Journal of Plastic, Reconstructive & Aesthetic Surgery (2012) **65**, e111—e120

The boomerang osteotomy — A new method of reduction malarplasty

Yuji Nakanishi [a], Tomohisa Nagasao [b,*], Yusuke Shimizu [b], Junpei Miyamoto [b], Kazuo Kishi [b], Keizo Fukuta [a]

[a] *Verite Clinic, Osaka and Tokyo, Japan*
[b] *Department of Plastic and Reconstructive Surgery, Keio University Hospital, Shinjuku-Ward, Shinanomachi 35 Tokyo, Japan*

Received 26 March 2011; accepted 24 December 2011

KEYWORDS
Zygoma;
Malarplasty;
Oriental;
Reduction;
Asian

Summary *Background:* To achieve optimal outcomes in reduction malarplasty, it is important to preserve the natural curvature of the cheek while reducing the zygoma prominence and the width of the midface. The present article introduces an effective technique that aims to achieve these purposes.
Methods: Through an intraoral approach, boomerang-shaped bone incision lines are marked on the anterior aspect of the zygomatico-maxillary junction. The lines are placed medial to the most prominent part of the zygoma. The zygomatic arch is divided at its posterior part through a small incision made in the pre-auricular region. By performing these manoeuvres, a unit of bone—composed of a part of the zygoma body and zygomatic arch — is mobilised. The mobilised bone is shifted medially, reducing the width of the midface and making the zygoma region less prominent. After performing reduction malarplasty for 89 patients (10 males and 79 females) using this technique, clinical outcomes were evaluated.
Results: Outcomes of the treatment was optimal, with over 80% of the patients evaluating the results as excellent in terms of effectiveness in malar prominence, facial width and symmetry.
Conclusion: Because the continuity of the main part of the zygoma body and zygomatic arch is preserved in our technique, medial transfer of the zygoma is enabled while preserving the natural curvature of the malar region and the superior—inferior position of the zygomatic arch. Because of these advantages, we recommend our technique as an effective technique of reduction malarplasty.

* Corresponding author. Tel.: +81 3 3353 1211; fax: +81 3 3352 1054.
E-mail address: nagasao@sc.itc.keio.ac.jp (T. Nagasao).

1748-6815/$ - see front matter
doi:10.1016/j.bjps.2011.12.032

Although a prominent zygoma is one of the features that characterise the crania of Oriental populations, this feature is not favoured in their cultures, ironically.[1,2] In many Asian countries, a prominent zygoma is associated with selfish and stubborn personalities. In particular, wide faces due to a prominent zygoma are considered unsightly for women, in whom a smooth contour of the midface — described as egg-shaped — is highly valued. Unevenness due to a prominent zygoma impairs the smoothness of the contour. There are even cultures that associate prominent zygomas with misfortune.[3] These cognitive backgrounds make reduction malarplasty one of the most common cosmetic surgeries in Asia.

Despite the popularity of reduction malarplasty, we perceive few existing surgical methods can provide satisfactory outcomes. Five conditions need to be achieved in reduction malarplasty. First, the width of the midface should be effectively reduced; second, the prominence of the zygoma should be flattened; third, the natural curvature of the malar region should be preserved; fourth, visible scars should be avoided; and fifth, the location of the zygomatic arch should be kept at the same superior—inferior level. To achieve these conditions, we have developed an original surgical technique. The present article introduces our technique and discusses advantages of the technique as compared with existing methods.

Materials and methods

Surgical techniques

Prior to operation, the degree of midface width reduction is decided through consultation with the patient and evaluation of cephalogram X-ray photographs. Under general anaesthesia, 0.5% lidocaine mixed with epinephrine (1:100 000) is infiltrated along incision lines. A 5-cm incision is made on the labiobuccal vestibular groove, and the periosteum on the maxilla is dissected. After exposing the zygomatico-maxillary junction, incision lines are marked referring to the most prominent part of the zygoma. Two

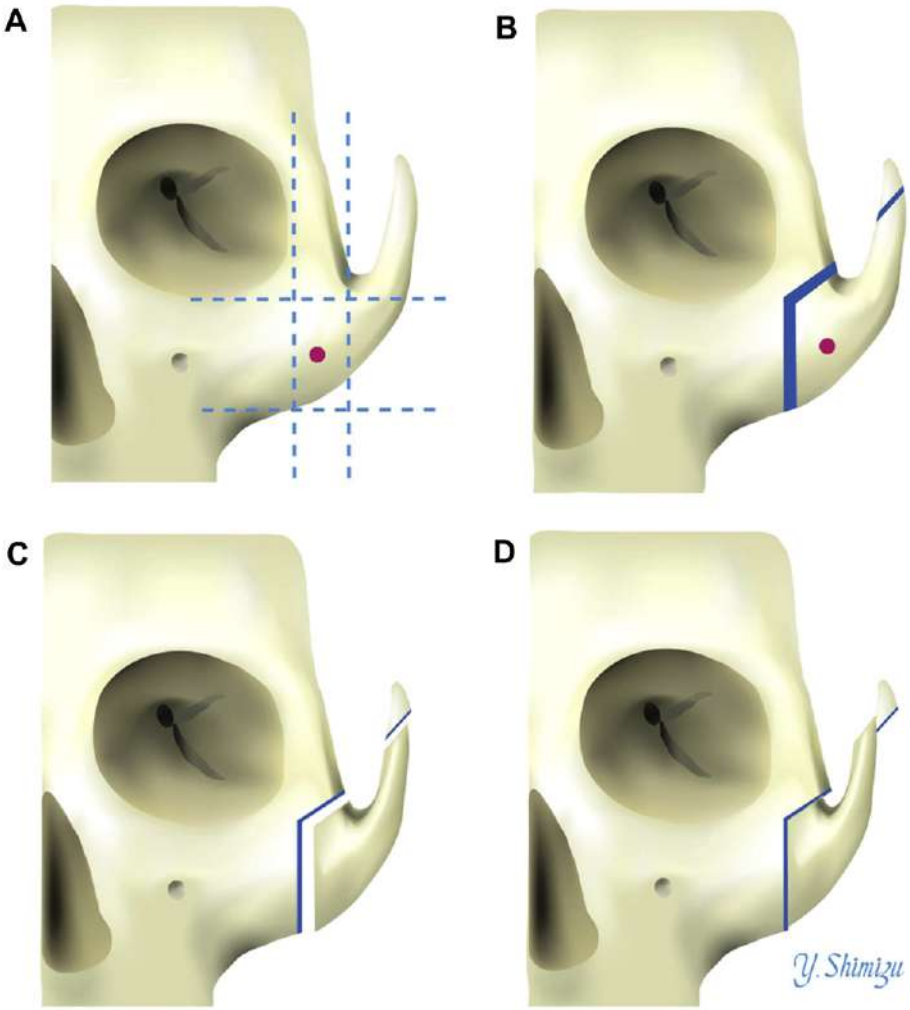

Figure 1 (*Left Above*) Location of the most prominent part of the zygoma body (red point) (*Right Above*) Incision of the Boomerang Osteotomy (*Left Below*) Mobilisation of the bone (*Right Below*) The complex of the zygoma body and zygomatic arch is shifted medially. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

vertical lines that pass the lateral rim of the orbit and posterior margin of the frontal process of the zygoma are marked; two horizontal lines that pass the inferior rim of the orbit and the lowest point of the zygoma are marked (Figure 1(A)). A rectangle is formed in the region surrounded by the four lines. The most prominent part of the zygoma usually exists somewhere near the centre of this rectangle (the red point in Figure 1(A)). The incision lines are marked medial to this point (Figure 1(B)). Two parallel lines — looking like a boomerang — are designed. Because of this design, we term our technique the boomerang osteotomy. The width of the boomerang is determined to provide half of the facial-width reduction decided in the preoperative planning. The lower leg of the boomerang must be vertical so that the zygoma can be shifted horizontally after it is mobilised. A small artery exists near the most prominent part of the zygoma. This artery is cauterised using a bipolar coagulator. Using a bone saw, the boomerang-shaped bone piece (the region marked with blue in Figure 1(B)) is removed. Thereafter, a 2-cm incision is made at the pre-auricular region. Through this incision, the posterior part of the zygomatic arch is exposed and divided. By this division, a bone unit — consisting of the zygoma body and the anterior part of the zygomatic arch — is isolated and mobilised (Figure 1(C)). The mobilised bone piece is transferred horizontally in the medial direction (Figure 1(D)). As the bone piece is transferred, a step develops between the anterior and posterior parts of the separated zygomatic arch. The step is flattened by scoring the posterior part with a drill. Thereafter, the junction between the anterior and posterior parts is fixed with an absorbable mini-plate and screws. On the anterior side of the maxilla, the fixation is performed using 3/-0 Nylon after drilling a small hole. After the fixation is performed, the incised mucosae and skin are sutured. Antibiotic tablets are administered for 5 days to prevent infection, postoperatively.

Evaluation of outcomes

Study sample

Among the patients who received malar reduction during the period from April 2000 to November 2009, 89 patients with whom postoperative follow-up over 6 months was possible were randomly selected and studied. The patients' ages ranged from 18 to 58 years (mean = 36.4; standard deviation = 10.4). The operation times were 84—144 min (mean = 114.4; standard deviation = 23.6).

Evaluation of treatment outcomes

Effectiveness of the treatment was evaluated by referring to patients' satisfaction. Photographs of frontal and oblique views of the face were taken preoperatively and between 6 and 18 months after the operation. After being presented with the pre- and postoperative photographs of themselves, the patients were instructed to evaluate the results in terms of (1) reduction of zygoma prominence; (2) reduction of midface width; and (3) symmetry. The patients were instructed to perform the evaluation using four grades (poor, fair, good and excellent). In the same way, the treatment outcomes were evaluated by two plastic surgeons (Nakanishi and Nagasao). With each of the three items for each patient, evaluation was independently performed independently by the two surgeons. Namely, two

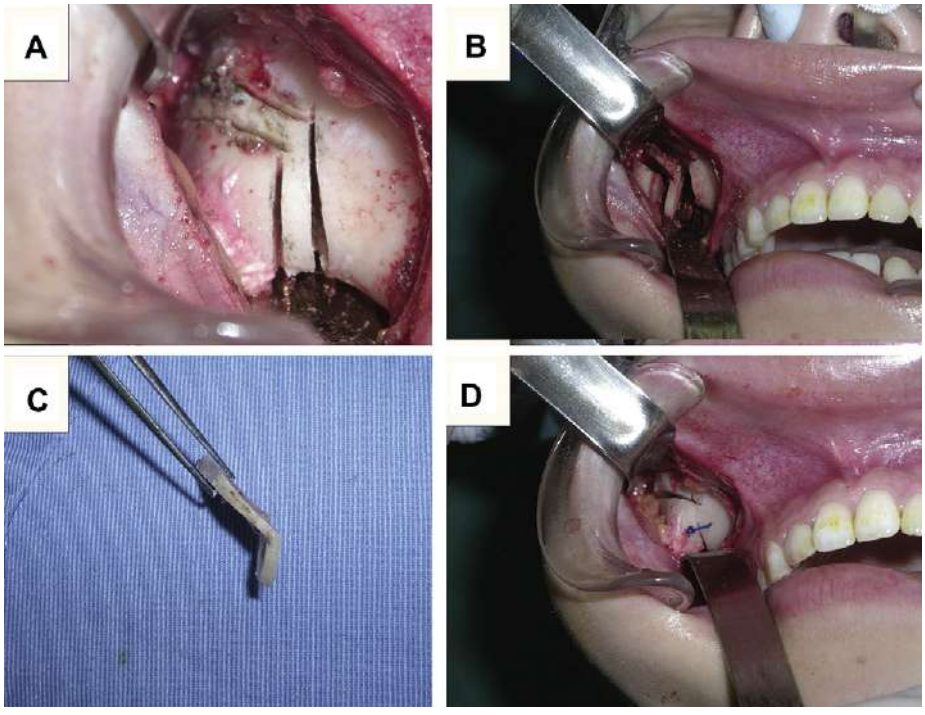

Figure 2 Demonstration of the Boomerang osteotomy.

'votes' were cast independently by the two surgeons for each of the three items with each patient.

Complications

Frequencies of complications and their percentages were evaluated.

Clinical cases

Case 1

A 23-year-old female patient consulted our institutes with the complaint of allegedly unsightly facial contour. She thought her midface was excessively wide and wished to reduce the width. The boomerang osteotomy was conducted to reduce the width of her midface (Figure 2). The anterior aspects of the maxilla and zygoma were exposed and boomerang-shaped osteotomy lines were designed (Figure 2(A)). The widths of the superior and inferior legs of the boomerang were 3 and 4 mm, respectively. By performing osteotomy along the boomerang-shaped lines, the lateral part of the zygoma was mobilised (Figure 2(B)). The removed boomerang-shaped bone piece is shown in Figure 2(C). After the lateral part is shifted medially, it was fixed to the medial part of the zygoma (Figure 2(D)). The postoperative course was uneventful. At 12 months after the operation, the patient is satisfied with the outcome and has evaluated it as excellent for all of the three items defined in 'Evaluation of Treatment Outcomes' (reduction

Figure 3 Pre- (*Left*) and postoperative (*Right*) conditions for Case 1.

of zygoma prominence; reduction of midface width; and symmetry). The two surgeons also evaluated the treatment outcome as excellent for each of the three items. Pre- and postoperative photographs of the patient are shown in Figure 3.

Case 2

A 35-year-old female patient received the boomerang osteotomy. The widths of the superior and inferior legs of the boomerang were 4 and 4.5 mm, respectively. In the evaluation at 12 months after the operation, the patient evaluated the result as 'fair' for reduction of zygoma prominence, 'good' for reduction of midface width and 'fair' for symmetry. The evaluation by the two surgeons were one 'good' and one 'fair' for reduction of zygoma prominence, one 'good' and one 'fair' for reduction of midface width and two 'fair' scores for symmetry. Pre- and postoperative photographs of the patient are shown in Figure 4.

Case 3

A 22-year-old female patient received the boomerang osteotomy. The widths of the superior and inferior legs of the boomerang were 4 and 6 mm, respectively. At 15 months after the operation, the patient, as well as the two surgeons, have evaluated the outcome as excellent for

Figure 4 Pre- (*Left*) and postoperative (*Right*) conditions for Case 2.

each of the three items. Pre- and postoperative photographs of the patient are shown in Figure 5.

Results

Evaluation of satisfaction

Over 80% of the patients evaluated their outcome as excellent with all of the three items ((1) reduction of zygoma prominence, (2) reduction of midface width and (3) symmetry). Evaluated results for each item are presented in Table 1. In general, the surgeons gave poorer grading than the patients themselves (Table 2).

Complications

Temporary numbness of the upper lip and pain on mouth opening were present with nine (10.1%) and four (4.5%) cases, respectively (Table 3). The temporary numbness of the upper lip disappeared in 4—6 weeks; the pain on mouth opening disappeared in 3—4 weeks. Although two cases (2.2%) developed minor infection — presenting with slight

Figure 5 Pre- (*Left*) and postoperative (*Right*) conditions for Case 3.

Table 1 Evaluation by individual patients.

	Poor	Fair	Good	Excellent
Malar prominence	0	2 (2.2%)	13 (14.6%)	74 (83.1%)
Midface Width	0	3 (3.3%)	14 (15.7%)	72 (80.9%)
Symmetry	0	1 (1.1%)	12 (13.4%)	76 (85.4%)

redness and swelling in unilateral malar regions on the fifth and seventh days after the operations, the symptoms disappeared with oral administration of antibiotics. Loosening of fixation screws occurred on the second postoperative day in one case, requiring re-operation. None of these complications coincided in a single patient.

Discussion

It is an often-observed anthropologic phenomenon that a physical feature characterising a certain ethnicity is not favoured in the very culture of that ethnic group. The difference in aesthetic valuation of nasal shapes between the Orientals and Caucasians exemplifies this phenomenon. The Caucasians — who generally have bigger noses than Orientals or Blacks — perceive big noses as unsightly. Therefore, rhinoplasty usually means to reduce the size of the nose in Western cultures.[4] Contrarily, rhinoplasty in Asian cultures means to increase the projection of the nose.[5] Similarly, aesthetic valuation of the malar contour differs in Western and Asian cultures. In Western cultures, moderate prominence of the zygoma is viewed as the symbol of youth and is attractive. Therefore, augmentation is performed to increase the prominence of the zygoma. Contrarily, augmentation malarplasty is seldom conducted in Asian cultures, where prominence of the zygoma is viewed as unsightly. Instead, reduction malarplasty is often conducted.

Despite the commonness of reduction malarplasty and considerable body of research regarding it, few trials have been conducted to categorise the operation techniques systematically. We developed an original categorisation system in which the existing operation techniques are classified into three groups depending on manner in which the zygoma is separated (Figure 6).

These three types are:

Type 1: Lateral separation type
Type 1a: Zygomatic arch reposition only
Type 1b: Zygomatic arch reposition and scoring of the zygoma body

Table 2 Evaluation by two surgeons.

	Poor	Fair	Good	Excellent
Malar prominence	0	16 (9.0%)	49 (27.5%)	113 (63.5%)
Midface Width	0	20 (11.2%)	41 (23.0%)	117 (65.7%)
Symmetry	0	9 (5.0%)	39 (21.9%)	130 (73.0%)

Table 3 Complications.

Temporary numbness of the upper lip	9 (10.1%)
Pain on mouth opening	4 (4.5%)
Infection	2 (2.2%)
Screw loosening	1 (1.1%)

Type 2: Tripod separation type
Type 3: Double-line separation type

The classifications and merit/demerits of each type are as follows. In type 1, the lateral part of the zygoma and zygomatic arch are separated and shifted in the medial direction. Type 1 is further divided into type 1a and type 1b; in type 1b, the anterior surface of the zygoma is thinned after separation of the zygoma and zygomatic arch. Variation exists in the way the separation is performed. Some methods mobilise the zygomatic arch by completely separating it from the cranium[6–8]; others mobilise it by breaking it at the anterior and posterior parts.[9] Methods belonging to type 1a are less invasive than other types. Type 1a methods are achievable using only minor intraoral incisions, without dissecting the periosteum of the zygoma body. On the other hand, type 1a methods are disadvantageous in that sufficient reduction of the malar prominence is unattainable with them. To make up for this disadvantage, some methods additionally thin the zygoma body after shifting the zygomatic arch. We categorise the modified method as type 1b.[3,10,11] By performing this thinning, the prominence

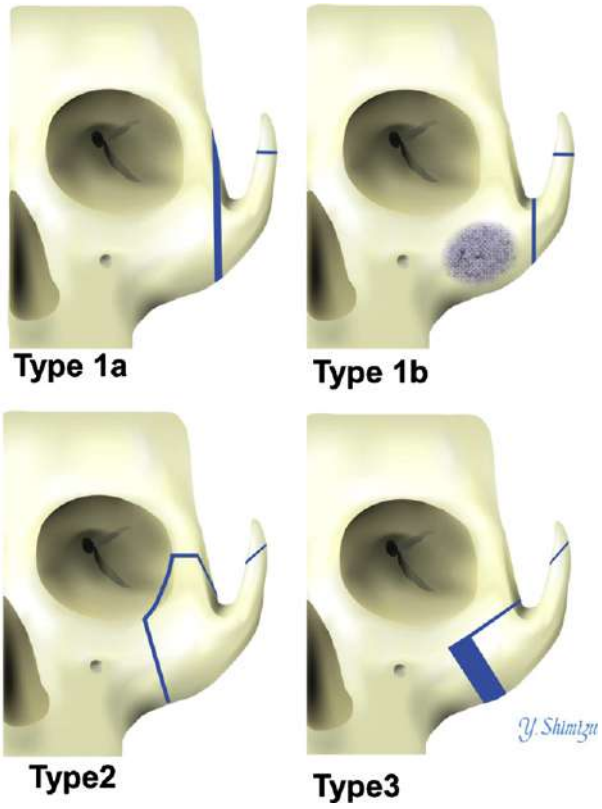

Figure 6 Our original classification of existing surgical methods for reduction malarplasty.

of the zygoma body can be reduced to some extent. However, the cortical bone of the zygoma body is lost, making it difficult to connect the mobilised zygomatic arch to the zygoma body. Consequently, irregularity develops at the junction between the zygoma body and zygomatic arch, which we consider a drawback of type 1b methods.

In surgical methods belonging to type 2, a tripod-shaped bone piece — consisting of the zygoma body, frontal process of the zygoma and zygomatic arch — is separated, mobilised and repositioned.[12,13] Type 2 methods are advantageous in that the structural continuity of the zygoma body and zygomatic arch is preserved and that prominence of the zygoma body is effectively reduced. On the other hand, type 2 methods are more invasive than other types in that they require coronal incision and wide dissection of the periosteum.

In type 3 methods, the zygoma body is partitioned by double lines on the anterior aspect of the zygoma to include the most prominent part of the zygoma in the lateral part after the separation.[14,15] Thereby, a bone piece consisting of the prominent part of the zygoma body and zygomatic arch is mobilised and repositioned. Our method belongs to type 3. Type 3 methods have the following advantages. First, the natural curvature of the cheek is preserved, because the continuity of the zygoma body and zygomatic arch is preserved. Second, type 3 methods do not need a coronal incision. Type 3 methods are achievable by the intraoral approach or intraoral approach plus pre-auricular approach. Third, rigid fixation of the mobilised piece can easily be achieved, as the cortical bone is preserved on the anterior side of the separated zygoma. For these merits, we prefer type 3 methods to other types. Among the existing methods, those reported by Wang[14] and Kim[15] belong to type 3. Our method and these existing type 3 methods differ in three aspects.

First, superior or inferior shift of the zygomatic arch does not occur with our method. With Wang's method, for instance, a rectangular bone tilting inward is removed (red region shown in Figure 7 *above*). Thereafter, the complex of the zygoma body and zygomatic arch is shifted inward. Hence, after shifting, the zygomatic arch is placed lower than the initial position (Figure 7 *above*). We do not view this as a favourable change, as lowering the zygomatic arch makes a person look old and tired. With Kim's method — contrary to Wang's method — the zygoma body—zygomatic arch complex is shifted in the upper-medial direction after a bone piece tilting laterally is removed. Accordingly, the zygomatic arch is placed at a higher position than initially. Kim — recognising this phenomenon — states "Patients look more exotic and younger after putting the malar eminence in a more superior position," with which we disagree. Shifting the zygomatic arch to a higher position emphasises the prominence of the cheek, which counters the purpose of the operation. As the lower leg of the boomerang in our method is vertical, the zygoma is shifted horizontally, without changing the superior—inferior position of the zygomatic arch (Figure 7, *below*), contributing to a natural appearance.

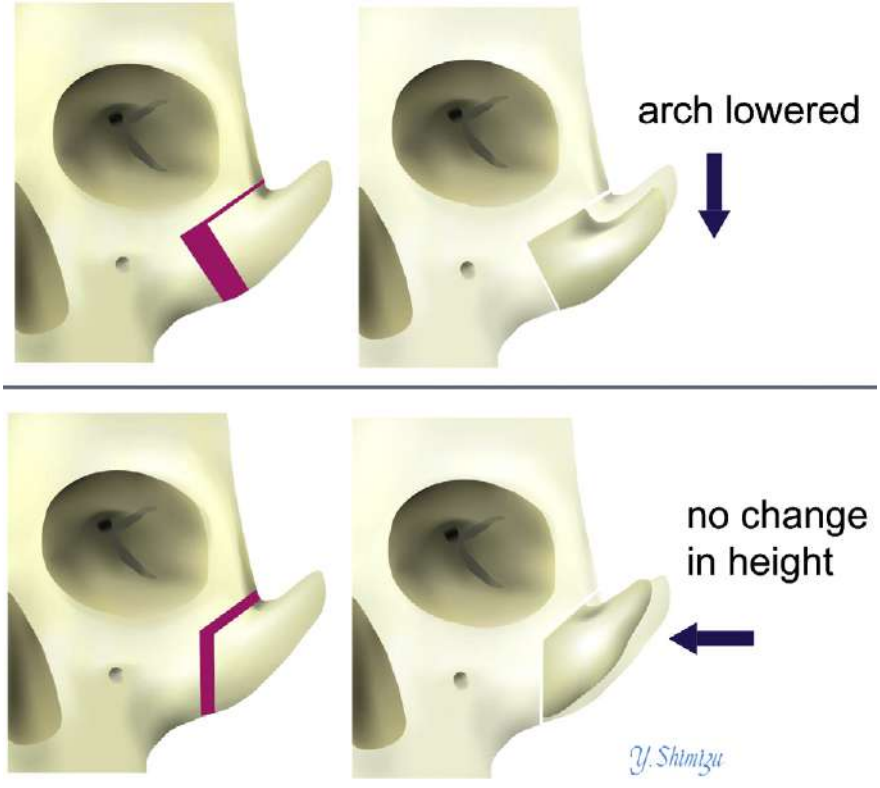

Figure 7 (*Above*) With Wang's method, a rectangular bone shape tilting medially is removed and the zygoma is shifted. The zygomatic arch is lowered by this shift. (*Below*) With our method, the mobilised bone is shifted horizontally. Hence, neither superior nor inferior transfer of the zygomatic arch occurs.

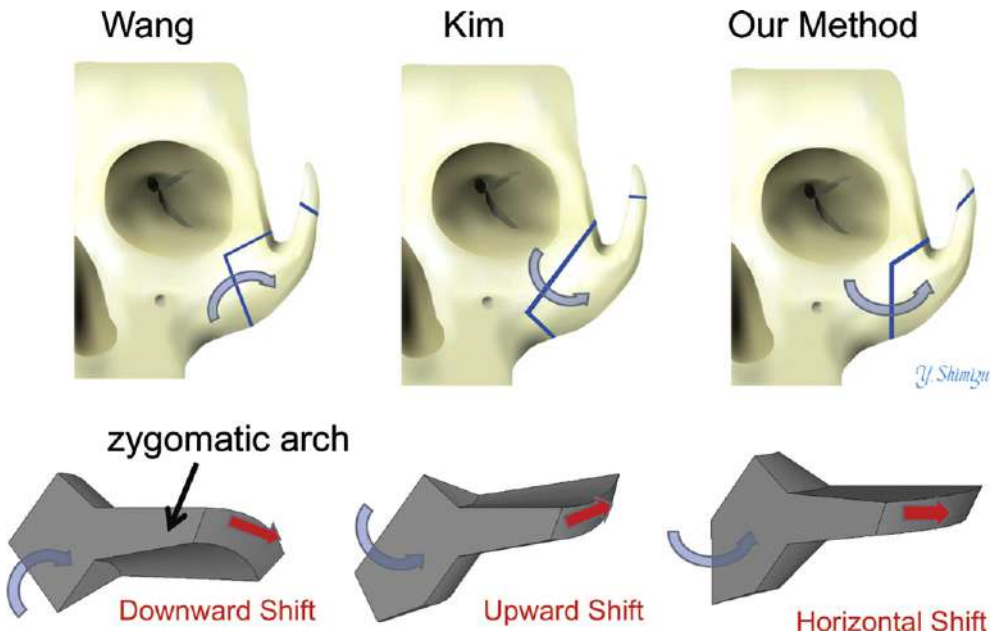

Figure 8 (*Left*) With Wang's method, when the zygoma is rotated inward for subtle adjustment of the face width, the zygomatic arch is lowered. (*Center*) With Kim's method, the zygomatic arch shifts upward as the rotation for subtle adjustment. (*Right*) The vertical height of the zygomatic arch presents no change with our method.

Second, the unevenness at the posterior part of the zygomatic arch is corrected with our method. After the complex of the zygoma body and zygomatic arch is shifted medially, a step develops between the anterior and posterior parts of the zygomatic arch. The step is conspicuous in frontal views of the patient. Therefore, it is flattened with our method to improve the cosmetic outcome as shown in Figure 2.

Third, our design of osteotomy is advantageous for subtle adjustment of the facial width at the level of the zygomatic arch. There are cases where the midface is still slightly wide after the complex of the zygoma body and zygomatic arch is shifted medially. In these situations, it is necessary to adjust the width of the midface by rotating the zygomatic arch inward. This rotation is performed with the longer one of the two osteotomy lines as the rotation axis. With Wang's method, the rotation tilts medially. Hence, the zygomatic arch shifts inferiorly after the rotation (Figure 8, *left*). Contrarily, with Kim's method — where osteotomy is performed along the line tilting laterally — the zygomatic arch is repositioned superiorly after the rotation (Figure 8, *centre*). Both superior and inferior shifting of the zygomatic arch are unfavourable. With our method, the lower leg of the boomerang osteotomy is vertical. Hence, the inferior—superior position of the zygomatic arch does not change with our method (Figure 8, *right*).

Because of these cosmetic considerations, we have achieved favourable treatment outcomes, with over 80% of the patients evaluating the outcomes as 'excellent' regarding all of the three items (malar prominence, midface width and symmetry). There might be a criticism that cutting in the maxillary sinus could cause bleeding or sinusitis.[15] However, no patient in our series developed these problems.

Because of the advantages discussed here, we recommend our original technique as an effective surgical option for reduction malarplasty.

Conflict of interest

None declared.

Funding

None declared.

References

1. Song WC, Choi HG, Kim SH, et al. Topographic anatomy of the zygomatic arch and temporal fossa: a cadaveric study. *J Plast Reconstr Aesthet Surg* 2009;**62**:1375—8.
2. Uhm KI, Lew JM. Prominent zygoma in Orientals: classification and treatment. *Ann Plast Surg* 1991;**26**:164—70.
3. Hwang YJ, Jeon JY, Lee MS. A simple method of reduction malarplasty. *Plast Reconstr Surg* 1997;**99**:348—55.
4. Neu BR. Use of the upper lateral cartilage sagittal rotation flap in nasal dorsum reduction and augmentation. *Plast Reconstr Surg* 2009;**123**:1079—87.
5. Hodgkinson DJ. The Eurasian nose: aesthetic principles and techniques for augmentation of the Asian nose with autogenous grafting. *Aesthetic Plast Surg* 2007;**31**:28—31.
6. Lee KC, Ha SU, Park JM, Kim SK, Park SH, Kim JH. Reduction malarplasty by 3-mm percutaneous osteotomy. *Aesthetic Plast Surg* 2006;**30**:333—41.
7. Sumiya N, Kondo S, Ito Y, Ozumi K, Otani K, Wako M. Reduction malarplasty. *Plast Reconstr Surg* 1997;**100**:461—7.
8. Sumiya N, Ito Y, Ozumi K. Reduction malarplasty. *Plast Reconstr Surg* 2004;**113**:1497—9.
9. Lee HY, Yang HJ, Cho YN. Minimally invasive zygoma reduction. *Plast Reconstr Surg* 2006;**117**:1972—9.
10. Lee JG, Park YW. Intraoral approach for reduction malarplasty: a simple method. *Plast Reconstr Surg* 2003;**111**:453—60.
11. Onizuka T, Watanabe K, Takasu K, Keyama A. Reduction malarplasty. *Aesthetic Plast Surg* 1983;**7**:121—5.

12. Satoh K, Ohkubo F, Tsukagoshi T. Consideration of operative procedures for zygomatic reduction in Orientals: based on a consecutive series of 28 clinical cases. *Plast Reconstr Surg* 1995;**96**:1298—306.
13. Baek SM, Chung YD, Kim SS. Reduction malarplasty. *Plast Reconstr Surg* 1991;**88**:53—61.
14. Wang T, Gui L, Tang X, et al. Reduction malarplasty with a new L-shaped osteotomy through an intraoral approach: retrospective study of 418 cases. *Plast Reconstr Surg* 2009;**124**:1245—53.
15. Kim YH, Seul JH. Reduction malarplasty through an intraoral incision: a new method. *Plast Reconstr Surg* 2000;**106**:1514—9.