Ministry of Higher Education and Scientific Research
Misan university
College of Dentistry
Graduation Project

وزارة التعليم العالي والبحـــث العلمي
جامعة ميسان
كلية طب الأسنان
بحث تخرج

Complications of zygomatic bone fracture and its effected on the teeth

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2025A.D **1446A.H**

Maysan-Iraq

بسم الله الرحمن الرحيم

﴿يَرۡفَعِ ٱللَّهُ ٱلَّذِينَ ءَامَنُواْ مِنكُمۡ وَٱلَّذِينَ أُوتُواْ ٱلۡعِلۡمَ دَرَجَٰتٖۚ وَٱللَّهُ بِمَا تَعۡمَلُونَ خَبِيرٞ﴾

صدق الله العلي

Dedication

To the one who adorned my name with the most beautiful titles and supported me without limits.

To the one under whom God made Paradise possible and whose supplications made hardships easy for me.

To the proof of God and His guardian on His earth and in His lands.

The one with whose light the earth will shine and with whose appearance justice will spread.

To the possessor of the righteous countenance and the praiseworthy forerunner.

The one who will fill the earth with justice and equity.

The namesake of the Messenger of God and the remainder of the righteous predecessors in his nation, the awaited Imam Mahdi (may God hasten his reappearance).

And to those who receive provision from their Lord. By their martyrdom we live.

Supervisor Certification

This is to certify that this undergraduate dissertation entitled "Complications of zygomatic bone fracture and its effected on the teeth" was prepared by the undergraduate students Abu Al-Hassan Ali And Fatima Khaled under my supervision at the College of Dentistry / University of Maysan as partial fulfillment of the requirements for B.D.S .degree

Supervisor's signature

Dr. Afrah Adel

MSc Human Anatomy

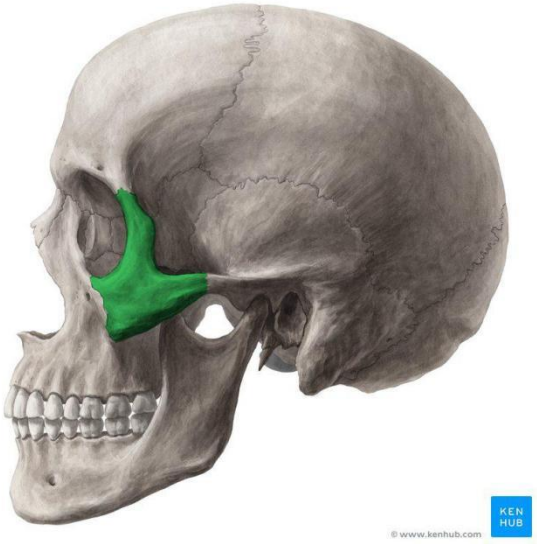
List of Contents:

Table of Figures

Introduction♦ :

One of a pair of bones on each upper side of the face that forms the cheek and part of the eye socket. The zygomatic bones help give shape and structure to the face and are connected to the jaw and bones near the ears, forehead, and skull.

They protect the nerves and blood vessels that run through the face and provide an attachment for muscles that help the jaw move. zygomatic" comes from the Greek "zygon" meaning a yoke or crossbar by which two draft animals such as oxen could be hitched to a plow or wagon the common name for the zygomatic bone is the cheekbone. It is also sometimes called the malar bone.(Yoon H, Kim J, Chung S, Chung YK. 2014;)



Yoon H, Kim J, Chung S, Chung YK. 2014;

This bone forms the part of the cheek that is most prominent and is a paired bone, occurring on both the right and left sides of the nose. Each zygomatic bone is diamond-shaped and composed of three processes with similarly named associated bony articulations: frontal, temporal, and maxillary.

Each process of the zygomatic bone forms important structures of the skull and zygomatic arch can see it from the base of skull The zygomatic bone is relatively strong and made of compact bone. It is a quadrilateral in shape and articulates with four other bones: maxilla, sphenoid, temporal, and frontal bones. The zygoma articulates with the maxilla in two junctions, superiorly forming the inferior orbital rim and inferiorly forming the zygomaticomaxillary buttress.

We have three sutures in zygomatic bone, the frontozygomatic, sphenozygomatic and temprozygomatic suture the zygoma represents a strong prominent bone with four processes. When force is applied to the zygoma, the forces are often transmitted along with the four processes which include the maxillary, frontal, orbital (sphenoidal), and temporal. Displaced ZMC fractures may produce gross asymmetry based on loss of anterior projection of the malar eminence, alteration of the lateral projection of the zygomatic arch, and the disruption of the three-dimensional position of the globe. Fractures of the zygomatic bone are common in facial trauma, and understanding the anatomy and relationships of the zygoma to the adjacent anatomical structures is the key for successful treatment

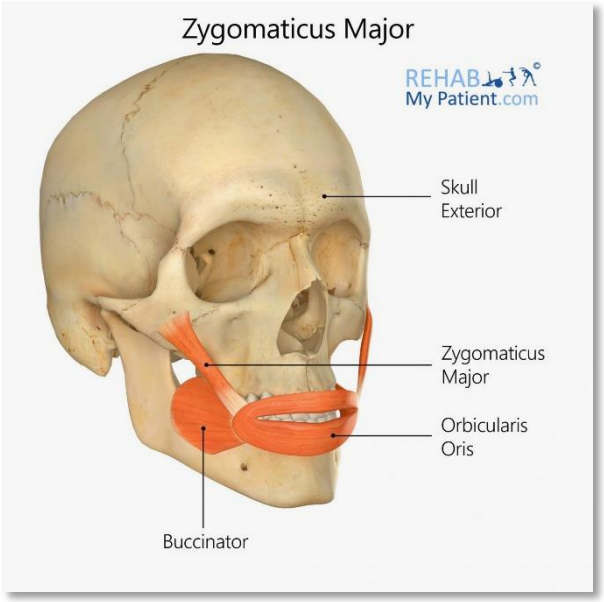
.(Head and Neck, 2016)

Muscles' attachment to the zygoma:

can be grouped, according to the surface of origin/attachment into two: the malar surface and the temporal surface.

A: The first is the muscles attached to the malar surface which includes the zygomaticus major, the zygomaticus minor, and the levator labii superioris .

1. The zygomaticus major muscle raises the upper lip to bare the upper teeth. It additionally deepens and raises the nasolabial furrow. Acting in conjunction with other muslces of facial expression that elevate the lip, it curls the upper lip to produce facial expressions such as smiling, disdain, contempt, or smugness.



van Hout WM, van Cann EM, Muradin MS, Frank MH, Koole. 2014

It is a muscle of facial expression, which draws the angle of the mouth superiorly and posteriorly to allow one to smile. Bifid zygomaticus major muscle is a notable variant, and may cause cheek dimples .

2- Musculus zygomaticus minor

It draws the upper lip backward, upward, and outward (used in making sad facial expressions). Like all muscles of facial expression, it is innervated

B: The second group include the masseter and temporalis muscles

The muscles attached to ZMC are the zygomaticus major, zygo maticus minor, orbicularis oculi, and masseter Masseter is

attached to the zygomatic arch on the lateral and inferior aspect

as well as the zygomatic tuberosity the downward

displacing forces of the masseter have been considered by many

as the principal cause of post-reduction instability

The temporal fascia attached to the arch superiorly plays

a major role in resisting the downward displacement of frac turned ZMC or arch. *Standring, S. (2016)*

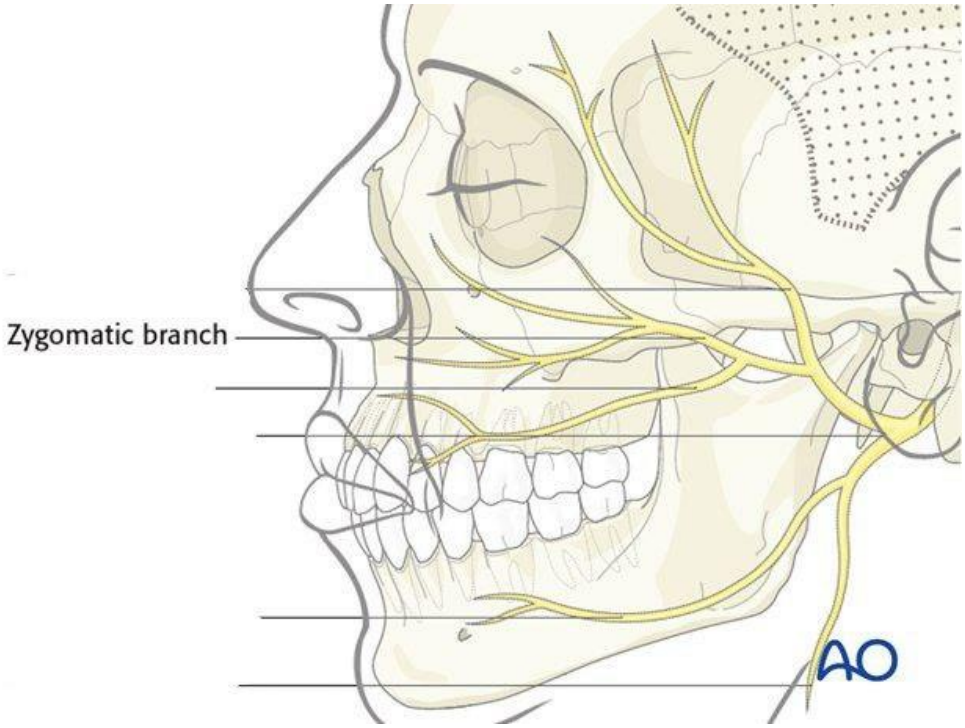
The zygomatic nerve:

a branch of the superior trigeminal nerve, arises in the pterygopalatine fossa. This nerve carries cutaneous fibers and postsynaptic parasympathetic fibers arising from the pterygopalatine ganglion.

These latter fibers, the zygomatic nerve enters the orbit through the inferior orbital fissure and along the floor of the orbit (infraorbital sulcus) branches into the zygomatic facial nerve and the zygomaticotemporal nerve (ZTN) at an angle of approximately 20° to 40° between them (4, 7).

In the lateral orbit, a communicating branch of the lacrimal nerve joins the ZTN. The ZTN then passes through the zygomaticotemporal foramen on the temporal surface of the zygomatic bone to enter the temporal fossa (10). Sensory fibers from the lateral aspect of the forehead enter the eye socket through a foramen in the zygomatic bone as the zygomaticotemporal nerve. Fibers from the lateral aspect of the cheek and lower eyelid enter the orbit through a foramen in the zygomatic bone as the zygomatic facial nerve.

These two nerves join to become the zygomatic nerve and run along the lateral orbital wall, exiting the orbit through the inferior orbital fissure and joining the maxillary nerve. (*Rea, Paul ,2016).*



osensory change in the infraorbital nerve following zygomatic 2005;

Etiology:

➢Road traffic accidents (RTA): the most frequent causes of facial fractures.

➢Assaults and interpersonal violence

➢Fall

➢Sport-related injuries.

➢Work-related accidents

➢Gunshot or missile injuries; usually cause complex pattern of trauma characterized by bone and soft tissue loss and comminuted fractures of the facial bones.

There are three main functional limitations that can result from an OZM fracture

1-The first is diplopia. For vision, the eyes focus on the same object and move in synchronous motion. Even though the eyes are in different positions ،

Diplopia occurs because the eyes are unable to coordinate focus so that two separate images are perceived. The eyes are unable to coordinate movement to focus on a single object .

But the main cause is retention of orbital contents, muscle, fat, or a combination of the two. In addition, edema after the injury may also cause restricted movement of the globe. In rare cases, damage to the oculomotor nerve has been documented

1- The second functional deficit is the sensory alteration of the maxillary branch of the trigeminal nerve.

This often occurs from nerve contusion or constriction from the OZM fracture Although there is cortex surrounding the foramina, the infraorbital foramen represents a weak point in the zygomaticomaxillary complex, and fractures tend to propagate through this foramen. In addition,

oftentimes the nerve is also damaged due to the orbital floor fracture, similar to isolated orbital floor fractures. Patients will often develop V2 paresthesia when the force propagation from the development of the OZM directly traumatizes the nerve coursing from the inferior orbital fissure to the infraorbital foramen.

2- The third functional deficit involves the development of trismus Although patients who sustain OZM fractures will have difficulty opening their mouth due to pain and edema, there is a need to differentiate between mechanical obstruction and guarding and pain.

   If the OZM complex is displaced posteriorly or significantly medial, then there is a possibility that the patient’s coronoid process will be restricted in movement during opening motions. If the patient presents with trismus that cannot be manipulated

or opened due to the feel of a mechanical restriction, then most likely the OZM complex is the likely cause. *(Suresh V et al ,2018)*

The isolated zygomatic arch fracture is classified as,

Type I: Nondisplaced fractures,

Type II: Greenstick fracture with or without coronoid impingement,

Type III: Single displaced fracture with or without coronoid impingement,

Type IV: Multiple displaced fracture with or without coronoid impingement

Type V: Comminuted

Zygomatic Arch Fractures

Zygomatic arch fractures can occur as isolated fractures or as part of ZMC fractures Isolated zygomatic arch fractures make up 10% of all zygomatic injuries, and result when a blow is applied directly to the lateral aspect of the head.15 Characteristically, isolated fractures of the zygomatic arch result in a V-shaped or W-shaped fracture segments.

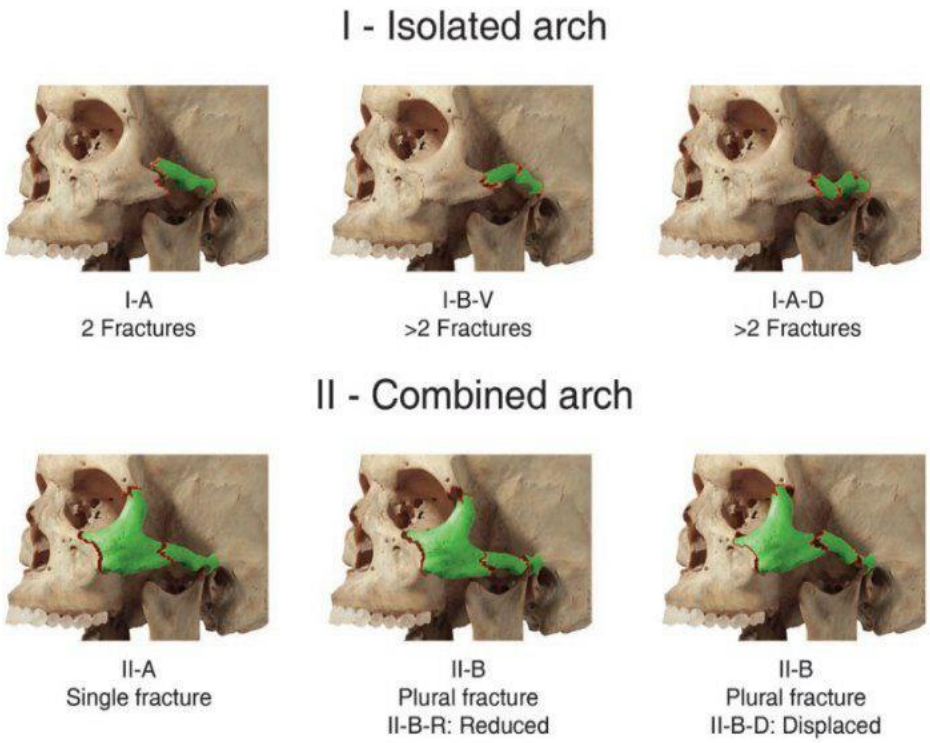
These segments are usually displaced inwards, resulting in a dimple in the overlying skin. The fracture segments may impinge on the coronoid process or temporalis muscle and interfere with mandibular movement.

Nondisplaced or minimally displaced fractures of the zygomatic arch often require no treatment. The exception is in the thin-skinned, often older patient in whom minimal deformity is esthetically apparent.

Two weeks should be given for resolution of swelling for final evaluation of esthetic deformity. Isolated zygomatic arch fractures often involve the ZT suture and posterior zygomatic arch. For noncomminuted zygomatic arch fractures, a straight rigid instrument such as a Dingman elevator can be used to run the arch. After reduction via techniques that are discussed later, the arch usually maintains its integrity.

Only in the most severe, high-energy comminuted fracture does the ZT need to be exposed reduced and plated. *(Atlas of the Oral and Maxillofacial Surgery Clinics, 2013)*

Le Fort fractures are fractures of the midface, which collectively involve separation of all or a portion of the midface from the skull base. In order to be separated from the skull base, the pterygoid plates of the sphenoid bone need to be involved as these connect the midface to the sphenoid bone dorsally. The Le Fort classification system attempts to distinguish according to the plane



of injury.

Dym H, Wolf JC. Oroantral communication 2012

The used classification is as follows:

Le Fort type I

horizontal maxillary fracture, separating the teeth from the upper face

fracture line passes through the alveolar ridge, lateral nose and inferior wall of the maxillary sinus also known as a Guerin fracture

Le Fort type II

pyramidal fracture, with the teeth at the pyramid base, and nasofrontal suture at its apex fracture arch passes through the posterior alveolar ridge, lateral walls of maxillary sinuses, inferior orbital rim and nasal bones

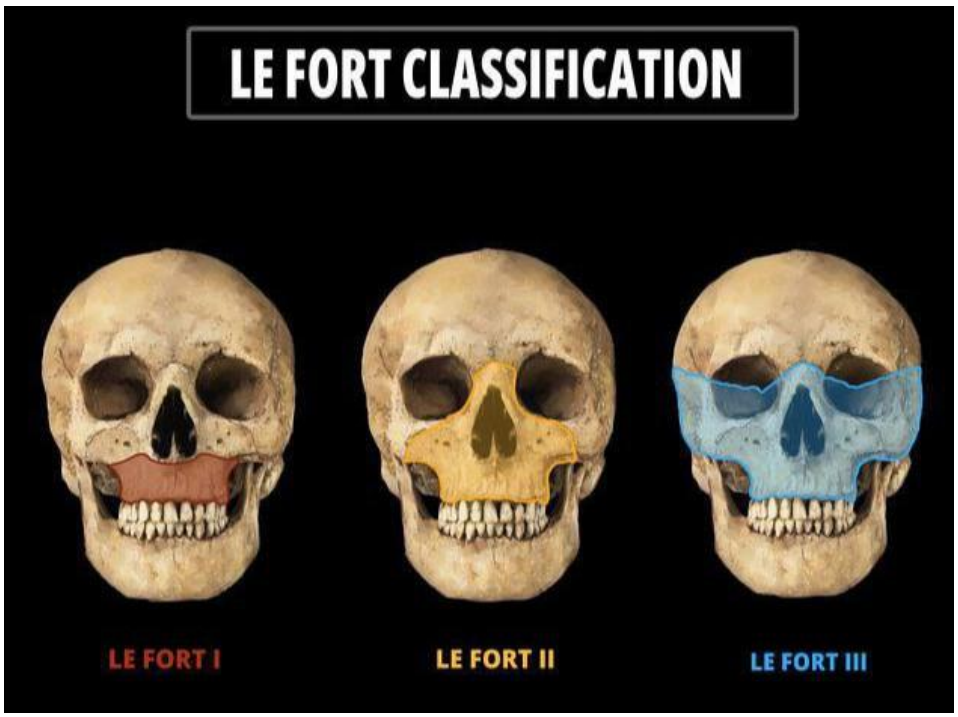
uppermost fracture line can pass through the nasofrontal junction or the frontal process of the maxilla 3

Le Fort type III

craniofacial disjunction transverse fracture line passes through nasofrontal suture, maxillo-frontal suture, orbital walls, and zygomatic arch/zygomaticofrontal suture because of the involvement of the zygomatic arch, there is a risk of the temporalis muscle impingement

unsurprisingly type III fractures have the highest rate of CSF leak

Lippincott Williams & Wilkins. (2007)



Rajantie H, Snäll J, Thorén H. 2018

Assessment for Facial Deformity

1-Malar area

One of the most obvious clinical presentations of a displaced OZM fracture includes the gross asymmetry of the face. This asymmetry may be a manifestation of a depressed malar prominence or a unilateral widening or depression of the lateral face.

These deformities are often better appreciated from a “bird’s eye” view standing from behind the head of the patient looking downward, or a “worm’s view” looking upward from below. The malar prominence is usually located 1 cm lateral and 2 cm inferior to the lateral canthus.

When flattening of the malar prominence occurs, the complex is usually displaced posteriorly or rotated in medially. When the widening of the face is noted, the cause usually involves the medial rotation of the anterior component of the OZM, with lateral rotation of the zygomatic process at the arch. Bony steps, depression, and tenderness are findings

often associated with palpation of the malar area of the OZM fracture. Loss of malar projection may be difficult to discern secondary to facial edema. It is very important to simultaneously palpate both sides of the face from a “bird’s eye” perspective for a better perception of the posterior displacement of the fractured complex.

Finally, crepitus may also be palpable in the malar and periorbital soft tissue areas due to air emphysema from the maxillary sinus.

2- Zygomatic arch:

The arch area of an OZM fracture commonly reveals depression of the lateral aspect of the cheek. The manifestation of zygomatic arch displacement depends on the vector in which the force is applied. If there is a force applied directly to the arch or from a lateral to direction, most commonly the arch will be fractured inward.

However, if the force is applied to the complex in a posterior direction, the arch tends to displace in a lateral dimension. Steps, tenderness, edema, depression, and a mobile fragment of the arch are often palpated in the area of the arch secondary to an OZM fracture.

3- orbital and ocular structure :

the patient will present with edema, ecchymosis, and, on occasion, lacerations of the periorbital tissues including the eyelids. Additional traumatic orbital findings involve the sclera, which includes chemosis and subconjunctival heme.

Globe positioning is often affected by a displaced zygomaticomaxillary complex and can manifest itself in enophthalmos, exophthalmos, and dystopia. In addition, change in position of the palpebral fissure, antimongoloid slant, or ectropion may occur from downward and lateral displacement of the OZM on the lateral canthal ligament.

(Winegar, et al,2013)

Rradiographic Examination:

A non-contrast maxillofacial CT with axial and coronal cuts at 1.5 mm increments is the standard radiographic study utilized in providing the

information required to diagnose and plan for the treatment of the OZM fracture.

The CT examination customarily begins with the axial orientation. The axial CT is always obtained for the evaluation of a trauma patient with suspected head and neck injuries. The axial orientation allows the brain, cervical spine, and face to be evaluated at the same time.

During the CT examination, all aspects of the facial bones should be examined, however for the purposes of confirming an OZM fracture, the first component encountered will be the zygomatic sphenoid fracture.

As the exam progresses inferiorly, the next fracture that will be identified is the zygomaticotemporal fracture, followed by the zygomaticomaxillary component. If there is a fracture located at each of these locations, there is a very high suspicion of an OZM fracture.

On the coronal orientation of the maxillofacial CT, a systematic examination progressing from the anterior aspect to the posterior is completed. The first fracture encountered on the coronal perspective is the orbital rim or zygomaticomaxillary component, and almost simultaneously the zygomaticofrontal component will come into view. In addition, the coronal CT will confirm the presence of an orbital floor fracture

The sagittal perspective is not necessary to diagnose an OZM fracture *(Susan Standring. Gray's Anatomy. (2015)*

Principles of Management

Timing of Intervention

ZMC fractures are not emergencies, and treatment can be

delayed, if necessary - When the decision is “no immediate intervention,” sur gery may be postponed for up to 2 weeks, following

which a reassessment may be made-

When the indications are questionable, for example, pres ence of severe edema or fractures with minimal displace ment, it is advisable to wait for the edema to subside so that the deformity may be assessed better -

When the indications are defnite, immediate intervention

Fracture reduction may be done either by direct or indirect method, and the approaches may be extraoral or intra oral

Direct vs. Indirect Method

The indirect method is a blind technique where fracture is

reduced without exposure of the fracture site (e.g., Gillies

reduction), while direct method involves reduction of the

fracture under direct visualization (e.g., coronal approach to reduce arch fracture).

The differences between the two methods However, indirect method is more commonly practiced. Open method is resorted to when the ZMC fracture is severely displaced, complex orcomminuted, when stable reduction is doubtful, and there is a need for internal orbit reconstruction. However, no single technique" is superior, and sometimes, a combination of techniques is more effect

The extraoral reduction techniques may be either percutane ous, temporal, or endoscopic

Temporal approach, commonly called the Gillie's is the most popular method of ZMC reduction. This approach is favored because the

incision is placed within the hairline which does not leave

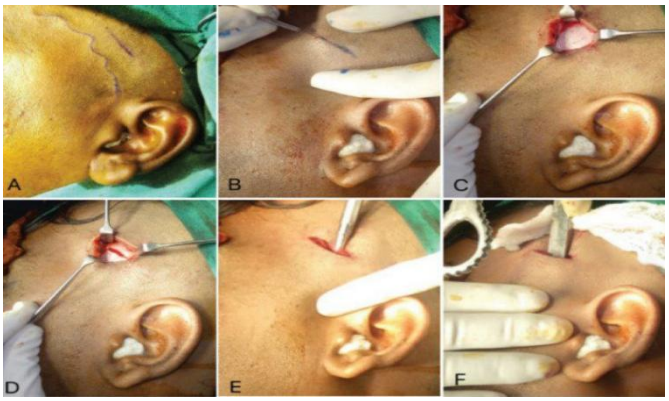
a visible scar. The technique is based on the ana tomical basis that the plane between the temporalis fascia and the temporalis muscle offers direct access to the zygomatic arch and zygoma. The only contraindication to this approach is the presence of concomitant temporal bone fracture.

The incision is placed at a level 2 cm above the helix of the ear, paralleling the anterior branch of the superfcial temporal artery, well within the hairline

Dissection is carried down through the skin ‹subcutaneous tissue, and galea aponeurotica (temporopa rietal fascia—TPF) to reach the tempo

The process

An incision is made through the temporalis fascia to reveal the underlying temporalis muscle. A Howarth's elevator is inserted between the temporalis fascia and the muscle, to create a plane for the zygomatic elevator. Two types of zygomatic elevators, namely, the Bristow's and Rowe's are commonly used; the Bristow' s



Ellis E 3rd, Perez D.2014;

has a single fat and elongated working tip attached to a handle and is used like a spatula for elevation, while the Rowe's elevator has an additional arm attached to the

working tip which serves two purposes:

(1) to provide thenecessary countertraction during elevation so that it relieves the fulcrum off the temporal bone and

to eval uate the approximate depth of insertion of the working tip when inserted into the tissue. The zygomatic elevator is positioned in the plane created, directed inferiorly to

reach the deeper surface of the zygoma and carefully elevated, while an ironing motion is used to smoothen (Yoon H et al,2014)

Intraoral Techniques

The greatest advantage of intraoral techniques is “no skin

:incision.” Commonly followed methods are

Balasubramaniam’s/Keen’s approach (upper buccal sulcus approach) •

This approach uses a vestibular incision behind the zygomatic buttress. A Howarth’s periosteal elevator is inserted in a supraperiosteal plane to engage the infratemporal surface of the zygoma. Reduction is achieved an upward, forward, and outwardly directed force. with

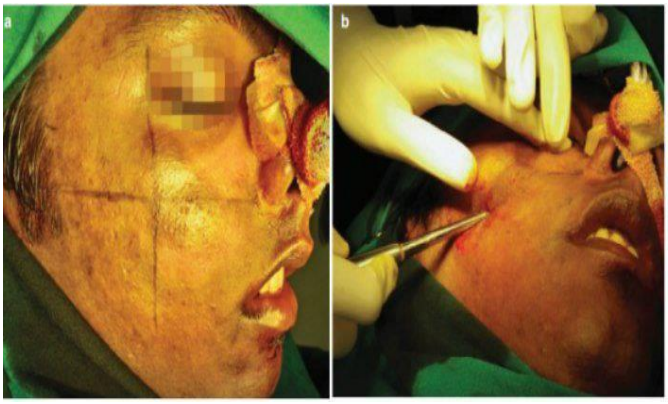
When greater force is needed to elevate as in impacted
zygomas Different approaches for reduction of fractured ZMC. (a)
E. Gillie’s. (b) Poswillo. (c) Dingman. (d) Balasubramaniam. (e) Quinn
Panneerselvam et al.

Intra-operative Assessment

of Reduction

The intra-operative assessment of reduction is a critical step in zygoma management, especially in closed reduction. The methods commonly used are (1) clinical assessment, (2) imaging, and (3) use of prefabricated .guides/stents

1-Clinical assessment is usually done by eyeballing, comparing with the normal side or palpation of the rims for steps. However, the adequacy of reduction may be diffcult to assess intra-operatively because of edema as well as patient position.



Menon A, Karikal A, Shetty V. 2018

Audible click during manipulation is also indicative of reduction Surgical exposure of multiple suture sites is the other method to confrm reduction but is less favored because of surgical morbidity. However, exposure at all sites of articulation is not required; two sites .are considered perfect indicators of accurate reduction

2- Intra-operative imaging such as C-arm CT , O arm, or endoscopes

3- Prefabricated guides/ stents

are valid tools which ensure accuracy of reduction. *(Connolly KL et al,2015)*

Model Surgery

The process begins with obtaining CT scans of patient with minimum slice thickness of 0.6 mm.This is followed by two .different sequences of workflow which are described below

(A) Planning Using Physical Models

The first step involves generation of a physical stereo-lithographic model (STL) from the CT scan of the patient. There are two methods by which :this can be done

1-STL model with the actual deformity: This model presents the posttraumatic deformity, as observed clinically. A routine model surgery is then per formed, by which the displaced fragments are cut and .repositioned to obtain optimal anatomical form

The repositioned fragments are stabilized temporarily with wax. The fxation devices (miniplates) are then pre-contoured over the model. Such pre-contoured implants are used to guide intra-operative .fracture reduction as well as fxation

2. STL model after mirroring: CT scan is used to generate a virtual model wherein the normal side is mirrored onto the fractured side. The virtual model is used to print a physical model which demonstrates the skull which is bilaterally symmetrical, mimicking ideal reduction status. Similar to the earlier method, implants for fxation are pre-contoured over this model to help achieve optimal results intra-oper atively.

(Martinez AY et al,2012)

(B) Planning Using Virtual Models

This method utilizes the complete spectrum of computer- assisted surgical planning. A CT scan is obtained to create a virtual model on reduction is performed and on which the entire surgical sequence of which the stents for intra-operative guidance are designed. Intra- .operative stents are printed from these virtual designs

In the case of a unilateral ZMC fracture, the normal side is mirrored to • the fractured side to obtain bilateral symmetry. CAS technology is then utilized to design "guidance stents" on the mirrored side.

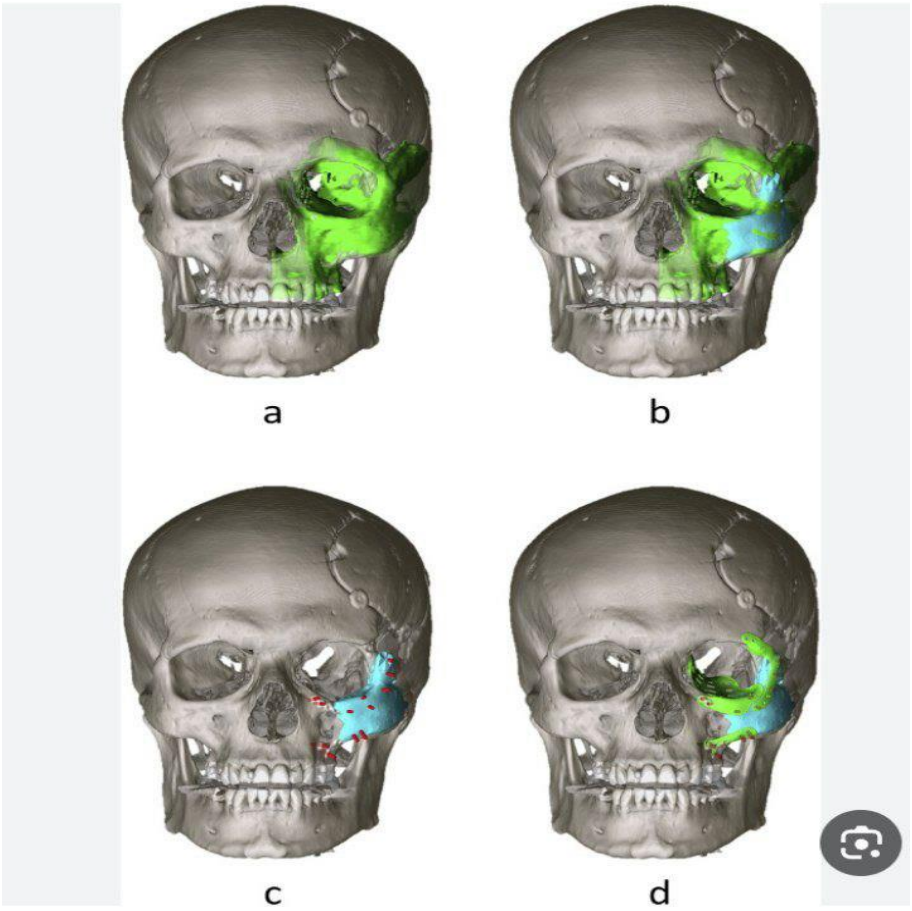
These stents can be utilized intra-operatively to (1) verify ideal reduction position in primary trauma or (2) design the osteotomy and repositioning, in secondary corrections. Another important advancement in recent years is the design and printing of "patient- -specific implants" (PSI) using .virtual planning

In bilateral ZMC fractures mirroring is not an option•

(Martinez AY et al,2012)

Roig AM, Mommaerts MY, I Ayats

JP. Jacob's disease:. 2001



Roig AM, Mommaerts MY, i Ayats JP. Jacob's disease:. 2001

Fixation Techniques for Fixation of Orbital, Zygomatic and Maxillary Fractures

The purpose of internal fixation is to stabilize the bony fragments to allow the bone to heal normally. The generally accepted theory of bone healing for facial fractures is osteoporotic fixation. The concept is based on normal physiologic fracture healing that relies on vitality, stability and .minimal spacing between the fractured fragments

Three basic fxation methods are available for ZMC

fractures

1 Temporary support

2 Indirect fxation and

3. Direct fxation

Trans-osseous wiring using stainless steel wires is rarely •

used in current practice due to its nonrigid mode of fxa tion that ‹compromises post-reduction stability. However

it still remains a useful technique for fracture reduction by

traction, especially at the FZ and IOR. The advantages

include minimal periosteal stripping and lesser hardware

.as compared to use of miniplates and screws

Antral packing [89] with gauze or balloon/Foley's cath eter is used in • special scenarios where the ZMC

[90 ‹1] Kirchner or K wires and Steinmann pins •

K wires and Steinmann pins constitute an indirect method •

of fxation whereby the fractured zygomatic bone is fxed

in a secure fashion to another stable point in the craniofacial skeleton. Such indirect anchorage may be obtained by

using pins (1) to secure the fractured fragment to other

stable bones or (2) to provide anchorage for connectors of

an external fxator.

Lag screws have been found to be an effective alter native at the FZ region because of the additional stability

offered by interfragmentary compression. But this tech nique requires .adequate bone stock for fxation

Micro screws Micro screws are 2 mm screws which •

are used to fx sagittal zygomatic fractures by using the

lag screw technique. These screws also reduce hardware

• Miniplates The principal method of fixation isminiplate osteosynthesis.

Digital surgical tem plates for managing high-energy zygomaticomaxillary complex 2013;

Fixation of Zygomatic Arch:

The ORIF of arch fracture is indicated when the fragments

are unstable after closed reduction and in cases where reestablishment of .sagittal projection of face is needed

‹Fixation may be performed by one of the three methods

based on the fracture pattern:

1- a miniplate for an arch demonstrating a single fracture line

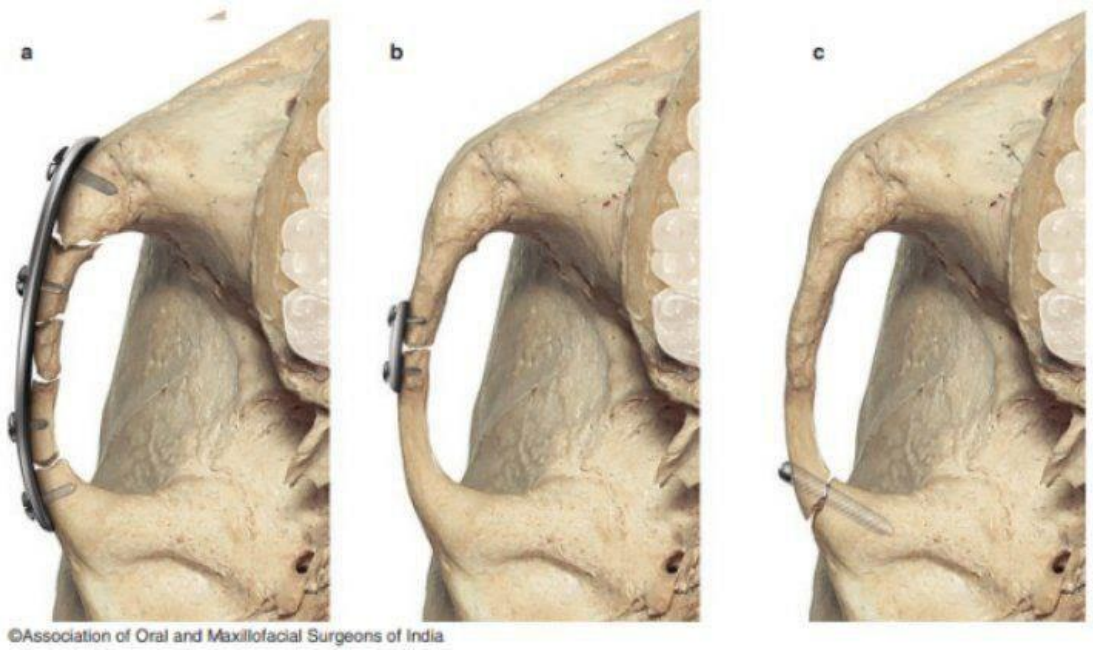
‹ 2- a spanning adaptation plate when the arch is multi-fragmented

3-a micro screw for an outfractured root or sagittal fracture of the arch

Kim et al. proposed plating on the superior .

surface of the upper border as an alternate line of arch fxation which negated the drawbacks associated with the conventional fxation

(Brown R et al,2017



.Gong X, He Y, An J, Yang Y, Huang2013

References

Brown, R., Lozada, K., Kadakia, S., Gordin, E., & Ducic, Y. (2017). Prophylactic midface lifts in midfacial trauma. Facial Plastic Surgery, .33(3), 299-304

Connolly, K. L., Albertini, J. G., Miller, C. J., & Ozog, D. M. (2015). The suspension (Frost) suture: experience and applications. .Dermatologic Surgery, 41(3), 406-410

Dähnert, W. (2007). Radiology review manual. Lippincott .Williams & Wilkins

Martinez, A. Y., & Bradrick, J. P. (2012). Y modification of the transconjunctival approach for management of zygomaticomaxillary complex fractures: a technical note. Journal .of Oral and Maxillofacial Surgery, 70(1), 97-101

Rea, P. (2016). 2 - Head. In Essential clinically applied anatomy of .the peripheral nervous system in the head and neck

.Standring, S. (2015). Gray's anatomy. Elsevier Health Sciences

Standring, S. (2016). Gray's anatomy (41st ed.). Elsevier .Churchill Livingstone

Suresh, V., Anolik, R., & Power, D. (2018). The utility of Polyether-Ether-Ketone implants adjacent to sinus cavities after craniofacial trauma. Journal of Oral and Maxillofacial Surgery, .76(11), 2372-2377

Winegar, B. A., Murillo, H., & Tantiwongkosi, B. (2013). Spectrum of critical imaging findings in complex facial skeletal .trauma

Yoon, H., Kim, J., Chung, S., & Chung, Y. K. (2014). Effectiveness of dual maneuver using K-wire and Dingman elevator for the reduction of unstable zygomatic arch fracture. .Archives of Craniofacial Surgery, 15(2), 59-62

Atlas of the Oral and Maxillofacial Surgery Clinics. (2013).