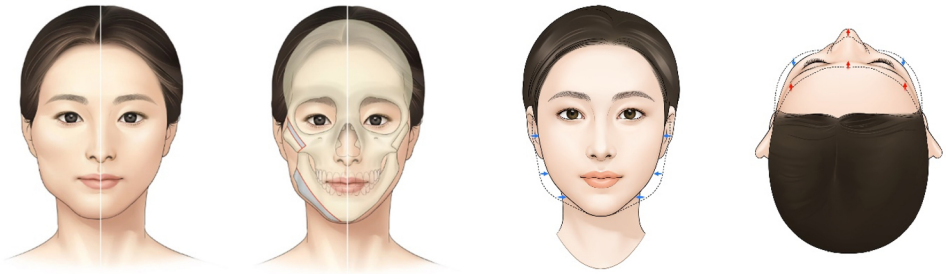

Figure 2. The object of Asian facial bone contouring is not just reducing the bony amount but refining the facial shape to a harmonious face in terms of three-dimensional contour.

reduction malarplasty[21]. Surgeons have favored the use of L-shaped osteotomy when a patient has both zygomatic body and arch protrusion[21]. If a patient has arch protrusion only, both osteotomies can meet the requirements. L-shaped osteotomy without bony resection has been reported to have the lowest incidence of postoperative complications.

PREOPERATIVE ASSESSMENT

The consultation process for facial contouring surgery involves a structured approach to gather relevant medical information, understand the patient's motivations, and assess their suitability for the procedure. A thorough facial evaluation is conducted, considering bone structure, soft tissue, and facial proportions. The surgical procedure, including potential risks and benefits, is explained using accurate medical terminology. A three-dimensional analysis is crucial to understanding the patient's facial contours fully. This involves evaluating the face from various angles and planes. Three-dimensional computed tomography scans are beneficial for preoperative assessment and surgical planning. Computer simulations may be employed to help the patient understand potential outcomes. Realistic expectations are set by discussing achievable improvements without making promises of specific results. The patient's questions and concerns are addressed, and informed consent is obtained. Financial aspects, scheduling, and postoperative care are discussed objectively, providing the patient with clear and accurate information. The consultation process aims to ensure the patient is well-informed, confident, and ready for the surgical process.

CURRENT CONCEPT OF ASIAN MANDIBULOPLASTY

The contemporary approach to Asian mandibuloplasty involves reshaping the mandibular contour to achieve a more balanced and aesthetically pleasing facial profile. This process is not limited to the isolated reduction of the mandibular angle but encompasses a comprehensive evaluation of the entire mandible, including the angle, body, and chin. The choice of method is influenced by factors such as the patient's facial anatomy, desired outcomes, and the surgeon's expertise, all of which contribute to a tailored approach.

Mandibular prominence occurs in both frontal and lateral profiles. From a frontal view, a prominent mandibular angle contributes to the masculine appearance of a square jaw, which can be a concern for female patients. In the lateral view, prognathism is characterized by an acute gonial angle and mandibular protrusion. However, the evaluation of the mandible should not be limited to the reduction of prominence in just these two profiles. Instead, the overall shape of the entire mandible should be considered in the context of the whole facial contour.

Ostectomy is divided into three different patterns [Figure 3]. One commonly employed technique combines a curved ostectomy with a narrowing genioplasty[22]. When angle reduction surgery focuses on the reduction of the posterior mandibular angle, it can often result in an increased gonial angle, leading to malposition of the gonial angle and an elongated chin shape. This issue can be addressed through oblique osteotomy involving the angle and body regions, along with a combined genioplasty. This method is suitable for individuals seeking a reduction in multiple aspects of their mandibular structure, including the angle, body, and chin. While effective in achieving harmonious contours, surgeons must exercise caution to prevent potential postoperative irregularities in the anterior body region, ensuring a smooth and natural appearance [Figure 4].

Another method, referred to as one-piece mandibuloplasty or long-curved osteotomy, is well-suited for patients with a prominent mandibular angle and a wider chin[13,23]. This technique allows for simultaneous reduction of both the angle and body without the need for additional procedures like reduction genioplasty. By treating the mandible as a cohesive unit, surgeons can create a more streamlined lower facial contour while maintaining structural integrity. This approach helps avoid excessive resection of ramus height and the need for reduction genioplasty, which would otherwise require additional horizontal osteotomy of the mandible. As a result, the surgical process is shortened and simplified [Figure 5].

Researchers have explored various devices for mandibuloplasty, including electrical saws, grinding devices, and manual osteotomes[6,24-27]. The focus has been on the posterior mandible due to limited visibility even after tissue retraction. The development of the cutting device has been focused on the posterior mandible, as this region is an area of limited visual access, even after the surrounding tissue is fully retracted. Traditional tools like oscillating saws have drawbacks, such as difficulty in cutting the mandibular angle accurately, potential for stepping deformities, and complications like condylar fractures[28,29]. In an attempt to overcome these limitations, certain studies have implemented various modifications. Park *et al.* introduced a technique involving the creation of multiple holes using burring along the anticipated osteotomy line before employing the oscillating saw[26]. This method appeared to be straightforward and beneficial in guiding the osteotomy with the oscillating saw. Other surgeons have proposed using the oscillating saw at different angles and lengths, guided by endoscopic visualization[6,27]. While this approach offers enhanced visualization, even for the posterior aspect of the mandibular angle, it necessitates a learning curve to achieve precise osteotomy under an endoscopic view rather than direct visualization.

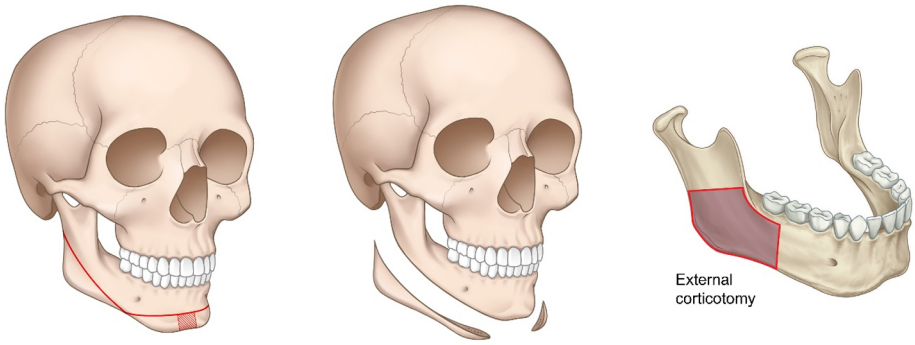

Figure 3. Current surgical techniques in mandibuloplasty. (A) Curved ostectomy accompanied by narrowing genioplasty; (B) One-piece mandibuloplasty, or Long-curved mandibular osteotomy; (C) External corticotomy.

A more intuitive option is the reciprocating saw, which allows precise osteotomy along a designed line with easy control of angle and depth. In contrast to the oscillating saw, the reciprocating saw's inherent intuitiveness empowers surgeons to achieve greater accuracy in performing osteotomies along predetermined lines. This method permits the osteotomy to be executed with fewer cycles of the device, initially cutting the outer cortex and subsequently progressing to the inner cortex in a sequential manner. Furthermore, this device can be modified into a desired shape to facilitate the cutting process[30]. By designing a twice-bent neck reciprocating saw, it can prevent the surgeon's hand from blocking the visual field while allowing the control of the saw angle from the bony surface in an ergonomic way.

Finally, ostectomy of the lateral cortex is often performed to narrow the bigonial distance in mandibles with lateral flaring in frontal view[31]. The mandibular angle ostectomy has the drawback of the ostectomy site appearing unnatural as the gonial angle becomes abnormally large. This can be improved by reducing the lateral cortex of the mandibular angle to achieve a more natural-looking mandibular angle[2]. This technique focuses on narrowing the bigonial distance to achieve facial balance. To avoid an unnatural-looking outcome, surgeons must carefully determine the extent of reduction, ensuring that the resulting angles align seamlessly with the patient's overall facial proportions. Whitaker suggested that lateral cortectomy with resection of the masseter muscle could reduce one side of the mandibular area by 5 to 6 mm. This reduction in masseter muscle volume could lead to a total reduction of the bigonial distance by 10 to 12 mm. However, more recently, it has been found that the volume of the masseter muscle can be reduced over time even without muscle resection following angle reduction[32,33].

CURRENT CONCEPT OF ASIAN MALARPLASTY

Over time, the field of malarplasty, a cosmetic surgery aimed at reshaping the cheek and midface area, has undergone significant changes in surgical techniques. Initially, the method of choice was bony shaving, as introduced by Onizuka *et al.*[34]. However, this technique was limited to mild cases of zygomatic body prominence and suffered from a high recurrence rate, leading to its decline in use. Local grind and file procedures were then employed, flattening the zygomatic process to create a broader appearance post-surgery, resulting in a more angular contour. Nevertheless, these approaches often led to postoperative relapses due to hyperosteogeny or periosteal proliferation. Additionally, issues like unnatural curvature, undercorrection, and asymmetry further restricted their popularity.

In contrast, modern malarplasty now strives for comprehensive three-dimensional repositioning of the malar bone, aiming to achieve lateral reduction, anteroposterior setback, and oblique displacement upwards

Figure 4. Clinical photographs and computed tomography scans in a patient who underwent angle and body osteotomy combined with narrowing genioplasty.

as needed. This paradigm shift has led to the development of various surgical methods, including simple reduction, setback, and rotational malarplasty, each targeting specific movement vectors.

Figure 5. Clinical photographs and computed tomography scans in a patient who underwent one-piece mandibuloplasty.

For instance, conventional zygomatic arch reduction suffices for cases where patients exhibit lateral zygomatic protrusion with noticeable arch prominence. However, individuals with prominent zygomas often present an anterior protruding component that necessitates not only simple arch reduction but also

posterior setback of the malar bone. In the present landscape, many Asian plastic surgeons lean toward employing linear osteotomy techniques without bony removal, while emphasizing the stability of the malar bone through plate fixations [Figure 6]. This approach allows for precise control over the degree of repositioning, leading to enhanced outcomes [Figure 7].

To extend beyond the limits of intraoral malar reduction, an intraoral infracture technique with incomplete osteotomy has emerged[16,35]. This innovative method involves infracturing the malar bone, thereby reducing the risk of postoperative soft-tissue ptosis and malar reunion. Furthermore, addressing the bony step in the malar area often necessitates careful burring to achieve a smoother contour. Successful implementation of this technique may require the use of secure zygomatic arch fixation to ensure the desired results[36]. Several authors highlighted the significance of rigid fixation in reduction malarplasty for the malar complex[36,37]. If fixation is inadequate or bone-to-bone contact is not precise, the masseter muscle's pull might cause inferolateral displacement of the malar complex, leading to malunion or nonunion. This can result in undesirable symptoms such as cheek drooping, malar depression, and trismus.

Another consideration that should be focused on is gender differences, which can significantly affect surgical techniques. A noticeable distinction exists in the anatomical structure of the zygoma between sexes, and this distinction has implications for malarplasty techniques. Nagasao *et al.* found that the summit of the zygoma (the most protruding part) is positioned higher in male patients compared to female patients in terms of inferosuperior position[38]. This anatomical difference is attributed to the greater masticatory forces in males, resulting in thicker zygomas. The authors suggested that this difference should be taken into account when designing bone incision lines for reduction malarplasty procedures. Consequently, bone incision lines should be placed higher in male patients than in female patients to achieve optimal outcomes in reduction malarplasty.

Reduction malarplasty, while providing aesthetic enhancements, can entail several potential complications. The systematic review and meta-analysis discussed in the provided article shed light on various complications associated with reduction malarplasty. Transient sensory weakness was the most frequently observed postoperative complication, with a rate of 5.8%. This complication could be attributed to excessive traction during surgery or neuropraxia of sensory nerves, such as the infraorbital and zygomaticofacial nerves, during dissection. While these symptoms tend to improve over time, they can be distressing for patients during the initial recovery period. Another significant complication mentioned in the article is soft tissue drooping, occurring at a rate of 2.8%. This complication involves the downward sagging of facial soft tissue, particularly around the cheekbone and lower facial area. It often requires corrective procedures such as facelift surgeries to address the aesthetic concern. Additionally, asymmetry was identified as a complication, with a rate of 1.8%, possibly resulting from undercorrection or overcorrection during surgery. Although the actual rate may be higher due to underreported cases, addressing asymmetry remains a concern in reduction malarplasty.

In summary, the evolution of malarplasty techniques has witnessed a transformative shift from a unidimensional reduction approach to a multidimensional repositioning strategy. This progress has given rise to a range of surgical options that cater to specific anatomical variations and patient needs. Surgeons now have the ability to tailor their approach, combining methods such as zygomatic arch reduction, setback, and infracture to achieve balanced and harmonious facial contours. As surgical techniques continue to evolve, malarplasty is poised to offer even more refined and personalized outcomes for individuals seeking facial enhancement.

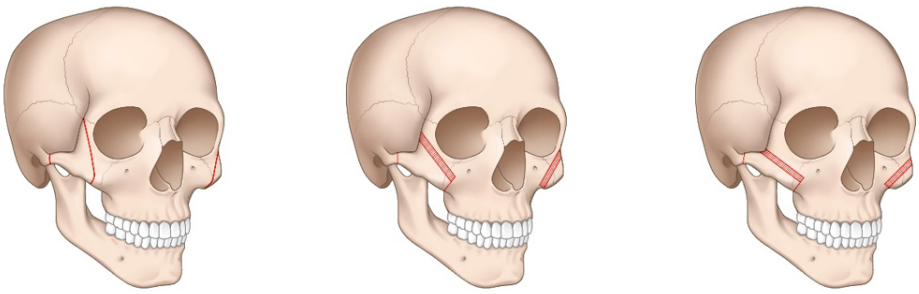

Figure 6. Current surgical techniques in malarplasty. Based on the movement vector, the osteotomy line onto the body of the malar bone can be modified. (A) Vertically based malarplasty; (B) Obliquely based malarplasty; (C) Horizontally based malarplasty.

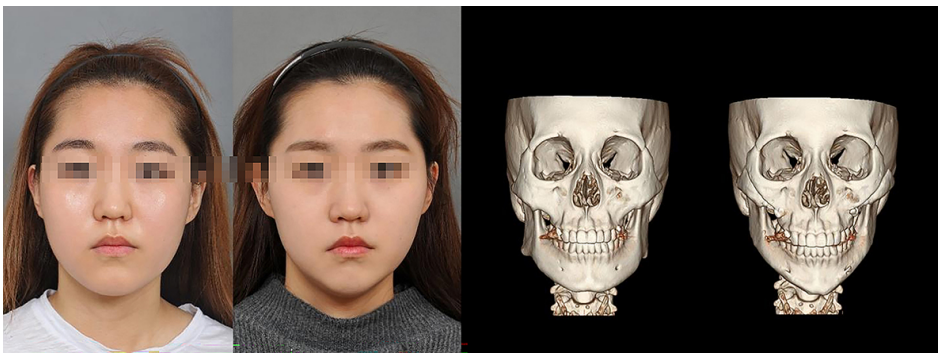

Figure 7. Clinical photographs and computed tomography scans in a patient who underwent L-shaped malar osteotomy with an oblique direction, and medial reposition of the zygomatic body.

CURRENT CONCEPT OF ASIAN GENIOPLASTY

The evolution of genioplasty techniques has been driven by the pursuit of achieving desired facial aesthetics, particularly in the context of East Asian facial bone contouring. Historically, methods aimed at rectifying square and elongated chin contours often involved mandibular angle resection or reduction. However, a shift towards creating a harmonious and smooth overall curve from the chin to the mandible's inferior margin has led to the development of more refined techniques.

Literature has highlighted that solely resecting the mandible does not always achieve the desired slender appearance due to factors such as a wide, flat chin and U-shaped lower facial morphology[5,39,40]. Surgical interventions targeting the central chin area have emerged to address these concerns. The horizontal osteotomy and central segment resection method, introduced by Park *et al.*, presents a significant advancement[39]. This approach involves horizontal osteotomy and resection of the central segment, effectively reducing chin width and promoting a more ovular shape. The extent of resection in the central segment is determined preoperatively, accounting for the chin's width and patient preferences. Post-osteotomy, the two segments are aligned centrally and stabilized using microplates and screws. Adjustments can be made to project these segments anteriorly as required, effectively refining the chin's profile from a lateral perspective. Despite its popularity, this method might not sufficiently address vertical length issues associated with elongated chins [Figure 8].

One novel approach involves an inverted V-shaped osteotomy[40]. This technique not only reduces chin width but also contributes to vertical length adjustment without additional bony segment resection. Unlike

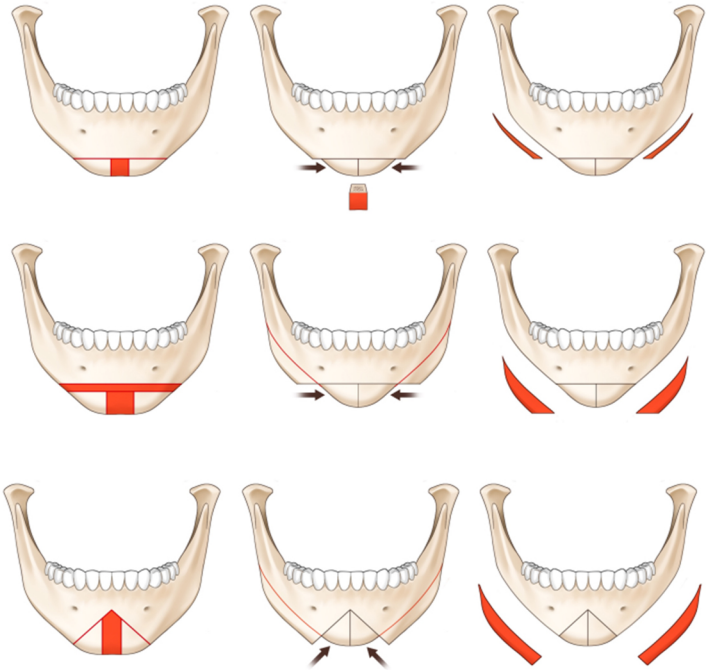

Figure 8. Various surgical techniques in narrowing and reduction genioplasty. (A) The horizontal osteotomy and central segment resection method; (B) The horizontal osteotomy and central segment resection method with additional horizontal bony segment resection to shorten the length; (C) The inverted V-shaped osteotomy with central segment resection

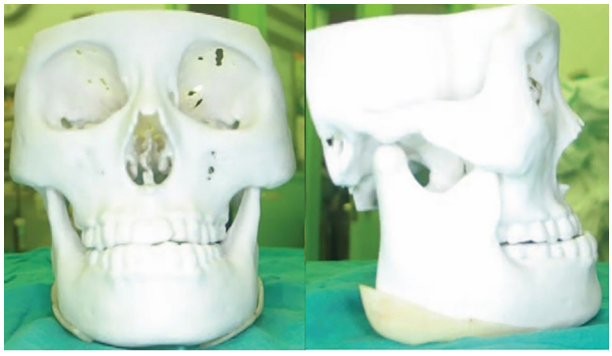

Figure 9. 3D-printed surgical guide for mandibular osteotomy.

traditional horizontal osteotomy techniques, which involve cutting the bone horizontally and then vertically to reposition the central segment, the inverted V-shaped osteotomy employs an osteotomy line that resembles an upside-down "V" shape and preserves genial musculature while achieving greater width reduction through the central segment's repositioning. This technique offers a comprehensive approach to genioplasty, addressing multiple aspects of chin contouring while minimizing the risk of complications [Figure 8].

BONE CONTOURING COMBINED WITH ORTHOGNATHIC SURGERY

Bone contouring combined with orthognathic surgery aims to harmonize facial proportions and refine facial features in a single operation[41]. In certain cases, particularly among individuals with class III malocclusion, there is a consideration for performing facial contouring procedures alongside orthognathic

surgery in Asian populations. This is due to the distinctive facial characteristics often observed in these patients. In class III malocclusion, where the lower jaw projects forward, the lower face can appear both long and wide compared to other facial features. Similarly, individuals with low-angle prognathism may have a shorter face, but the lower face can still appear wide. Moreover, if maxillary excess is present and corrected through maxillary shortening, the lower face might seem relatively wider postoperatively.

During the surgery, sagittal split ramus osteotomy is often employed to reposition the mandibular segments for improved occlusion and facial balance. In cases where facial width and mandibular prominence need adjustment, techniques like mandible contouring are incorporated. This involves reshaping the mandibular angle, body, and chin to create a more slender lower face.

POSTOPERATIVE MANAGEMENT

After the surgery, JP drains were kept in place for a few days to prevent the formation of hematomas. A 5-day postoperative course of oral antibiotics is necessary. Elastic bandages were employed for a duration of 4 weeks following the surgery to facilitate the adjustment of soft tissues to the new skeletal structure.

EMERGING TECHNIQUES IN ASIAN FACIAL BONE CONTOURING

The recent advancements in computer simulation techniques allow surgeons to develop a preoperative plan for facial bone contouring and perform simulation surgeries that can produce accurate execution of the actual procedure[42,43]. The CAD/CAM technology enables efficient simulation and validation of surgical procedures before surgery. A 3D-printed surgical guide for osteotomy can serve as a bridge between simulation and actual surgery. It is especially helpful when the osteotomy line is less visible and accessible in the posterior part, thereby facilitating the surgical process and shortening the operation time [Figure 9].

The process of using CAD/CAM techniques involves several steps. Computed tomograms (CT) of the patient's mandible are taken preoperatively and reconstructed into 3D images using specialized software. Virtual surgery is performed using a method that aims to maintain facial symmetry and avoid damage to the inferior alveolar nerve. An osteotomy guide, designed to fit over the occlusal surfaces of the teeth, is created based on the 3D images generated from the virtual surgery's osteotomy design. Once the guide is manufactured, it undergoes sterilization with ethylene oxide gas before the actual surgical procedure.

CONCLUSION

Asian facial bone contouring surgery has evolved from localized mandibular angle and malar reduction to addressing the entire facial profile from a three-dimensional perspective. Successful mandibuloplasty can be achieved through the comprehensive reshaping of the entire mandibular contour, including the angle, chin, and body, using a one-piece osteotomy. Contemporary malarplasty can reposition the malar bone to the desired location with simple reduction, setback, or rotational movement. Surgeons specializing in Asian facial bone contouring should aim to discover a more aesthetically pleasing and precise approach to meet each patient's individual needs and desired outcomes.

DECLARATIONS

Authors' contributions

Made substantial contributions to the writing and editing of this review: Choi JW, Kim YC

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None.

Conflicts of interest
All authors declared that there are no conflicts of interest.

Ethical approval and consent to participate
Not applicable. Consent to participate was obtained from each patient.

Consent for publication
All participants provided written consent for their information to be used in this study.

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