Correction of zygoma and zygomatic arch protrusion in East Asian individuals

Tao Chen, DDS, Yuchun Hsu, DDS, Jihua Li, MD, PhD, Jing Hu, MD, Ashish Khadka, DDS, Qiushi Wang, DDS, and Dazhang Wang, MD, Chengdu, China
SICHUAN UNIVERSITY

Objective. Prominent zygoma is commonly seen in the East Asian population with the clinical characteristics of anteriorly and/or laterally projected zygoma and zygomatic arch resulting in an increased midfacial width. The esthetic surgical modification of zygoma is one of the major aspects of facial-contouring surgery in certain parts of the world. This article aims to evaluate the effectiveness of various surgical methods for reducing the prominent zygoma so as to obtain a harmonious and natural facial contour.

Methods. Surgical approaches, such as zygomatic complex shaving, I-shaped osteotomy, L-shaped osteotomy, and C-shaped osteotomy were used according to the clinical characteristics of zygoma and zygomatic arch protrusion. The corrective effectiveness was then evaluated through cephalometric radiographs, 3D-CT, and pre- and postsurgical standard facial photographs.

Results. The zygoma and zygomatic arch protrusion was effectively corrected resulting in improved facial contours in all cases postoperatively. The postoperative period was uneventful except for the slight limitation in mouth opening, which recovered fully after mouth-opening exercises. Serious complications, such as facial nerve injury, were not witnessed in our study.

Conclusions. Malar reduction is an effective and a safe method for the treatment of prominent zygoma. The selection of surgical procedure should be based on different presenting characteristics of zygoma and zygomatic arch protrusion. The correction of prominent zygoma should be designed well, performed precisely, and observed carefully to avoid severe complications so as to achieve a harmonious facial contour. (Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011;112:307-314)

The shape and projection of zygoma, which influences the width of the middle face, plays an important role in determining the midfacial contour. High cheekbones characterize the appearance of the East Asian population, especially those of Chinese, Korean, and Japanese descent. In the West, such features are valued, and these areas are frequently enhanced for optimal esthetic appearance. However, because of the more delicate topography of a typical Asian face, zygomas and zygomatic arches that are overly prominent upset the balance, rendering the face overly rough, aggressive, and masculine. Likewise, as the facial soft tissue shrinks, there is a depression of the temporal area and cheek resulting in increased protrusion of the zygoma and zygomatic arch. For these reasons, in an East Asian population, especially among young women, cosmetic surgery for correction of such unesthetic facial profiles using various modalities has been on the rise. Thus, corrective surgery for zygoma and zygomatic arch protrusion plays an important part in esthetic surgery of facial contouring in East Asian patients. The correction of malar-zygomatic protrusion, also known as reduction malarplasty, is a part of facial-contouring esthetic surgery. The most common methods include the zygomatic complex shaving and zygomatic osteotomy with complex shifting, which includes the I-shaped osteotomy, L-shaped osteotomy, or C-shaped osteotomy. This article aims to compare the correction techniques, select the indications, and formulate the best treatment for reducing the prominent zygoma so as to obtain a harmonious and natural facial contour and provide reasonable, safe, and effective references to clinical plastic surgery projects.

PATIENTS AND METHODS

A total of 38 cases ranging in age from 20 to 41 years, presenting with zygoma and zygomatic arch protrusion with or without bilateral symmetry were included in the study. All the patients in the study were females. Patients who could not tolerate the operation were excluded. Likewise, patients who presented with acute and/or chronic diseases or with psychological and
mental illness or abnormal esthetic concepts were also excluded from the study.

The patients were further divided into small groups as per their facial characteristics: A, antero-lateral protrusion of zygomaticofacial area; B, wide zygomatic arch and lateral protrusion of the zygomatic body without prominence; C, protrusion of both the zygomatic body and the arch, especially serious protrusion of the anterior part of the zygomatic arch; D, prominent zygomatic complex, protrusion of both the zygomatic body and the arch, involving the lateral orbital margin and the infraorbital margin. Based on the presenting facial features, the surgical technique was likewise selected. Simple protrusion of zygoma was treated by a zygomatic shaving procedure. An osteotomy was performed depending on the severity of the protrusion of zygomatic bone and the arch. A wide zygomatic arch with lateral protrusion of the zygomatic body but without prominence was corrected by I-shaped ostectomy. Likewise, protrusion of both the zygomatic body and the arch, especially serious protrusion of the anterior part of the zygomatic arch was treated by L-shaped osteotomy. If there was involvement of the lateral orbital margin and the infraorbital margin, then a C-shaped osteotomy was selected. The distribution of the patients and the operative method selected is shown in Table 1. Some of the patients also had masseter muscle hypertrophy and a square face. The aim was to modify and recontour the protrusion to satisfy the esthetic requirements of the patients. Comprehensive communication was done with the patients to comprehend the patients’ demands and requirements. Along with this, different facial features, the degree of severity, and location of the protrusion were taken into consideration when selecting the surgical methods so as to achieve a natural and harmonious facial contour and fulfill the esthetic needs of the patient.

Operative Technique

All procedures were performed under general anesthesia using naso-tracheal intubation. Four different operative methods were performed depending on the clinical characteristics of zygoma and zygomatic arch protrusion, which are listed as follows:

- **Zygoma shaving procedure**: The zygoma is approached through an intraoral incision at the buccal sulcus adjacent to upper premolars and molars. The entire zygomatic body and arch is exposed and the dissection is carried out subperiosteally. The most prominent portion of the zygoma, including part of the zygomatic arch, is shaved using a broad chisel or a bone bur. While shaving the outer cortex, care should be taken to avoid shaving off the alveolar bone or exposing the maxillary sinus. Likewise, extra attention should be paid to protect the facial nerve, infraorbital nerve, and the associated blood vessels (Fig. 1).

- **I-shaped osteotomy**: The zygoma is approached via an intraoral incision as mentioned in the zygomatic shaving procedure; however, care should be taken not to dissect the periosteum on the outer side of the zygoma. Using a reciprocating saw, 2 parallel cuts are made on the zygomatic body from inner cortex toward the outer cortex resembling an I shape. The amount of bone to be resected between the 2 parallel

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<thead>
<tr>
<th>Clinical characteristics</th>
<th>No. of patients</th>
<th>Operative method</th>
<th>Degree of satisfaction</th>
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<tr>
<td>A</td>
<td>11</td>
<td>I</td>
<td>Very satisfied 5</td>
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<tr>
<td>B</td>
<td>7</td>
<td>II</td>
<td>Satisfied 5</td>
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<tr>
<td>C</td>
<td>13</td>
<td>III</td>
<td>Not satisfied 8</td>
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<tr>
<td>D</td>
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A, antero-lateral protrusion of zygomaticofacial area; B, wide zygomatic arch and lateral protrusion of the zygomatic body without prominence; C, protrusion of both the zygomatic body and the arch, especially serious protrusion of the anterior part of the zygomatic arch; D, prominent zygomatic complex, protrusion of both the zygomatic body and the arch, involving the lateral orbital margin and the infraorbital margin.

Fig. 1. Illustration of zygomatic shaving procedure. Note the shaving area involved the zygoma and the anterior part of zygomatic arch.
lines is per preoperative design. Posteriorly, a small incision is made in the preauricular region, and through this incision, a reciprocating saw is used in a similar manner (from inner surface to outer surface) to osteotomize the root of the zygomatic arch. Then, the zygoma and the zygomatic arch complex are displaced antero-medially resulting in a small step off with the size corresponding to the extent of narrowing of the zygomatic arch. The cut segment is then fixed with the help of screws (Fig. 2).

- **L-shaped osteotomy**: The intraoral incision is same as in the I-shaped osteotomy but slightly longer. The dissection is carried out subperiosteally, especially in the area of the body of the zygomatic bone. A small incision is made at the same time in the preauricular region for osteotomy of the zygomatic arch. An L-shaped osteotomy line is formed by 1 oblique and 2 vertical lines meeting at right angles resulting in a small step off with the size corresponding to the extent of narrowing of the zygomatic arch. The cut segment is then fixed with the help of screws (Fig. 2).

- **C-shaped osteotomy**: The procedure is as same as for L-shaped osteotomy. The main difference is in the oblique part of the osteotomy line; the oblique line is moved more toward the external orbital rims than in the L-shaped osteotomy and consists of 2 parallel lines unlike just 1 in an L-shaped osteotomy. The distance between each of these parallel lines is governed by the preoperative design and the amount of reduction required. The oblique line near to the orbital rims is more vertical than in the L-shaped osteotomy, extending more toward the external orbital rims, and the point where the 2 oblique lines meet lies at the area of protrusion of the zygoma just parallel to and above this first line, which is followed by complete osteotomy in both the lines. Using a reciprocating saw, an oblique line is drawn from the 2 vertical lines at right angles superiorty, parallelleing the lower border of the zygomatic body and approximating the lateral orbital margin. A thin osteotome is then used to complete the osteotomy. An osteotomy on the zygomatic arch is then performed and the entire zygomatic segment is mobilized. The complex is then fixed in intended position using screws (Fig. 3).
above the maxillary sinus. A reciprocating saw is used for osteotomizing the zygomatic arch and after the planned reduction, the rigid internal fixation is done using screws on the zygomatic body and/or zygomaticomaxillary buttress (Fig. 4).

After watertight closure using sutures, the zygomatic area was covered with a pressure dressing using a bulky sponge. Negative pressure drainage was applied. Systemic antibiotics were given before and during surgery and for 3 to 5 days afterward. The patients were told to limit their mandibular movement for 3 days and were kept on a soft diet for 3 weeks after the procedure.

RESULTS

All cases showed satisfactory healing with no signs of infection, and were discharged after a week of hospital stay. Follow-up at 6 to 24 months showed slight limitation of mouth opening, which recovered fully after mouth-opening exercises, but there were no other serious complications, such as facial paralysis. All patients were satisfied with the cosmetic results with effective correction of zygoma and zygomatic arch protrusion both subjectively and objectively. The prominent zygoma achieved natural and harmonious facial contour postoperatively. When comparing preoperative and postoperative standard facial photographs, cephalometric radiographs, and/or 3D-CT, data showed that the projected zygoma was reduced and the distance between zygomatic arches was also noticeably narrowed. The results are shown in the Table I.

CASE REPORT

Clinical Case 1

A 31-year-old woman with overly high zygomatic process reported to our department for correction. After necessary preoperative preparation, an intraoral shaving of the zygomatic body was performed. In subsequent visit 12 months after the operation, the projected zygoma was reduced and a better soft facial contour was achieved (Fig. 5).

Clinical Case 2

A 39-year-old woman visited our department complaining of a diamond shaped face with overly wide zygomatic arch. After preoperative evaluations, an L-shaped malar osteotomy and repositioning through an intraoral incision were performed. At the 12-month follow-up visit, the wide zygomatic arch was narrowed notably and the patient was satisfied with the postoperative facial contour (Fig. 6).
Clinical Case 3
A 27-year-old woman with a diamond-shaped face and zygoma and zygomatic arch protrusion visited our department to attain an attractive profile. Detailed preoperative evaluation and planning was made so that both surgeon and patient had mutual understanding and agreement regarding the treatment procedure. An intraoral L-shaped malar osteotomy and repositioning were performed. In subsequent visit 12 months after the operation, protrusion of the zygoma and the anterior part of the zygomatic arch had corrected massively, and the diamond-shaped face had become natural and harmonious (Fig. 7).

Clinical Case 4
A 41-year-old woman visited our department complaining of the zygoma and zygomatic arch protrusion and a square face. After preoperative preparation, an intraoral C-shaped malar osteotomy and repositioning were performed with mandibular lower border ostectomy, combined with mandibular outer cortex splitting ostectomy under general anesthesia. In subsequent visit 12 months after the operation, the patient’s midface and lower face had become slender oval with appropriate facial proportion and natural contour without limitation of mouth opening or facial paralysis (Fig. 8).

DISCUSSION
Because of the difference in race, region, culture, and aesthetic trends, the standards of prominent malar complex vary. Generally speaking, Asian individuals are mesocephalic, whereas whites are dolichocephalic; the face is wider and shorter in the former than in the latter. An even greater prominence of the zygoma among Asian individuals, which causes the face to be wider and shorter, is widely regarded as an unattractive feature in the Asian culture. In Western cultures, facial skeletal contouring mostly involves augmentation, whereas skeletal reduction is most often performed in Asian societies. Facial skeletal augmentation surgery with alloplastic implants is commonly performed in the West where it is generally preferred to have well-defined and sharply accentuated facial contours. On the contrary, various operative techniques for facial skeletal reduction surgery have been developed, and are frequently performed in Asia where most people perceive a square face as masculine and rough.
The improvement in surgical instruments and increase in surgical experience has led to the development of many techniques independently by several authors. In 1982, Onizuka et al. first reported an intraoral approach to shave the malar complex. In 1991, Baek et al. described techniques for malar reduction involving a coronal approach; however, this free graft technique is now abandoned because of external scar- ring and the possibility of facial nerve injury. Later in 1997, Sumiya et al.7 advocated another malar reduction technique known as I-type osteotomy. The technique is derived from the widely performed osteotomy augmentation plasty of the zygoma and zygomatic arch among whites individuals, which included osteotomy of the zygoma, insertion of a bone graft, and fixation of the graft on the recipient bone. Kim and Seul and colleagues described a modified technique of reduction malarplasty through an intraoral incision separately in 2000, which is the L-shaped osteotomy. Later, our group advocated the C-shaped osteotomy based on principles of L-shaped osteotomy. This requires a high degree of surgical skill, as the bone cut should not only avoid the internal infracture of the maxillary sinus, but at the same time should provide larger range of movement of the osteotomized segments.

One surgical method is not suitable for surgical improvement of the facial contour in all cases of prominent zygoma and zygomatic arch. The prominence of the malar area varies according to differences in the inherent bony structure. To achieve a harmonious and natural facial contour, the whole face should be regarded as 1 U. Thus, zygomatic complex contouring operations should be conducted with a view of treating the entire disproportional face and not just focusing on the zygomatic region. Therefore, for those who have square faces, simultaneous reduction of the mandibular angle should also be done to create an oval-shaped face, as reduction malarplasty alone causes an imbalance in the facial shape with the remaining mandibular angles appearing more prominent after the procedure.

With the advent of better technologies, newer methods have been put forth and various classifications have been proposed. Treatments based on those classifications have been formulated, and it is imperative that patients fulfill the standards presented in those classifications so as to corroborate with the specific type of treatment proposed. However, patients with prominent zygoma come with a multitude of facial features, which makes it difficult to categorize them as per the classifications and types stated. The authors have listed the current techniques for reshaping the prominent zygoma and their indications in the following paragraphs.

**Zygoma shaving procedure**

Indication: antero-lateral protrusion of zygomatico-facial area, such as mild prominence of zygomatic body and the anterior part of the zygomatic arch. This procedure is still widely applied, as the procedure is less complex and the skills are easy to master; however, the drawbacks of this procedure are obvious. Zygomatic bone and zygomatic arch are flat bones, and overshaving increases the possibility of postoperative fracture. Furthermore, the chance of midfacial asymmetry increases after the procedure because of difficulties of comparing bilateral symmetry as well as calculating the quantity of shaving during the procedure. Additionally, patients with an apparently wide malar area (especially the zygomatic arch) are not ideal candidates for this procedure, because the amount of shaving that can be performed is limited.

**I-shaped osteotomy**

Indication: wide zygomatic arch and lateral protrusion of the zygomatic body without prominence. This is mainly used for narrowing the bilateral overly wide zygomatic arches and reducing the anterior protrusion.
of the zygomatic body at the same time. It can effectively reduce the zygomatic complex, and make the zygoma and zygomatic arch small resulting in narrowed facial contour. The posterior segment is anteromedially displaced, impacted underneath the anterior segment. There is a small step off, of around 3 mm; however, if there is large step off, and if the soft tissue cannot completely mask the step defect, then the junction between the zygomatic bone and the arch will have a ladderlike appearance resulting in patient complaints postoperatively. Likewise, if the posterior segment is pushed too far inside, it can encroach upon the space needed for movement of the coronoid process, limiting its movement and ultimately limiting the mouth opening. Beyond that, many patients undergoing I-shaped osteotomy have complained of soft tissue sagging postoperatively. Thus, to avoid this sagging the overlying muscle attachment and the periosteum should be kept intact as far as possible. Here in our facility, the osteotomy is not carried out from the external surface of the zygomatic complex but from the internal surface, as this helps to avoid the unnecessary stripping of the muscle and the periosteum and ultimately prevents postoperative sagging. Moreover, after the osteotomy, the segments should be fixed with screws. The fixation should be strong enough to resist the pull on the posterior cut segment during mastication, which is another key point to prevent the sagging of soft tissues. As the zygomatic arch is a bony archlike structure, even if it is cut at both ends, the arched shape does not change. After surgery, there will still be bulging of the most prominent part of the zygomatic arch.

**L-shaped osteotomy**

Indication: protrusion of both the zygomatic body and the arch, especially suitable for patients with serious protrusion of the anterior part of the zygomatic arch. The L-shaped osteotomy of the zygomatic body corrects the protrusion of the zygoma and the anterior part of the zygomatic arch, and maintains the natural shape of the malar protrusion; however, it does not change the curvature of the zygomatic arch and width of the posterior part of the zygomatic arch. The zygomatic arch and the zygomatic bone after resection are antero-medially displaced, resulting in a small step off. This step off is located not at the malar area where there is less soft tissue but is located at the lower part of the zygomatic bone where there is more soft tissue. Thus, even when there is a large step off, it is easily masked by the presence of abundant soft tissue in that area. Thus, with this method a large amount of medial reduction can be achieved without limiting the mouth opening. However, there is no bony support to the cut segment, so a possible inferior displacement can occur. Therefore, rigid internal fixation with screws is essential. As the level of the cut in this method is usually low, this method can result in oro-antral communication resulting in postoperative infection and bleeding.

**C-shaped osteotomy**

Indication: prominent zygomatic complex, protrusion of both the zygomatic body and the arch, involving the lateral orbital margin and the infraorbital margin. This procedure requires a high degree of surgical skill, as the bone cut should not only avoid the internal infracture of the maxillary sinus but at the same time should provide larger range of movement of the osteotomized segments. Removal of the segment between the 2 osteotomy lines can decrease the prominent body of the zygomatic bone, and can also correct the prominent infraorbital and lateral orbital margin. As the posterior bony segment is well supported by the anterior bone, there is no inferior displacement of the cut bone segment after the osteotomy, thus preventing soft tissue sagging in the zygomatic area. However, this procedure demands a high degree of surgical skill; only if the 2 cuts are parallel to each other then only the segments can be moved up and/or pushed medially. Thus, a novice surgeon who does not resect the bone completely or parallel to each other, can hardly achieve the desired result.

Reduction malarplasty is an effective and a safe method for the treatment of prominent zygoma and zygomatic arch and brings about great changes in patients’ facial contour with great deal of satisfaction; nonetheless, it is not free of complications. Complications, such as cheek asymmetry, cheek drooping, severe bleeding, and nerve palsy have been reported.12,13 Thus, detailed preoperative evaluation and a clear understanding between the patient and surgeon regarding the esthetic goals are essential before proceeding with the surgery. In addition, these procedures should be selected according to the patient’s complaint, esthetic standard, cultural background, age, sex, and psychological status.

**CONCLUSIONS**

This study illustrates the comprehensive application of 4 surgical methods selected with reference to different presenting characteristics of zygoma and zygomatic arch protrusion. Zygomatic shaving and osteotomies, such as I shape, L shape, and C shape, have been put forth for reduction of such protrusion. These procedures are effective in treating the prominent zygoma and zygomatic arch and result in positive changes in the patients’ facial contour with patient satisfaction.
REFERENCES


Reprint requests:
Jihua Li, MD, PhD
State Key Laboratory of Oral Diseases
Department of Oral and Maxillofacial Surgery
Sichuan University
West China College of Stomatology
Chengdu 610041, China
leejiwa6698@sohu.com