Journal of Plastic, Reconstructive & Aesthetic Surgery (2019) 72, 322–334

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Revision malarplasty guided by strategic categorization

Chang Heon Hwang[a], **Myung Chul Lee**[b,*]

[a] *Ilumi Plastic Surgery Clinic, 596 Gangnam-daero, Gangnam-gu, Seoul 06038, Republic of Korea*
[b] *Department of Plastic and Reconstructive surgery, Konkuk University School of Medicine, 120-1 Neungdong-ro, Gwangjin-gu, Seoul 05030, Republic of Korea*

Received 12 September 2017; accepted 28 October 2018

KEYWORDS
Zygoma;
Reduction;
Revision;
Categorization

Summary *Background:* Esthetic reduction malarplasty is popular in East Asia, where a small and balanced facial profile is considered a desirable characteristic. Various surgical techniques have been applied; however, several complications can impact the bony structure and final esthetic appearance. We examined the outcomes of revision malarplasty with regard to strategic assessments to achieve facial balance and skeletal stability.
Methods: This retrospective study reviewed 97 patients who underwent revision malarplasty between December 2014 and November 2016. We analyzed the indications of revision and categorized the patients into three surgical groups. Dual bone flap procedures utilizing new osteotomies were performed to achieve a natural malar contour in certain cases. In addition, zygomatic arches were fixed in a lifted position to revise both bony dehiscence and soft tissue drooping. Postoperative results were assessed using medical records, photographs, and facial bone computerized tomography images.
Results: The major reason for revision malarplasty was undercorrection that required additional repositioning. The zygomatic body and arch with a bony gap (5–7 mm) necessitated additional osteotomy and repositioning to achieve zygomatic continuity and natural curvature. Significant bony defects and segmental resorption were addressed with reconstructive bone grafts.
Conclusion: The causes of complications after malarplasty should be cautiously evaluated before revision procedures. We categorized patients on the basis of strategic analysis considering reposition vector and the necessity of additional osteotomy. Unstable zygomatic segments were revised to obtain structural stability, and the zygomatic arch lifting technique using an intraoral approach can be used to achieve promising and predictable outcomes in revision malarplasty.

* Corresponding author.
E-mail address: mcleehwang@gmail.com (M.C. Lee).

https://doi.org/10.1016/j.bjps.2018.10.024

Introduction

Reduction malarplasty is performed in Asian population to achieve an oval face shape with a balanced profile. Reduction methods include shaving, resection, or setback procedures followed by bony fixation to maintain the reconfigured position.[1,2] An infracture technique without rigid fixation has also been used to accomplish adequate reduction while avoiding additional percutaneous incision.[3] However, the various reduction procedures can cause complications related to bony malunion or nonunion, as well as cheek drooping.[4,5]

Postoperative complications can be classified into three categories. First, structural problems are caused by the failure of bone union. Insecure fixation after osteotomy leads to unexpected lateral and postero-inferior zygoma movement due to masseter and temporal muscle activity.[4,6] Second, soft tissue drooping on the midface, which is common with aging, can occur following malar reposition.[7] Third, surgical results may not meet patient expectations if there is miscommunication or a perceptive imbalance between the patient and their surgeon. Postoperative facial asymmetry and the three reasons mentioned above may lead to revision surgery.[8]

Revision procedures utilizing various approaches have been presented, namely, bicoronal and intraoral incisions. The bicoronal approach provides a wide surgical field and enables rigid fixation on the uppermost portion of a dehisced lateral orbital rim and zygomatic arch.[9] However, this method requires radical dissection and increases the risk of additional complications.[10,11] In this context, it is necessary to use revision strategies involving less invasive approaches. We hypothesized that a cautious preoperative analysis, repositioning with regard to an optimal vector and rigid fixation considering the action of adjacent muscles, could extend the indication of the intraoral approach. The aim of our study was to present three revision malarplasty procedures using an intraoral approach and their combination and additionally to analyze postoperative results based on objective data. The details and outcomes of these procedures are demonstrated.

Materials and methods

This study included 97 consecutive patients (93 females and 4 males) who had undergone revision malarplasty between December 2014 and November 2016. The average age at the time of surgery was 28 years (range: 20–46 years). The investigators implemented a retrospective cohort study and enrolled samples. All procedures were conducted by the single surgeon CH Hwang. The study was conducted in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments. Required informed consent was obtained when recognizable patients' data were exhibited. Revision malarplasty was conducted when (1) the bony structure was problematic, (2) patients presented esthetic dissatisfaction, or (3) symptoms related to previous malarplasty had been noted.

The patients were included in one of three therapeutic groups: Group 1 ($n = 36$), adequate reposition using previous osteotomy lines when repositioning without additional osteotomy could result in sufficient bone-to-bone contact and esthetic malar curvature; Group 2 ($n = 32$), additional osteotomy medial to the previous one and repositioning when bony discontinuity and unnatural malar curvature required new osteotomies; and Group 3 ($n = 5$), bone graft after repositioning to fill the bony gap (Figures 1 and 2). In addition, 24 patients received different procedures on bilateral sides and were analyzed in terms of postoperative symmetry. They were not included in the three groups.

Preoperative assessment was performed with regard to each patient's previous operation and the resulting state. The primary reason for revision malarplasty was analyzed and categorized according to the following: (1) bony problem, (2) esthetic dissatisfaction, or (3) functional abnormality. Patients were evaluated depending on preoperative consultation, physical examination, and facial bone computed tomography (CT) images (Dentri-S; Willmed Co. Ltd [HDX Corp.], Seoul, Korea). Radiographic scans were examined using image analyzing software (Invivo5 v5.3.4; Anatomage Dental, San Jose, CA, USA). The combination of assessment methods provided objective information and enabled optimal preoperative planning.

Surgical techniques

Under general anesthesia, 0.5% lidocaine mixed with epinephrine (1:100,000) was infiltrated on the vestibular labiobuccal groove. A 1.5-cm incision was made on the mucosa covering the zygomatico-maxillary buttress, and the periosteum of the maxilla was dissected. After exposing the anterolateral aspect of zygomatico-maxillary complex, fixation materials from the previous surgery, including plates, screws, and wires, were fully removed.

Group 1 underwent repositioning of the malar complex when previous osteotomy lines were adequate and the complex was sufficiently movable. The procedure was facilitated using a freer or periosteal elevator. Osteotomies were performed along the previous osteotomy line when bony malunion had hindered reposition, and undercorrection was one of the indications for corrective surgery. The zygomatic arch was placed in a lifted position, and the zygomatic arch and body were fixed in a sequence.[12]

Group 2 underwent conservative debridement of the fibrous union if previous fixation was unstable, and a bony gap was noted. The bony margin was trimmed with a mechanical burr until the healthy bone tissue was exposed. Additional osteotomy lines were designated considering the malar eminence position and esthetic malar curvature, thus allowing both further malar repositioning and approximation of the bony gap. At this stage, the osteotomy vector was carefully considered because sliding of the zygomatic bone toward the posterior zygomatic arch could lead to the correction of a considerable defect length (approximately 5–7 mm). Zygomatic body thickness can be utilized as a supportive source of bony contact. The additional osteotomy allows malar repositioning using dual zygomatic bone flaps.

In Group 3, autologous bone grafting was considered if the bony gap was noticeable on the zygomatic arch or considerable resorption had restricted additional osteotomy on

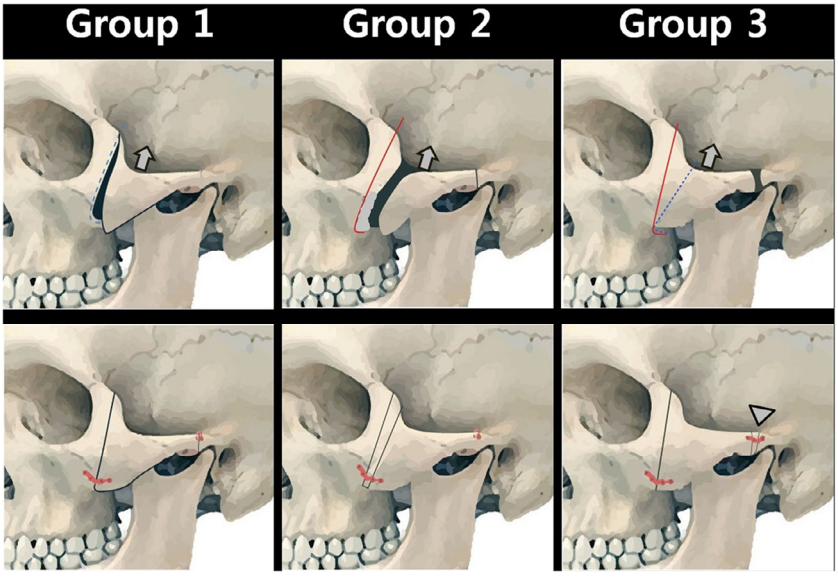

Figure 1 Patients were classified into one of the three surgical groups. Preoperative malunion and bony dehiscence were noted (top), and they necessitated secure fixation in the lifted position (arrow). In group 1, adequate reposition resulted in bone-to-bone contact and esthetic malar curvature (bottom, left). In group 2, additional osteotomy medial to the previous one and reposition facilitated bony coaptation and a more natural malar curvature (bottom, middle). In group 3, prominent bony gaps required bone grafts (arrowhead) to achieve adequate union (bottom, right).

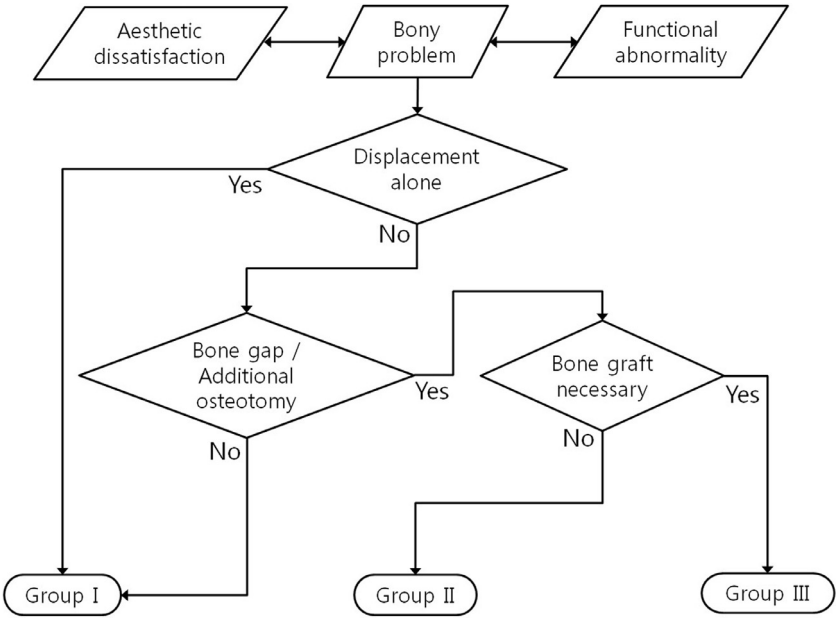

Figure 2 Revision malarplasty was considered when esthetic dissatisfaction, functional abnormality, and bony problems could be revised with corrective surgery of zygomatic complex. Patients were categorized into one of the three therapeutic groups. In group 1, malar repositioning could achieve satisfactory esthetic outcome. In group 2, additional osteotomy was considered for bony coaptation and esthetic malar curvature. In group 3, bone graft was indispensable to achieve bony alignment and union.

the zygomatic body. Free bone was harvested from the zygomatic body or the lower border of the mandible when adjunctive mandible contouring was performed. The junction between bony segments was rigidly fixed with a 4-hole L-shaped or X-shaped titanium mini-plate and screws. The operative wounds were irrigated and closed with sutures (Figure 1).

Outcome analysis

The resulting appearance and images were assessed using data sets. Photographs of antero-posterior, oblique, and worm's eye views were taken preoperatively and 8–16 months after surgery. CT images were used to evaluate bony union and anthropometric dimensions. The

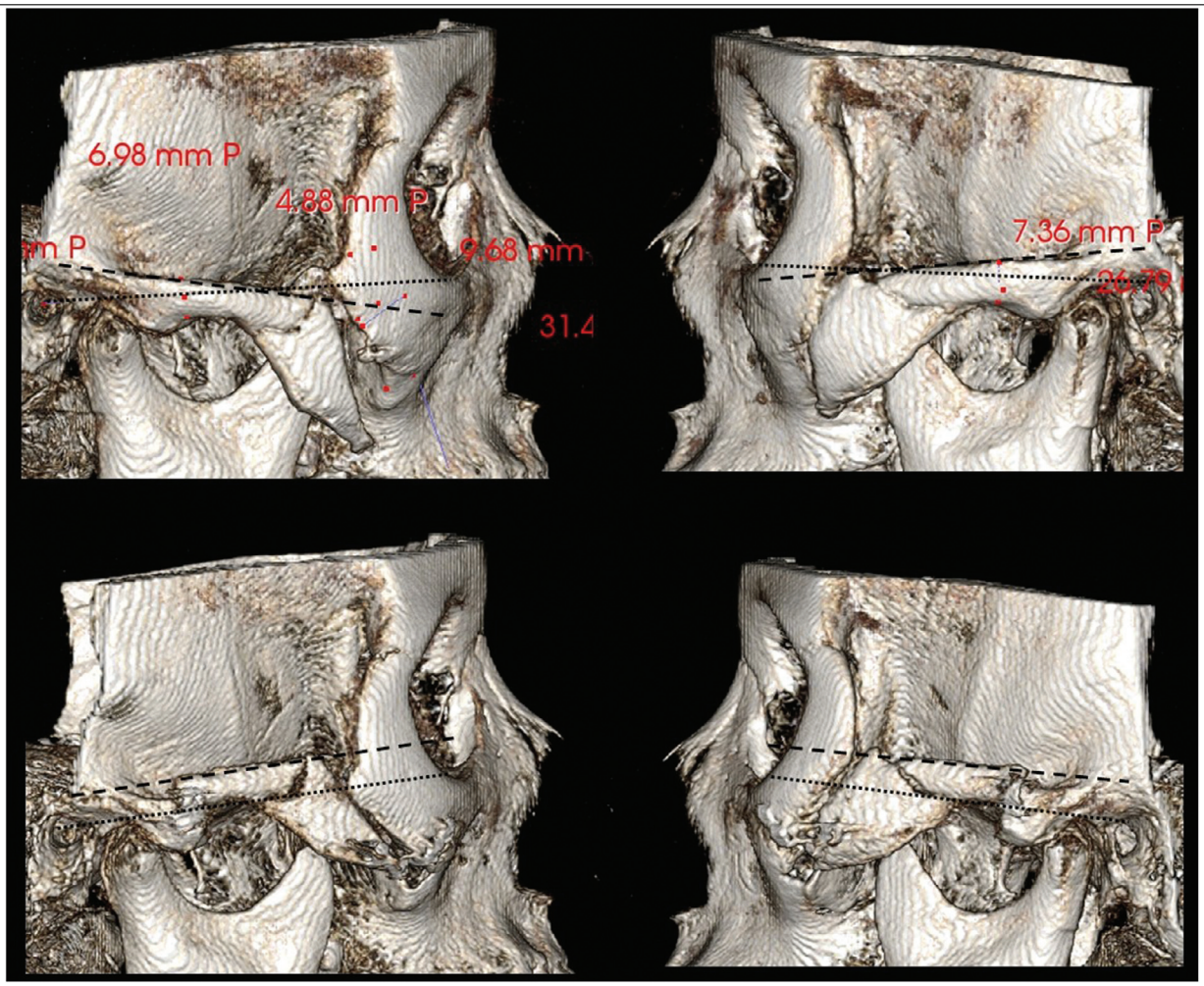

Figure 3 We performed asymmetric procedures in 24 patients who presented dissimilar bony malposition on the left and right sides. An appropriate combination of our techniques was applied to achieve bony union and symmetric outcomes. For objective analysis of pre- (top) and postoperative (bottom) states, the angle between two lines was measured: Frankfort horizontal line (dotted line) – upper border line of the zygomatic arch (dashed line). The difference of angles on both sides was calculated, and a comparative analysis was performed using pre- and postoperative facial bone 3D CT images.

analysis was performed with regard to three indices: (1) skeletal stability based on bony union, (2) aesthetic improvement as evaluated by the patient, and (3) functional improvement considering patient interviews and physical examinations. Esthetic measurements were scored using the 5-point Global Aesthetic Improvement Scale (GAIS), which uses the following five scales: much improved (2), improved (1), no change (0), worse (−1), or much worse (−2). The pre- and postoperative photographs for each patient were compared, and responder-based improvement was defined as the proportion of patients with ratings of improved or much improved.[13]

We performed asymmetric procedures in 24 patients who presented with dissimilar bony malpositioning on the left and right sides. An appropriate combination of our techniques, namely, repositioning only, neo-osteotomy followed by repositioning, and dual zygomatic bone flap method, was applied to achieve bony union and symmetric outcomes. For objective analysis of pre- and postoperative states, the angle between two lines was measured on facial bone 3D CT images: (Frankfort horizontal line – upper border line of the zygomatic arch). The difference of the angles on bilateral sides was calculated, and comparative analysis between pre- and postoperative discrepancy was performed using the paired *t*-test (Figure 3). A single investigator who was blinded to the surgical method performed all measurements.

Wilcoxon signed-rank test was used to evaluate esthetic and functional improvements. Standard software was used for statistical analysis (SPSS for Windows v20.0; SPSS, Inc., Chicago, IL). p-value < 0.05 was considered statistically significant.

Results

Among the 97 patients, 93 (95.9%) were women and 4 (4.1%) were men. The median operative duration was 75 min (range: 50–120 min). The median postoperative follow-up period was 12 months (range: 8–21 months). Previous

Table 1 Patient demographics.

	Group 1	Group 2	Group 3	Total[a]
Patients, number	36	32	5	97
Female/male	34/2	30/2	5/0	93/4
Age, years (range)	29 (23-46)	28 (20-37)	26 (21-30)	28 (20-46)
Observation period, months (range)	12 (8-17)	13 (12-21)	16 (14-17)	12 (8-21)
Previous operative method (infracture/one fixation/two fixation)[b]	10/14/12	14/11/7	3/2/0	39/32/26
Period from previous malarplasty to revision, months (range)	26 (8-43)	29 (9-47)	22 (12-39)	27 (8-47)

[a] The total number of patients includes 73 in groups 1-3, and 24 of them underwent different procedures on bilateral sides.
[b] Infracture, infracture without fixation; one fixation, single malar fixation; two fixation, two-point fixation on the zygomatic body and arch.

Table 2 Preoperative assessment of presenting symptom, radiologic evaluation, and functional problems.

	Group 1 ($n=36$)	Group 2 ($n=32$)	Group 3 ($n=5$)	Total ($n=73$)
Bony problem				
Malunion	21	15	4	40
Nonunion (bony gap)	2	10	5	17
Esthetic dissatisfaction				
Asymmetry	35	30	5	70
Anterior undercorrection	29	27	3	59
Arch undercorrection	16	18	4	38
Cheek drooping	2	6	3	11
Functional abnormality				
Headache, temporal tenderness	1	4	3	8
Trismus	0	5	4	9
Masticatory myofascial pain	0	5	3	8
Movable bony segment	0	4	3	7

Table 3 Postoperative patient evaluation for outcome analysis.

	No. of patients ($n=73$)	Postop. assessment (symptom remained)	Improvement rate (%)
Bony union			
Malunion	40	4	90
Nonunion (bony gap)	17	0	100
Esthetic improvement			
Asymmetry	70	4	94.3
Anterior undercorrection	59	5	91.5
Arch undercorrection	38	0	100
Cheek drooping	11	2	81.8
Functional improvement			
Headache, temporal tenderness	8	2	75
Trismus	9	1	88.9
Masticatory myofascial pain	8	0	100
Movable bony segment	7	1	85.7

Table 4 Comparative analysis of the discrepancy in the zygomatic position using bilateral angle measurements [Frankfort horizontal line – the upper border line of the zygomatic arch] ($n = 24$).

	Difference between bilateral angles
	right–left
Preoperative	7.8°
Postoperative	1.1°
p-value	0.004*

* $p < 0.05$.

operative methods were analyzed using facial bone CT images that provided information about osteotomy lines, operative technique, and bony union. With regard to the techniques, 39 patients had received an infracture procedure without rigid fixation, 32 had single malar fixations on the zygomatic body, and 26 had two-point fixations on the zygomatic body and arch. The median period from previous malarplasty to revision procedure was 27 months (range: 8–47 months). Demographic data for each group, including sex, age, observation period, previous operative method, and period from previous malarplasty to revision, exhibited comparable outcomes (Table 1).

Indications for revision were evaluated on the basis of physical examination and imaging studies. Regarding bony problems, 40 patients had malunion and 17 patients showed bony gap with nonunion. Nonunion can be caused by excessive bony resection, inadequate osteotomy vector or fixation, and adjacent muscle activities, including masseter and temporalis. In accordance with esthetic assessments, 70 patients complained about facial asymmetry, which was

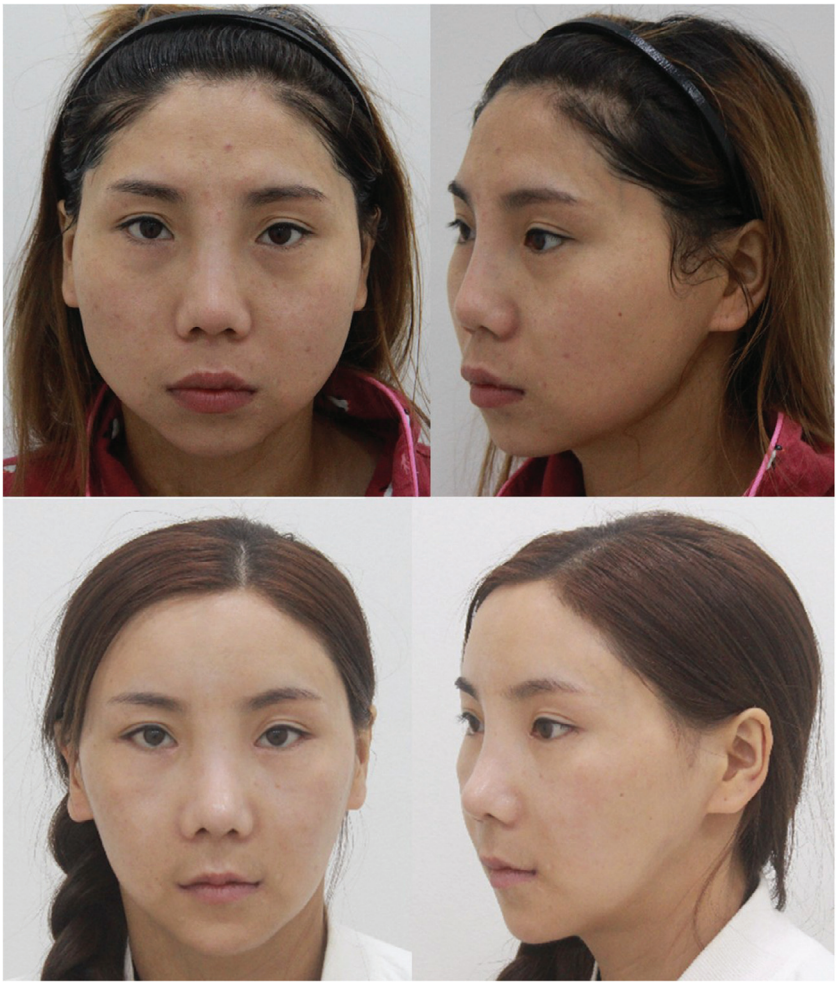

Figure 4 A 25-year-old woman exhibited bilateral cheek drooping preoperatively (top). She had received reduction malarplasty using single fixation technique 3 years before. After revision, cheek drooping was improved and her mid-face became narrower showing an esthetic profile (bottom).

the major cause of esthetic dissatisfaction. Anterior undercorrection ($n = 59$) and arch undercorrection ($n = 38$) were other esthetic concerns. With regard to functional aspects, patients reported tenderness ($n = 8$), trismus ($n = 9$), intermittent pain during mastication ($n = 8$), and unstable movable bony segments ($n = 7$) (Table 2).

Postoperative results were evaluated with regard to three categories: (1) bony union, (2) esthetic improvement, and (3) functional improvement. The 40 bony malunions and 17 nonunions were ameliorated in 90% (36/40) and 100% (17/17) of cases, respectively. Adequate bony coaptation was confirmed on CT images of improved cases. In terms of esthetic improvement, asymmetry was corrected in 94.3% (66/70) of cases. Anterior and arch undercorrections were successfully revised in 91.5% (54/59) and 100% (38/38) of patients, respectively. Cheek drooping was improved in 81.8% (9/11) of cases. As for functional problems, headache and temporal tenderness were corrected in 75% (6/8) of cases. Trismus and masticatory myofascial pain were reduced in 88.9% (8/9) and 100% (8/8), respectively. Movable bony segment was improved in 85.7% (6/7) of cases (Table 3). *All esthetic and functional issues demonstrated significant improvement ($p < 0.05$)*. Twenty-four patients underwent asymmetric procedures to achieve balanced symmetry. The difference between bilateral sides was 7.8° preoperatively and improved to 1.1° after our combinational design and strategic procedures ($p < 0.05$) (Table 4).

Complications following revision

Complications after revision surgery were evaluated through patient interview and physical examinations. Minor wound infections that resolved with conservative antibiotic treatments occurred in five patients. One major wound infection occurred 2 weeks after operation and required irrigation and drainage. Repeated surgical procedures can compromise the blood supply and cause delayed wound healing between skeletal and overlying soft tissues. Four patients presented bony gaps on follow-up CT scans, thus necessitating additional secure fixations. The pulling action of the masseter muscle explained the dehiscence. Cautious observation for at least 2 months is necessary after revision procedures because repeated surgeries can increase the possibilities of bony malunion and delayed wound healing. Paresthesia of the zygomaticofacial nerve area was noted in 10 patients, and 8 patients recovered with conservative management.

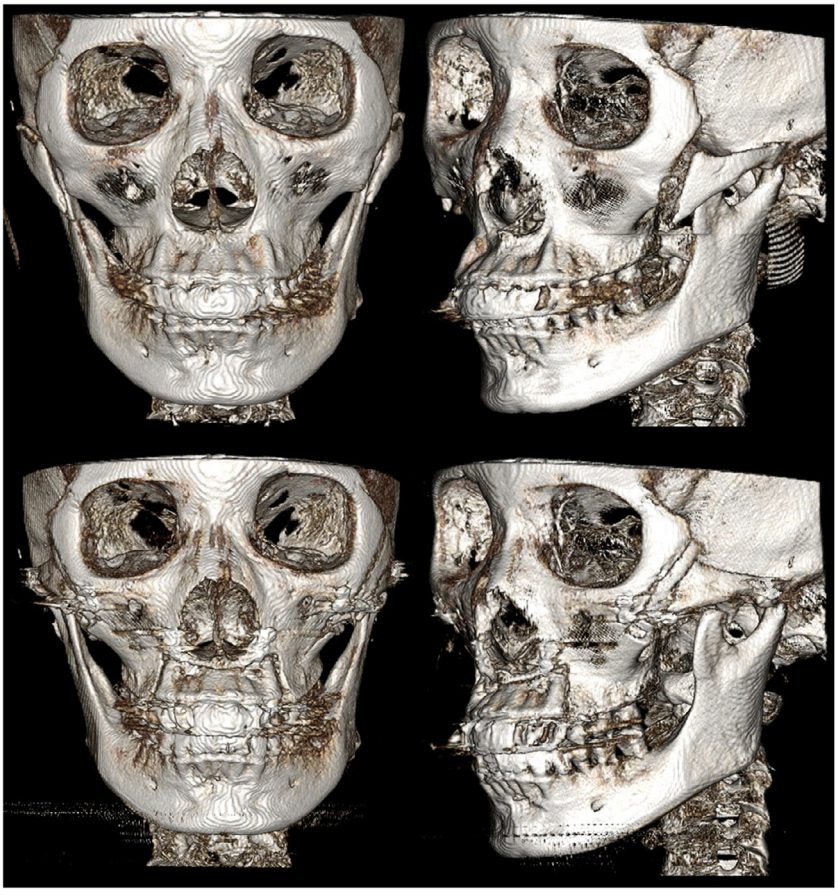

Figure 5 Facial bone 3D CT images of the 25-year-old woman presented bony nonunion with displacement (top). For revision, additional lateral orbital osteotomy was performed to achieve adequate malar curvature and arch lifting. Anterior segmental osteotomy was conducted as an adjunctive procedure. Postoperative CT images showed adequate bone-to-bone contact and alignment of the zygomaticomaxillary complex (bottom).

Patient 1

A 25-year-old woman presented with bilateral cheek drooping and bony nonunion on facial bone CT images. The patient had undergone reduction malarplasty with single fixation at malar body 3 years before. For revision, additional lateral orbital osteotomy was carried out to achieve malar alignment and arch lifting. The procedure resolved both cheek drooping and undercorrection. In 8-month follow-up photos, her midface was narrower and the natural cheek line was preserved. In postoperative CT images, precise bone-to-bone contact was achieved, and zygomatic arches were well maintained in the lifted position (Figures 4 and 5).

Patient 2

A 28-year-old woman had undergone reduction malarplasty with infracture and shaving methods 2 years before. Facial bone CT images showed nonunion at the malar body. She requested further narrowing of her face. For revision, trimming of the margin and reposition were conducted for bony alignment. At the 16-month follow-up visit, her midface showed a narrow contour and the natural cheek line was preserved on oblique view. In postoperative CT images, bony union was noted after revision procedures and zygomatic arches were well maintained (Figures 6 and 7).

Patient 3

A 30-year-old woman presented with a wide midface and severe cheek drooping with exaggerated malar highlights. She had undergone a malar reduction using the infracture technique 3 years before. Additional osteotomy between the lateral orbital rim and previous osteotomy line was performed to achieve an esthetic contour. Bone flap segments were realigned and fixed with a mini-plate and screws. At the 8-month follow-up visit, the midface was narrower with

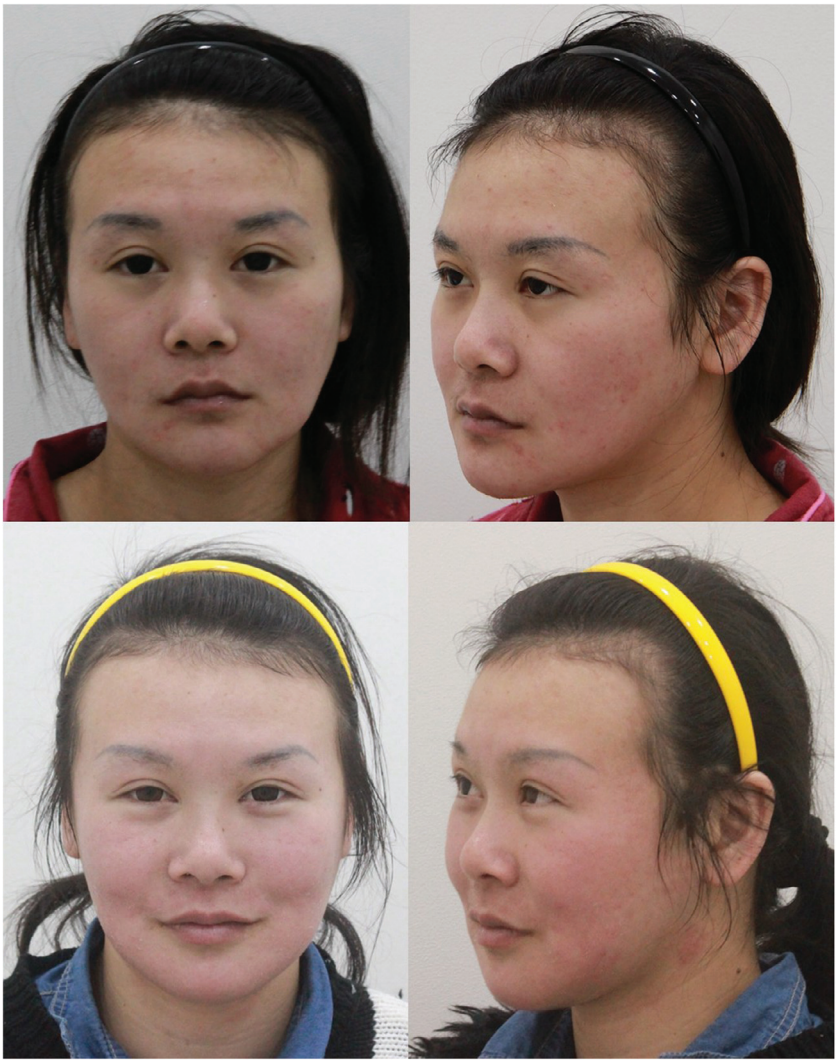

Figure 6 A 28-year-old woman revealed cheek drooping preoperatively (top). She had received reduction malarplasty with infracture and shaving methods 2 years before. After revision, cheek drooping was improved and the natural cheek line was preserved (bottom).

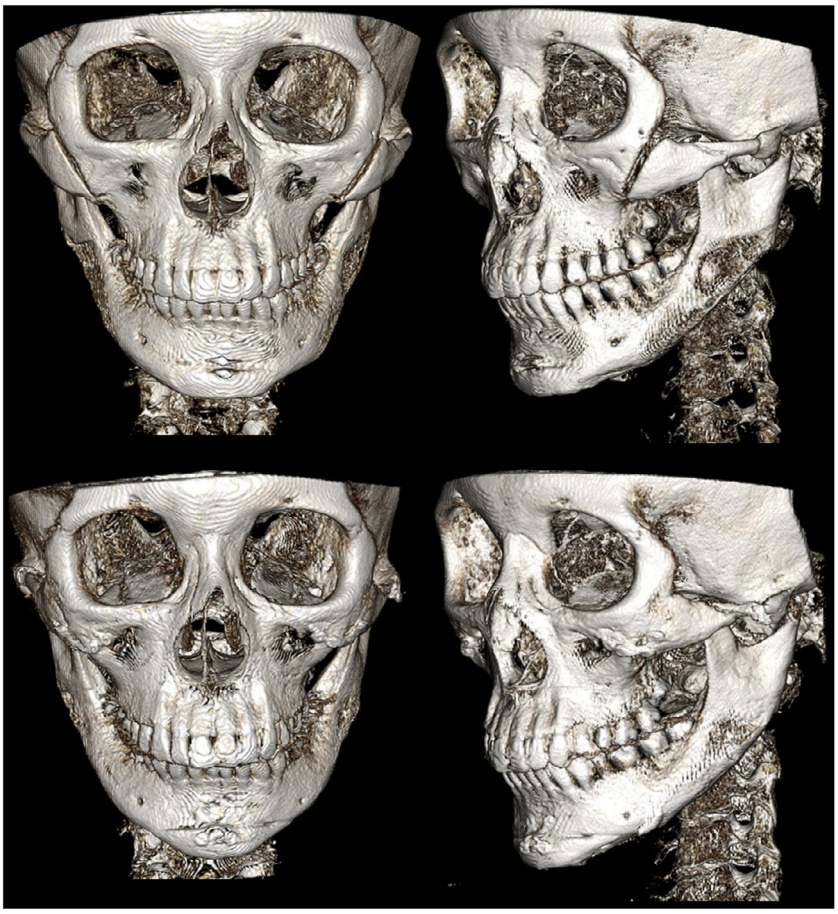

Figure 7 Facial bone CT images of the 28-year-old woman presented a bony gap on the malar body (top). For revision, trimming of the margin and reposition were conducted for bony alignment and further narrowing. Genioplasty was performed simultaneously. In postoperative CT images, bony union was evident and zygomatic arches were well maintained (bottom).

a balanced profile and soft tissue drooping was improved. Precise bone-to-bone contact was noted on postoperative facial bone CT views (Figures 8 and 9).

Discussion

Esthetic preferences of an oval face with a dolichocephalic contour have led to refining procedures to achieve balanced facial profiles. The trait accounts for the creation of various reduction malarplasty techniques that have been frequently applied in recent years. Diverse methods have been introduced for reduction malarplasty, including an L-shaped osteotomy using an intraoral approach, limited preauricular incisional access, zygomatic arch reduction through multiple osteotomies, rotational techniques, and boomerang osteotomy.[1,3,14-20] Such modifications have gradually evolved and resulted in effective reduction of the zygoma; however, their frequent implementation led to subsequent complications related to the zygomaticomaxillary complex and an undesirable facial appearance.

Baek et al. pointed out several morbidities and disadvantages when reduction procedures were applied inappropriately.[4] Unfavorable outcomes such as an aged and gloomy appearance can occur when excessive reduction has been performed or if the superior vector was not considered during repositioning. There may be nonunion or inferolateral displacement of the zygomaticomaxillary complex with masseter muscle action. *Cheek ptosis has been noted as a major complication of the infracture method when it was implemented without a direct approach to the zygomaticomaxillary complex*. It involves osteotomy on the malar body with maximal protrusion, which is followed by narrowing of the malar complex with manual infracture. The malar complex being repositioned requires adequate support to maintain stability against adjacent mobile structures, namely, the masseter muscle and overlying soft tissue. However, previous studies using the method have advocated malar reduction procedures without sufficient fixation on the zygomatic body and arch.[3,21]

We categorized clinical cases into three groups with regard to the bony displacement, malunion or nonunion, and applicable revision methods: (1) zygomatic displacement without a significant bony gap that can be treated with secure fixation following reposition, but an osteotomy adjacent to previous one can be necessary if esthetic undercorrection is an indication; (2) additional osteotomy medial to the previous one and postero-superior repositioning that can lead to a dual zygomatic bone flap procedure; and (3) repositioning to a more natural position and bone graft can be

Figure 8 A 30-year-old woman showed severe cheek ptosis with wide mid-face (top). She had undergone reduction malarplasty using the infracture technique 3 years before and requested further narrowing of her face. After revision, cheek ptosis was improved and her mid-face became narrower showing a balanced profile (bottom).

performed to fill the bony gap. For group 1, the procedure focuses on restoring the malar position into the lifted site if reduction was sufficient with the previous procedure. Secure fixation using an arch-first and body-later sequence is crucial to avoid recurrence.

In group 2, an additional osteotomy line should be cautiously designed to achieve a balanced facial profile, malar curvature, and adequate fixation. Our oblique osteotomy, heading in the postero-superior direction, enables posterior sliding of the bony complex and can overcome a small amount of bony gap. Furthermore, an additional osteotomy between the lateral orbital rim and previous osteotomy can lead to natural malar curvature, hence mimicking a barrel-stave osteotomy.[22] Additional osteotomy is considered when malar reposition utilizing the previous osteotomy results in an awkward image or abrupt contour changes. Nonetheless, osteotomy position and direction should be carefully selected because the zygomaticomaxillary complex undergoing revision already has reduced amount and shorter horizontal length. Excessive osteotomy can result in bony resorption and necrotic sequelae of segments.

In the dual zygomatic bone flap procedure, bony segments (anterior, intermediate, and posterior pieces) are fixed using an L- or X-shaped mini-plate and screws. The stability of multiple segments depends on both rigid fixation and wedge-shaped osteotomies. Wedge-shaped bone pieces resemble stones in a masonry arch, and the center one is the keystone of the structure. Osteotomy angle and vector should be considered cautiously to achieve stability in the final result because the anterior zygomatic arch sustains most of the masseter muscle strength.[6,23-27] In addition, sliding of the zygomatic bone toward the posterior zygomatic arch facilitates natural zygomatic curvature and bone-to-bone contact.

In group 3, a bone graft is considered when the bony defect is too large to be filled with repositioning of the malar complex or when esthetic repositioning has necessitated a bone graft. The amount of bony defect is measured, and bone pieces are harvested from the zygomatic body during trimming procedures. The lower border of the mandible can be an alternative donor site when mandible contouring is performed as an adjunctive procedure.

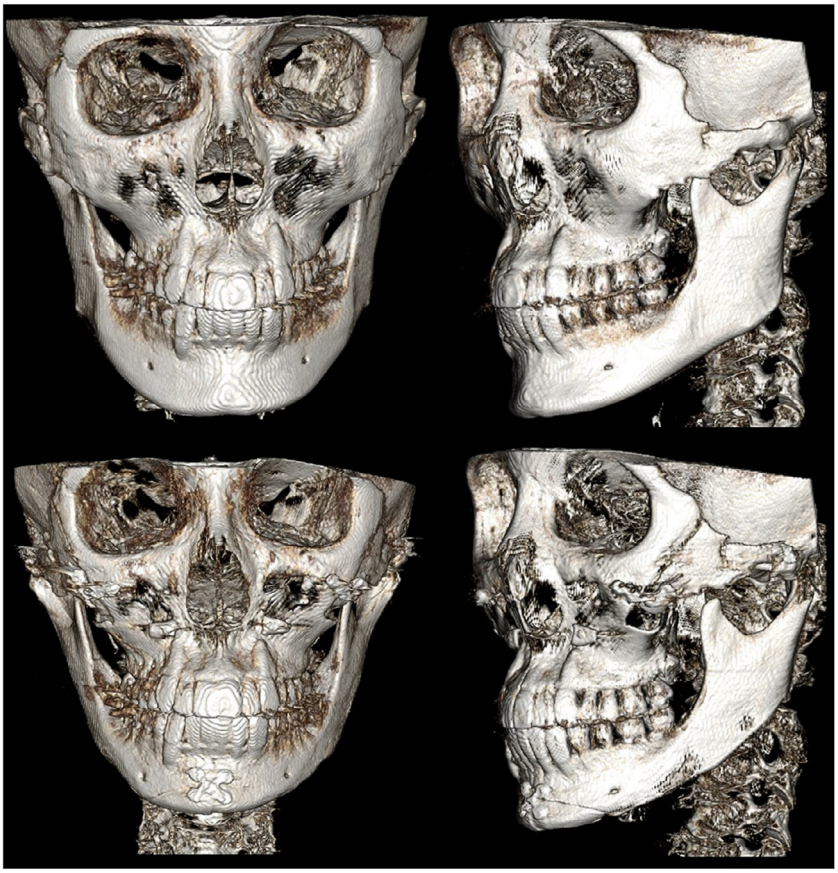

Figure 9 Facial bone CT images of the 30-year-old woman presented prominent malar body (top). In revision procedures, additional osteotomies were followed by reposition toward medial and superior vector. Mandibular contouring and genioplasty were conducted simultaneously. Postoperative CT images demonstrated adequate bone-to-bone contact and zygomatic arches in the lifted position (bottom).

Strategic approach is crucial in preoperative planning for revision malarplasty.[8] Surgeons should consider bony realignment, additional osteotomy, or bone graft to avoid further complications. The amount of bony gap, osteotomy design, and graft donor site are evaluated cautiously. Our strategic categorization can be beneficial for surgical preparation in advance (Figure 2).

For secure malar suspension in the revised position, a coronal incision has been suggested for accurate reconfiguring and rigid fixation.[9] The advantages of this technique include a wide surgical field that allows direct visualization, adequate removal of interposed soft tissues, and accurate fixation of the malar complex. However, the coronal approach requires radical dissection and increases the risk of complications such as excessive bleeding, injury to the temporal branch of the facial nerve, and temporal depression due to temporal fat pad atrophy.[10,28] In this context, an alternative approach should be considered if adequate reconfiguring and fixation can be achieved.[29] The intraoral approach enables direct visualization of the malar complex including the malar highlight and sufficient repositioning using sawing or osteotomy procedures.[30] The technique is commonly utilized in repositioning malarplasty and for open reduction of zygomaticomaxillary fractures.[31,32] However, technical challenges to expose the entire complex undergoing reposition and osteotomy lines have been noted as a disadvantage.[11,33] Nonetheless, our preoperative categorization, cautious consideration of the repositioning vector; and secure fixation of the lateral orbital rim, zygomatic body, and arch continuum enabled adequate correction in most cases requiring revision. The strategic approach widens the surgical indication for the intraoral approach.

A recent study has demonstrated postoperative complications related to reduction malarplasty using an intraoral approach. Major disadvantages included transient sensory weakness, cheek drooping, nonunion, asymmetry, restricted mouth opening, uncontrolled bleeding, and facial nerve injury in the meta-analysis.[7] Nonetheless, cautious preoperative planning and strategic selection of the operative methods could achieve predictable outcomes using an intraoral approach. Furthermore, the complications are still possible even when a coronal incision is applied. Considerable care must be taken when choosing an approach for revision reduction malarplasty.

Asymmetry of bilateral zygoma was noted in 95.9% patients (70/73) (Table 2) and has been presented in literature.[7,8] It is a major complication in the esthetic regard, showing awkward images. We compared pre- and postoperative angle discrepancy, using Frankfort horizontal line and upper border line of the zygomatic arch for objective

analysis (Figure 3). Maxillozygional anthropometric landmarks were presented to measure upper and midface, although adequate position of the zygomatic arch has not been studied.[34] Further, anatomical studies of horizontal and vertical arch dimensions can be beneficial to achieve an esthetic standard of the midface.

There are limitations of our strategic revision techniques because excessive bony loss requiring structural reconstruction necessitates visualization of the entire zygomaticomaxillary complex. The coronal approach should be considered when extensive bony resorption has destroyed the bony continuum including the lateral orbital rim and zygomatic arch and body.[9] Secure fixation on the damaged upper border using harvested calvarial bone is crucial for restoring bony complex impairments. In outcome analysis, 3D face scanner systems can be utilized for craniomaxillofacial imaging.[35] They are advantageous in measuring facial depth and shape. Our imaging device was not equipped with 3D face scan and could not evaluate facial surface. Further analysis can be possible using up-to-date imaging tools.

Conclusion

The reasons for dissatisfaction with the original surgery should be carefully evaluated before revision malarplasty. We performed strategic analysis to categorize patients considering the reposition vector and the need for additional osteotomy. Intraoperatively, unstable zygomatic segments should be carefully manipulated to obtain structural stability. The zygomatic arch lifting technique can be used in revision malarplasty using an intraoral approach to achieve accurate and predictable outcomes.

Conflict of interest

No authors have conflicts of interest that could potentially influence the described research.

Financial disclosure

None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this manuscript.

Funding

None.

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