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A New Infracture Technique for Reduction Malarplasty with an L-Shaped Osteotomy Line

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Background: Reduction malarplasty is one of the most common surgical procedures performed in the Asian population for aesthetic purposes. Although multiple methods have been developed for reduction malarplasty, including a variety of infracture techniques, most of the current procedures have limitations. In the current study we created a new infracture method to circumvent these shortcomings.

Material/Methods: Between January 2004 and October 2013, we applied this novel infracture technique in 700 patients. The highest area of the zygomatic body was marked pre-operatively and ground intra-operatively through an intraoral incision. An L-shaped incomplete osteotomy of the zygomatic body was performed with a reciprocating saw, and then a complete perpendicular osteotomy (1 cm anterior to the articular tubercle of the zygomatic arch) was made through a pre-auricular incision. Light pressure on the posterior part of the arch produced a greenstick fracture of the anterior osteotomy site, resulting in posterior-inward repositioning of the malar complex. Internal fixation was not required.

Results: Satisfactory aesthetic results and good post-operative stability were achieved. Three months post-operatively, the bone around the zygomatic arc osteotomy line was remodeled. The bone posterior to the articular tubercle of the zygomatic arch was partially absorbed, leading to a depression of the root of the arc and a natural transition on both sides of the osteotomy line, making the midface more slender. Instead, the anterior bone presented with new bones, making the malar complex more stable.

Conclusions: This new method has multiple advantages, including simple manipulation, no need for internal fixation, short operative and recovery times, and few complications. X-ray images showing the bony changes demonstrated that the infracture technique is an effective and ideal method for reduction malarplasty.

MeSH Keywords: **Esthetics, Dental • Osteotomy • Zygoma**

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Background

The zygomatic body and arch are located in the mid-face, which often affects the proportion of the entire face [1]. Aesthetic concepts regarding the facial contour greatly differ due to different ethnic and cultural backgrounds [2]. In Asia, individuals with a malar prominence are usually considered masculine, old, and unlucky [3,4]. In contrast, Westerners think people with high, prominent malar are beautiful. Among various facial contours, the oval or melon seed facial shape of Asian women is considered the most popular and attractive [5]. Therefore, reduction malarplasty is one of the most widespread aesthetic surgeries performed in the Asian population.

A variety of methods for reduction malarplasty have been described since Onizuka et al. [6] first reported the technique by chiseling of the zygoma via an intraoral incision in 1983. According to the surgical routes, these methods can be divided into the following 3 categories: intraoral [2,7–9], coronal [10–12], and intraoral combined with pre-auricular approaches [5,13,14]. Considering the basic principles, these techniques mainly consist of bone shaving, complete I-type, L-type, or wedge-section osteotomy on the zygomatic body, and the infracture procedure on the zygomatic body.

Different infracture techniques through a temporal pre-auricular incision have been introduced for the reduction of the prominent zygomatic body and arch [5,15–19], but these methods have limitations and are primarily effective for improvement of lateral protrusion of the zygomatic arch [5]. To overcome this shortcoming, we developed and used a novel L-shaped infracture method in 700 patients. Post-operative follow-up and X-ray imaging demonstrated this technique to be an effective and safe reduction malarplasty method.

Material and Methods

Patient data

Seven hundred consecutive patients with prominent malar complexes (65 males and 635 females; 19–39 years of age) were treated with the infracture technique between January 2004 and October 2013. All of the enrolled patients sought evaluation for cosmetic improvement. Patients who had contraindications to cosmetic surgery, such as severe diabetes, hypertension, or mental disabilities, were excluded from this study.

Pre-operative examinations

All patients underwent routine physical and laboratory examinations, including hemograms, urinalyses, liver and renal function testing, coagulation profiles, electrocardiograms,

Figure 1. Schematic depiction of the incision. The marked circle is the bone for preservation.

chest X-rays, and cranial X-rays (Waters and submentovertex views). Facial photographs from the frontal, oblique, and submentovertex views were obtained. While in a sitting position, anterior oblique profiles of the patients were evaluated, the facial proportion and symmetry were assessed, and the dominant area of protrusion was marked on the corresponding skin.

Surgical procedures

All of the patients received general anesthesia via nasotracheal intubation. When general anesthesia was established, 0.6% lidocaine containing epinephrine (1:100,000) was injected along the incision line, the upper labiobuccal sulcus, the periosteum of the zygomatic body, and the periauricular incision. After 10 min, a 4-cm intraoral incision was made down to the periosteum on the buccal vestibule. The zygomaticomaxillary and zygomatic bodies to the lateral orbital margin were exposed through subperiosteal dissection. Meticulous dissection techniques were used to protect the infraorbital nerve and minimize detachment of the origin of the masseter to the zygomatic arch to prevent post-operative cheek drooping. According to the pre-operative mark on the skin, the outer cortex of the protruding zygomatic process was shaved with sufficient exposure using a zygomatic retractor, followed by an L-shaped osteotomy. With an oscillating saw, the oblique osteotomy was first made from the zygoma-orbital concavity (concavity between the zygomatic arc and the lateral orbital wall) to the zygomaticomaxillary suture, and a vertical osteotomy was made from the zygomaticomaxillary suture or the lateral side of the zygomaticomaxillary suture, which mainly depended on the severity of the malar prominence. At this point, it was crucial to maintain a distance of approximately 2 mm between the 2 perpendicular osteotomy lines on the outer cortex and approximately 3 mm on the inner cortex. After the osteotomy procedures, a 1.5-cm vertical pre-auricular incision was made at the posterior margin of the sideburn (Figures 1, 2). Using a mosquito clamp, blunt dissection was performed from the subcutaneous tissue and extended to the periosteum of the

Figure 2. The incision during the operation. (A) An “L” type incision on the zygoma. (B) The incision on the zygoma arch.

Figure 3. (A–C) Comparison of the preoperative and the postoperative frontal and lateral views of a 43-year-old woman with prominent malar and mandibular angle.

zygoma root. A chisel was inserted for a vertical bony cut following the subperiosteal dissection around the osteotomy line. The posterior cutting line was approximately 1 cm anterior to the articular tubercle to avoid affecting post-operative function of the temporomandibular joint. Then, the proximal edge of the cut arch was lightly tapped with a hammer under direct vision, which would displace the zygomatic complex by making an incomplete fracture anteriorly and a complete fracture posteriorly, with the infracture point acting as a hinge. The amount of the inward rotation was determined according to the severity and symmetry of the malar prominence, ranging from 5 to 15 mm. If bilateral asymmetry was observed, more inward rotation was performed on the more prominent side. The margins surrounding the osteotomy lines were burred to smooth the malar contour. The same procedure was repeated on the contralateral side.

Post-operative management

Facial symmetry was carefully evaluated after the procedures. Thorough irrigation was carried out using normal saline. After hemostasis was assured, the intraoral and pre-auricular incisions were closed in a single layer using running sutures without drainage. A light pressure dressing was administered for 3–5 days. Systemic antibiotics were given intra-operatively and 3 days post-operatively.

Results

Surgical strategies

Among the 700 patients enrolled in this clinical trial, 200 (10 males) underwent mandibular angle hypertrophy in combination

Figure 4. Skull X-ray examination before and after surgery. (A) Preoperative view. (B) X-ray image at postoperative 1 week. (C) X-ray image at postoperative view 3 months. The bone surrounding the zygomatic arch osteotomy line was remodeled, and the bone posterior to the articular tubercle of the zygomatic arch was partially absorbed.

with mandibular angle reduction or genioplasty simultaneously through intraoral and submental incisions. The post-operative management was implemented as follows: a liquid food diet was introduced 6–8 hours post-operatively; and soft diet was recommended 3–5 days post-operatively. The follow-up ranged from 2 to 24 months, and the preoperative and the postoperative frontal and lateral views were recorded (Figure 3). Cranial X-rays, including Waters and submentovertex views, and facial photographs were obtained to observe the bony changes and assess the aesthetic effects. Satisfactory results were achieved in most patients.

X-ray imaging

Compared with pre-operative images, the X-ray images 2 weeks post-operatively showed that the contour of the mid-face was clearly narrowed. Three months post-operatively, the bone around the zygomatic arc osteotomy line was remodeled. Partial bone posterior to the articular tubercle of the zygomatic arch was absorbed, causing a depression of the root of the arc and a natural transition of the osteotomy line bilaterally, making the midface appear more slender. The anterior bone developed new bone, which made the malar complex more stable (Figure 4).

Post-operative complications

One patient (0.14%) developed maxillary sinusitis 2 weeks post-operatively, which completely resolved after systemic antibiotics and local drainage for 1 week. Skin necrosis approximately 1 cm in diameter was noted in 1 case (0.14%) after undergoing zygoma area liposuction, which was treated conservatively. A unilateral forehead wrinkle appeared in 1 patient (0.14%), which completely resolved within 3 weeks of surgery. Thirteen patients (1.9%) presented with slight asymmetry; 3 patients underwent secondary operations, but 10 patients declined further surgery. Other complications, such as hematomas, permanent facial nerve damage, recurrence of malar prominence, temporomandibular joint dysfunction, bone non-union, and cheek drooping, were not observed in the subsequent follow-up.

Discussion

Facial shape is mainly determined by skeletal contour. Asians and Westerners have different facial skeletal shapes; specifically, Asians have mesocephalic skull shapes, whereas Westerners have dolichocephalic skull contours [20]. As a result, Asians tend to have flatter and shorter faces compared with Westerners. In addition, malar prominence will accentuate these features, which in turn might make people appear unattractive and older than their actual ages. Thus, reduction malarplasty has been utilized as one of the most popular procedures for aesthetic purposes in Asians.

Among multiple methods applied for reduction malarplasty, osteotomy and repositioning are generally considered to be most reliable and effective [5], such as complete I-type, L-type, or wedge-section osteotomy on the zygomatic body and infracture procedure on the zygomatic body. Most of these methods, however, required rigid interosseous fixation with a miniplate or wire; incomplete and inappropriate fixation can result in bone non-union or malunion from an external rotation force through the action of the masseter muscle [21–23]. In addition, despite essentially no foreign body reaction with such materials, many patients are reluctant to use any metallic objects because it is visible on radiographs, and the patients have no intention of letting others know that they had undergone an operation. Moreover, the fixation is difficult via the intraoral approach due to the narrow surgical field. Indeed, many infracture techniques have been developed to overcome these shortcomings.

The infracture technique was introduced for reduction malarplasty by Uhm et al. [24] and Yang et al. [25]. A temporal preauricular incision can provide precise manipulation; however, a temporal preauricular incision may be inappropriate for young patients because of the long operative time, large scalp scar, potential risk of injury to the facial nerve, marked local swelling, and long recovery time [26]. Hwang et al. [18] modified the method proposed by Yang and Park [25] by cutting the outer cortex of the zygoma vertically from the level of the orbital rim outer margin, and repositioning the zygomatic arch

inward after 2-point fracturing (a green-stick fracture anteriorly and complete osteotomy posteriorly). Sumiya et al. [27] also described the technique of an oblique shape greenstick fracture of the zygomatic body and complete osteotomy of the zygomatic arch. The aforementioned infracture methods have limitations, and are only effective for subjects with lateral protrusion of the zygomatic arch; patients with severe protrusion of the zygomatic body and arch are not suitable candidates. Lee et al. [17] described a blind technique through a minimally invasive intraoral approach using a new instrument, but the technique was difficult to control and not appropriate for surgeons without experience with the technique.

We have developed a new L-shape infracture method for treatment of severe protrusion of the zygomatic body and arch. Compared with the I-shape infracture technique of the malar body, our technique is more suitable to achieve adequate reduction and efficiently alter the main protrusion area of the zygomatic body if the osteotomy line originates from the same point of the lateral orbit wall and on the premise of not destroying the orbital floor and maxillary sinus. Through the pre-auricular sideburn incision, the dissection area of the zygomaticomaxillary and zygomatic bodies can be confined to the lateral orbital margin to prevent the incidence of post-operative cheek drooping [26]. In addition, an osteotomy of the zygomatic arch is performed under direct vision and the angle of the inward rotation could be properly controlled, which facilitates bilateral symmetry, especially for patients with pre-operative facial asymmetry. Some authors have suggested that a pre-auricular incision might result in conspicuous scars; however, the sideburn scar is almost invisible [26]. Kim and Choi [28] suggested that the infracture technique could probably destroy the natural curve between the zygomatic body and zygomatic arch, but the infracture technique utilized in the current study reduces this risk by preserving the natural transition, and accentuates the malar highlight area at a more posterosuperior site.

Currently, complete fracture of the posterior arch has been widely utilized because it can significantly reduce facial width; however, some authors consider post-operative facial depression in the pre-auricular area to be a common problem because the arch is replaced medially and may generate a step-off [8]. In order to avoid this drawback, many authors advocate an oblique osteotomy of the zygoma arch root [29]. X-ray images revealed that the bone surrounding the zygomatic arch osteotomy line can be remodeled and partial bone posterior to the articular tubercle of the zygomatic arch is absorbed, which might lead to an depression of the root of the arch and a natural transition of the 2 sides of the osteotomy line, making the midface more slender. Instead, the anterior bone developed new bone and stabilized the malar complex. It is not necessary to worry about post-operative facial depression in the pre-auricular area, even using a vertical osteotomy at the

zygomatic arch root. We postulate that a pattern of self-regulation might occur in the bone segments and muscles, such as the masseter and temporalis muscles.

This novel procedure is simple, effective, and economical. The operation time is shortened to approximately 0.5 hour, and the time of recovery and swelling is decreased. A few surgical complications are induced using the infracture technique. In the current study, 1 patient had maxillary sinusitis 2 weeks post-operatively, probably due to the damages to the maxillary sinus during the surgery; however, opinions regarding the damages to the maxillary sinus greatly differ. Sumiya et al. [27] emphasized avoiding the sinus. Kim and Seul [2] noted that maxillary sinus damage was rarely a serious problem when bone segments were firmly fixed, if damaged. Skin necrosis approximately 1 cm in diameter occurred in 1 patient undergoing zygoma area liposuction, thus caution should be exercised to perform the 2 procedures simultaneously because it probably affects the blood supply of the local skin. The unilateral forehead wrinkle resolved in 1 patient; perhaps the forehead wrinkle was caused by dragging damage to the frontal branch of the facial nerve. Kim and Seul [2] reported there is possibility of facial nerve damage when surgeons use a pre-auricular incision. Although we had carefully assessed the pre-operative conditions of the patients and made adjustments during the operation, slight asymmetry was still observed in 13 patients, probably resulting due to the following reasons: (1) the osteotomy line was not identical on the 2 sides; (2) the soft tissue thickness in the zygomatic region is different on the 2 sides; and (3) the pre-operative asymmetry of the bone had not been properly corrected. Even though asymmetry can occur with other techniques, pre-operative evaluation and adjustment during surgery should be more precise to minimize such complications. Other complications, such as hematomas, permanent facial nerve damage, recurrence of the malar prominence, temporomandibular joint dysfunction, bone non-union, and cheek drooping, were not observed in the follow-up period. To achieve good results, mandibular angle reduction or genioplasty was also performed simultaneously in some of our patients. The entire face should be regarded as a single unit [26] and a coordinated proportion is crucial for facial beauty. If the patients have mandibular hypertrophy and/or a short chin, the above procedures should be recommended.

This technique has a limitation in that it is a demanding procedure, especially for neophytes, to properly control the distance between the 2 osteotomy lines to make a greenstick fracture.

Conclusions

This novel L-shaped infracture technique obtains good clinical results. Moreover, the L-shaped infracture technique has

many advantages, such as simple manipulation, no need for internal fixation, short operation and recovery times, and mild surgical complications.

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Disclosure

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