Zygoma Reconstruction

Michael R. Markiewicz, DDS, MPH, MD[a],
Savannah Gelesko, DDS[a], R. Bryan Bell, DDS, MD[b,c,d,*]

KEYWORDS

• Facial bones • Orbit • Zygoma • Maxillofacial surgery • Neuronavigation • Injuries
• Zygomaticomaxillary complex

KEY POINTS

- The most common error in reconstruction of acquired deformities of the zygoma is inadequate restoration of malar projection.
- Failure to adequately flatten the zygomatic arch and achieve optimal rotation of the zygomaticomaxillary complex results in flattening of the malar eminence and widening of the ipsilateral face.
- Modern digital technology may be used to optimize treatment outcomes in patients with complex deformities.
- Intraoperative navigation is used to assess malar projection and orbital implant position, and stereolithographic models are used to fit bone grafts or flaps at the time of inset.
- Modern mobile computed tomography scanners are helpful to evaluate the accuracy of the reconstruction and transfer the virtual plan into reality.

INTRODUCTION

The zygoma is a quadrangular structure composed of 4 articulations, commonly referred to as the zygomaticomaxillary (ZM), frontozygomatic (FZ), zygomaticotemporal (ZT), and the sphenozygomatic (SZ) sutures. Because the SZ is within the orbit, and the ZM and FZ articulations represent vertical buttresses of the face, accurate restoration of zygomatic anatomy is key to reestablishing facial projection, facial width, and orbital volume.[1] Knight and North[2] pointed out that the term zygoma fracture is misleading because there is usually no fracture of the zygoma bone, rather there are fractures of its neighboring sutures and their bones: the maxilla, the temporal bone, the sphenoid, and the frontal bone. Gruss and colleagues[3] recognized the importance of the zygoma in restoring facial projection, symmetry, and orbital volume. Posterior-lateral displacement of the zygoma results in ipsilateral facial widening and facial flattening. Normal anatomic contour and position of the malar eminence and zygomatic body is critical to achieving favorable results in reconstruction of the midface, regardless of cause.

APPLIED SURGICAL ANATOMY

Soft Tissue

Soft tissues of the face depend on the underlying bony architecture for functional support and appearance. Muscular attachments to the zygoma include (1) the masseter muscle, which attaches to the temporal surface of the zygomatic arch and zygomatic tuberosity, and has an inferior vector from its origin; (2) the temporalis muscle and

Funding Support: None.
Financial Disclosures: The authors have no financial disclosures to declare.
[a] Department of Oral and Maxillofacial Surgery, Oregon Health and Science University, SDOMS, 611 Southwest Campus Drive, Portland, OR 97239, USA; [b] Oral, Head and Neck Cancer Program, Providence Cancer Center, Oregon Health and Science University, 4805 NE Glisan Street, Suite 6N50, Portland, OR 97213, USA; [c] Trauma Service, Legacy Emanuel Medical Center, Oregon Health and Science University, 2801 N Gantenbein Avenue, Portland, OR 97227, USA; [d] Department of Oral and Maxillofacial Surgery, Legacy Emanuel Medical Center, Oregon Health and Science University, Portland, OR, USA
* Corresponding author. 1849 Northwest Kearney, Suite 300, Portland, OR 97209.
E-mail address: bellb@hnsa1.com

Oral Maxillofacial Surg Clin N Am 25 (2013) 167–201
http://dx.doi.org/10.1016/j.coms.2013.02.005
1042-3699/13/$ – see front matter

temporalis fascia, which originate at the frontal process of the zygoma, passing beneath the arch and attaching to the coronoid process of the mandible; (3) the zygomaticus major and minor muscles, which insert to support the oral commissures; and (4) the zygomatic head of the levator labii superioris, which originates just above the infraorbital foramen. The temporalis fascia resists inferior displacement of the downward pull of the masseter muscles in zygoma fractures. Tendinous attachments to the zygoma include the medial and lateral canthal tendons, and the Lockwood suspensory ligament. Horizontal globe position is maintained by the Lockwood suspensory ligament, which attaches laterally to the Whitnall tubercle 1 cm below the FZ on the medial aspect of the frontal process of the zygoma, and medially to the posterior aspect of the lacrimal bone (**Fig. 1**). The medial canthal tendon maintains vertical globe position, and is divided into 3 limbs: anterior, superior, and posterior. The anterior limb attaches to the anterior lacrimal crest and nasal bone. The posterior limb attaches to the posterior lacrimal crest and lamina papyracea. Accurate repositioning of the posterior attachment of the medial canthal tendon is critical to achieving ideal position during canthopexy. Accurate resuspension of the lateral canthus similarly depends on the position of the lateral canthal tendon at its attachment to the Whitnall tubercle. Inferior displacement of the lateral canthal tendon in zygoma fractures often results in an antimongoloid (downward) cant of the lateral canthus and care must be taken to reduce both components if the canthal attachments are disrupted.

Sensory nerves that travel through the zygoma originate from the second division of the trigeminal nerve and include the zygomatic nerve, which enters the orbit at the inferior orbital fissure and divides into its terminal branches; the zygomaticofacial nerve, which exits the orbit onto the face although the zygomaticofacial foramen; and the ZT nerve, which enters the temporal fossa through the ZT foramen on the deep surface of the zygoma. The zygomaticofacial and ZT nerves supply sensation to the skin overlying the malar prominence and the anterior temple area, respectively. The latter area is a focus of pain postoperatively after zygomatic trauma and reconstruction. Although the infraorbital foramen and nerve are often involved in zygoma fractures, they are located within the maxilla. The infraorbital nerve travels through the infraorbital groove and exits through the infraorbital foramen, 10 mm inferior to the rim and parallel to the lateral surface of the cornea in forward gaze. Before exiting the infraorbital foramen, its branches give sensation to the maxillary teeth, ipsilateral nose, upper lip, and lower eyelid. All these branches may be affected by zygoma fractures.

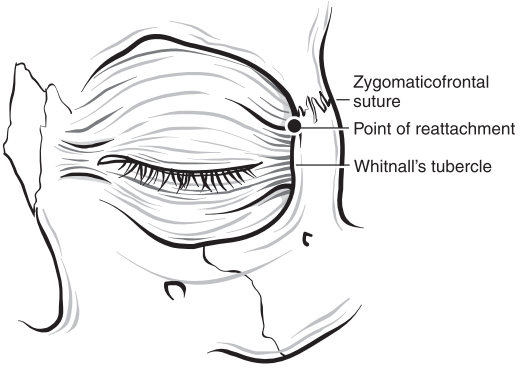

Fig. 1. Lockwood suspensory ligament attaches laterally to Whitnall tubercle, which is located on the zygoma approximately 1 cm below the FZ suture. (*From* Manson PN. Fractures of the zygoma. In: Booth PW, Schendel SA, Hausamen JE, editors. Maxillofacial surgery. 2nd edition. St Louis: Churchill Livingstone; 2006; with permission.)

Hard Tissue

The facial skeleton is composed of low stress-bearing curved areas composed of thin bones that surround pneumatic cavities and sinuses positioned between high stress-bearing buttresses. The low stress-bearing thinner bony walls are more likely to show instability and comminution following fracture. Buttresses are architectural structures built against or projecting from a wall that serve to reinforce and support that wall. As in architecture, the buttresses of the face may support bony walls from the side, from directly beneath, or from the top (**Fig. 2**). Trusses are architectural units built of 1 or more triangular units that resist tensile, compressive, and shear loading forces. The nodes of the trusses are where all legs of the triangles connect. These are areas where external forces and reactions to these forces are applied. The structural pillars of the face act as an interconnecting network serving as both buttresses and trusses that connect the facial bones to the cranial base.[4] Bones adjacent to these pillars form the walls of cavities, including paranasal sinuses, and the orbits.[5] These bones are thin because of the minimal force placed on them, and provide support and portioning of soft tissues.

The buttresses of the facial skeleton represent areas of thicker bone that transmit chewing forces to the supporting regions of the skull. The vertical structural pillars of the midface as described by Sicher and Tandler[6] include vertical buttresses of the midface: the nasomaxillary (continues as