MANAGEMENT OF ZMC FRACTURES

Contents

- Management of Zygomatic Fractures
  - Optimum time for treatment
  - Surgical approaches
  - Reduction techniques
  - Fixation techniques
- Pediatric Zygomatic Complex Fractures.
- Complications
- Conclusion
- References

The following factors have to be considered for open reduction:

- ✔The presence of any ophthalmic injuries.
- ✔Progressive proptosis
- ✔Deterioration in visual acuity
- ✔Visual integrity on the unaffected side
- ✔The necessity for immediate operation in relation to other facial or general injuries
- ✔The medical condition of the patient.

- Optimal time for Rx: after 5 – 7 days

Advantages :

- ✔ The gross edema of face subsides
- ✔ Assessment of diplopia
- ✔ Improved radiograph – because antrum is not totally obscured by blood.
- ✔ Hematoma is not organized into fibrous tissues, thus dissection is easier to achieve

Controversies in treatment of ZMC

1. Should surgical exposure of zygoma in 2, or 3 dimensions routinely be performed to determine if reduction is adequate?
2. Should fixation devices be routinely applied?
3. Does the internal orbit require reconstruction?

INDICATIONS FOR SURGERY

- To restore the normal contour of the face both for cosmetic reasons and to re-establish the skeletal protection for the globe of the eye.
- To correct diplopia .
- To remove any interference with the range of movement of the mandible .
- Relieve pressure on the infra-orbital nerve.

- While closed reduction techniques are popular and attractive in management of fractures in this region, the experienced surgeon will be quick to see, in many cases, the limitations the closed methods impose

-***Dingman and Natvig***

Determining if zygoma has been properly reduced

- Literature recommends closed reduction techniques to 3/4 point surgical exposure

- Surgical exposure helpful when:

1. Clinical & radio graphical exam indicate internal orbital reconstruction
2. Surgery to be performed in excessive facial edema, exposure to determine ZMC position

3. One can’t determine if reduction is adequate
4. Fixation devices are deemed necessary from preoperative evaluation.

- Fractures at ZM arch and S-Z suture are sensitive indicators of ZMC position.

- Exposure of ZM buttress: valuable clue about ZMC reduction

- Reciprocal relationship exists between malar projection and facial width

- Navigation or intra-operative CT Scan reduces amount of surgical intervention

INDICATIONS FOR FIXATION

1. Comminuted fracture fragments.
2. Doubt regarding the stabillty of zmc#
3. Role of masseter in displacement.

   Albright and McFarland recommended IMF following fracture reduction to help reduce the pull of the masseter muscle on the repositioned ZMC.

- *Dal Santo and colleagues* compared masseter muscle force post trauma and found that the muscle developed significantly less force amongst pts who sustained zmc fractures and even after 4 weeks the force was below control levels.

4. Long standing #
5. # with bone loss

Need for internal orbit reconstruction

- Low energy ZMC # don’t have herniation of orbital contents into sinus, or entrapment of ocular muscles

- Orbital floor and walls reconstructed in 44% isolated ZMC # -Ellis & Kittidumkerng

- Reconstruction of internal orbit:

1. Comminution of orbital floor and walls
2. Prolapse of orbital soft tissue in maxillary or ethmoid sinus
3. Orbital volume increase in blow out #

Treatment algorithm for ZMC # without need for internal orbit reconstruction

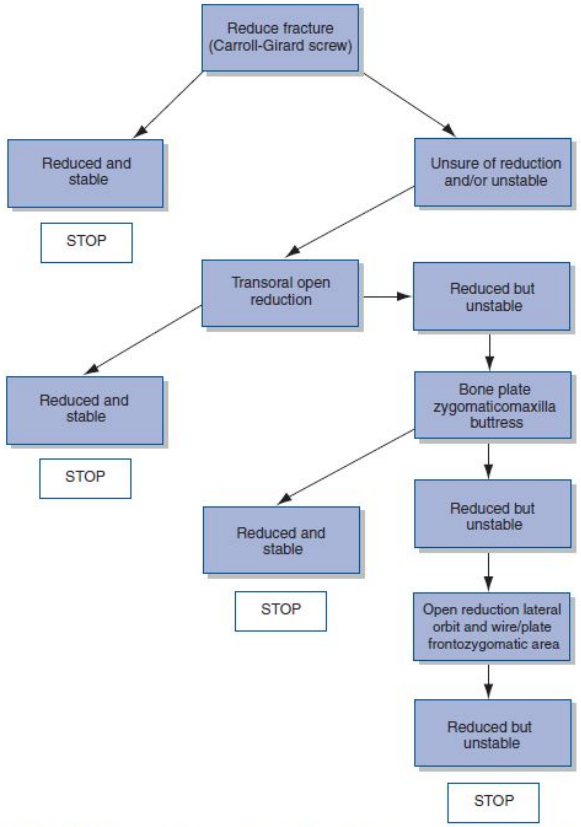


FIGURE 23.2-8 *Zygomatic complex fracture without need for internal orbit reconstruction. Adapted from Ellis E and Kittidumkerng W.*[23]

Principles in the treatment of ZMC Fractures

1. Prophylactic antibiotics
   - Infection post zmc #, reduction low
   - Zmc # compound—prophylactic Abs appropriate
   - Ampicillin, Amoxicillin, Clindamycin, Cephalosporin

2. Anesthesia
   - Isolated zmc # GA with oral intubation
   - Access to side of #, table head

3. Clinical examination and Forced Duction Test
   - In GA liberty for digital pressure palpation
   - Visualize contralateral zygoma

4. Protection of the globe
   - Scleral shield/ temporary tarsorraphy suture

5. Antiseptic preparation
   - Standard scrubbing and draping protocol
   - Prepare I.O with throat pack, antiseptic rinse

6. Reduction of the fracture

7. Assessment of reduction
   - Success/failure of reduction obvious after 3 pt exposure
   - Palpate orbital margin, F-Z region, Z-M buttress region

8. Determination of necessity for fixation
   - Imp to know post reduction if stable by itself or requires fixation

9. Application of fixation device

10. Internal orbital reconstruction
    - Often reduction of zygoma-allignment of orbital floor
    - Recons done post repositioning, stabilizing zmc #

11. Assessment of ocular motility
    - Forced duction test done @ end of all active Rx

12. Bone graft extra-orbital osseous defect
    - Recons with graft prevents soft tissue relapse in sinus, promotes osseous union

13. Soft tissue resuspension
    - Philips et al 1991, soft tissue resuspension of I/O, malar soft tissue prior closure
    - Prevents complications of facial asymmetry, ectropion

14. Post surgical ocular examination
    - Examine visual acuity, pupillary reflex, diplopia

15. Post surgical images
    - CT Scan to see adequacy of reduction

CLOSED REDUCTION TECHNIQUES

GILLIES TEMPORAL APPROACH

- Gillies and Coworkers in 1927

- For reduction of both ZMC and zygomatic arch fractures

Technique

- A 2.5cm incision - anterosuperior to postero-inferior
- Superior to the bifurcation of the superficial temporal artery.
- Glistening surface of the temporalis fascia is visualized.
- Deeper incision is carefully made the full length of the skin incision through the fascia.
- Temporalis muscle bulge through the incision.

- A flat instrument, such as a large freer elevator or the broad end of No.9 periosteal elevator is then inserted between the temporalis muscle and the temporalis fascia and the arch is elevated and reduction is achieved

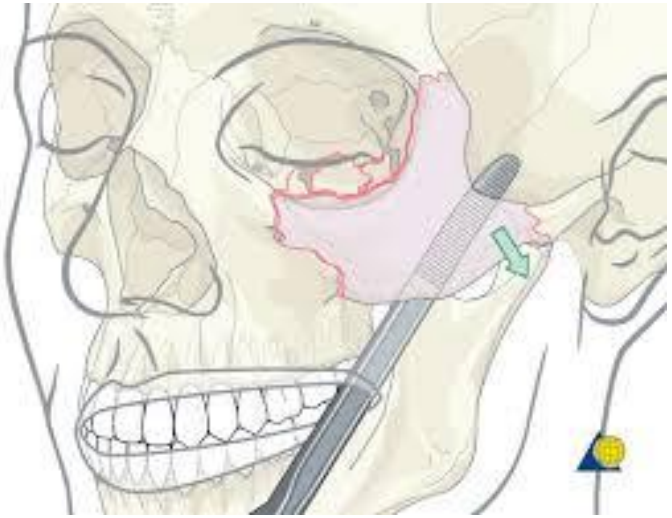
Advantages:

- Is that it allows the application of great amounts of controlled force to disimpact even the most difficult zygomatic fractures.

- Quick and simple -15- 20 min

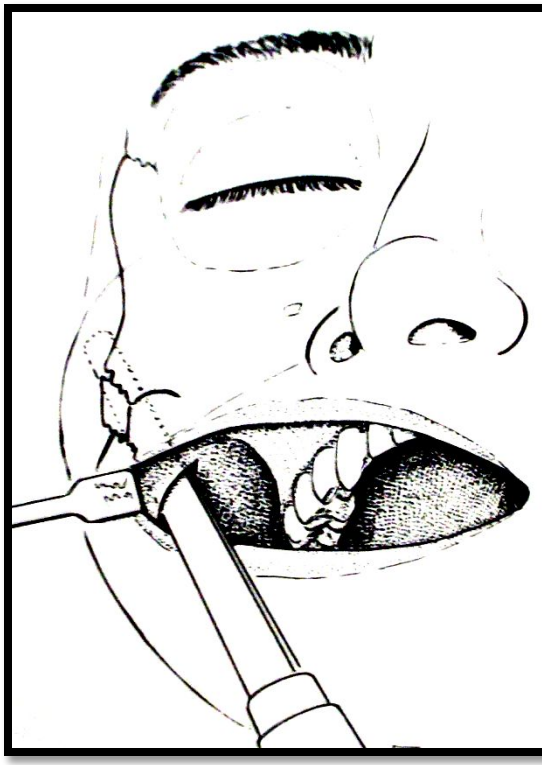
BUCCAL SULCUS APPROACH

- **Keen's Technique** (1909)
- Small incision (1 cm) made in the mucobuccal fold, just beneath the zygomatic buttress of the maxilla.
- A heavier instrument inserted behind the infratemporal surface of the zygoma, and using superior, lateral, and anterior force, the surgeon reduces the bone.
- Avoidance of any external scar



LATERAL CORONOID APPROACH -*QUINN(1977)*

- Simple method for isolated arch fractures.
- 3 to 4 cm incision -anterior border of the ramus.
- To the depth of the temporal muscle insertion
- Instrument between the temporal muscle and the zygomatic arch - readily palpable.
- *Placement lateral to the coronoid process*
- **Arch is elevated**



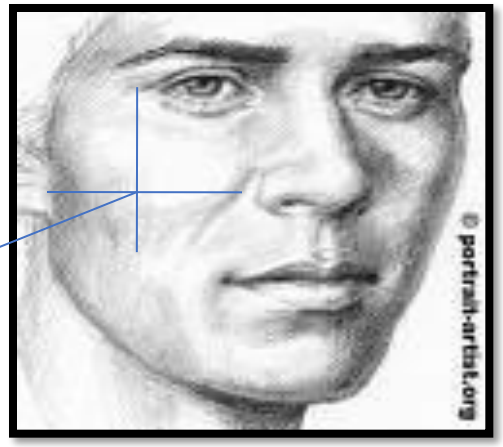
PERCUTANEOUS APPROACH

- Direct route to elevate depressed zygoma
- Done through skin surface of the face overlying zygoma.

ADVANTAGE

- Produces forces anteriorly, laterally, and superiorly in a very direct manner, without having to negotiate adjacent structures with the instruments.

POSWILLO`S INTERSECTING LINES.



DISADVANTAGE

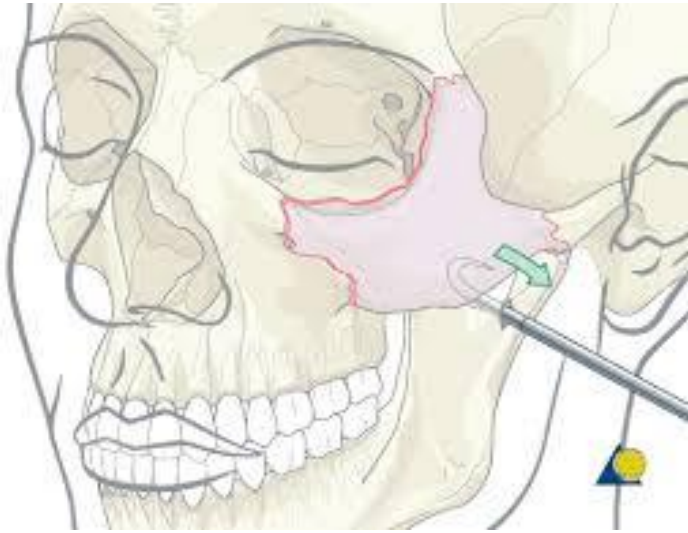
- Scar on the face in a very noticeable location.

Elevation Of The Zygoma With A Bone Hook.

- Stab incision made and bone hook inserted.
- Apply strong traction.

PRECAUTION - slippage into the inferior orbital fissure.

ADVANTAGE- can control ZMC position in all three planes of space.



OTHER INDIRECT APPROACH.

Carroll-Girard Screw :

screw placed directly into the body of the zygoma via a small transcutaneous stab incision.

OPEN REDUCTION TECHNIQUES

Maxillary vestibular approach

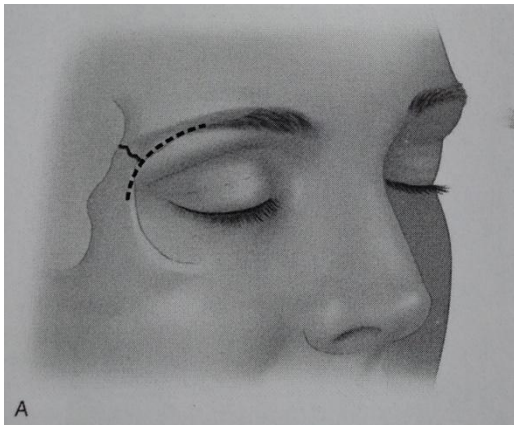
- The incision is usually placed approximately 3 to 5 mm superiorly to the mucogingival junction.

Advantages:

- ❑ Access to entire mid face skeleton(infraorbital rim, ant max, ZM buttress)
- ❑ Hidden intraoral scar.
- ❑ Rapid and simple
- ❑ Complications are few .

Supraorbital Eyebrow approach

- 2 cm incision, parallel to hair of eyebrow
- Incision made to depth of periosteum

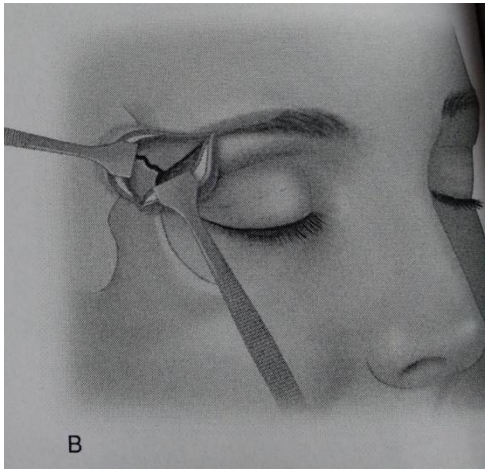


Advantages:

- ❑ Imperceptible scar
- ❑ Simple, rapid access to FZ region
- ❑ No imp neurovascular structures nearby

Disadvantage:

- ❑ Doesn't afford great surgical access

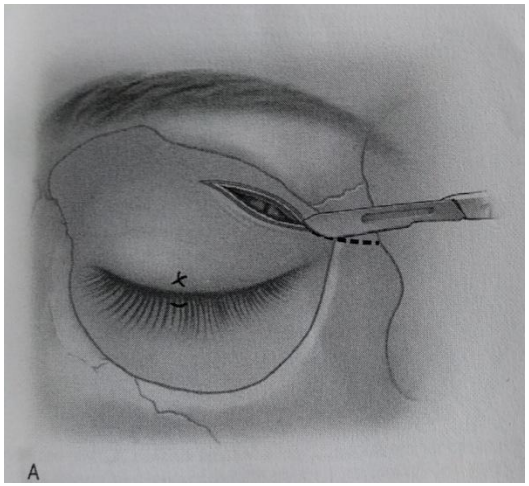


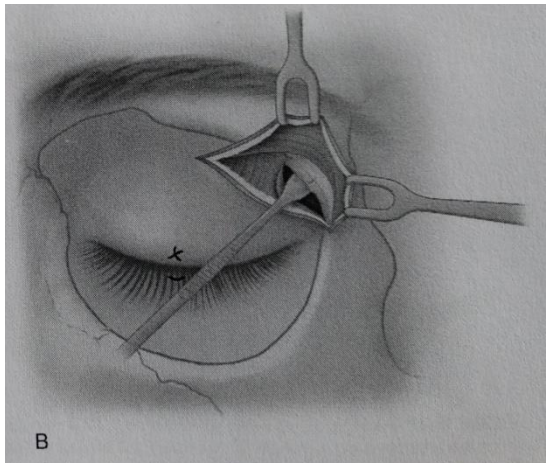
Upper Blepharoplasty approach

- Also known as upper eyelid approach/supratarsal fold approach
- Incision 10 mm superior to upper lid margin, 6mm above lateral canthus laterally

Advantages:

- ❑ Inconspicous scar
- ❑ Best approach to supero-lateral orbital complex



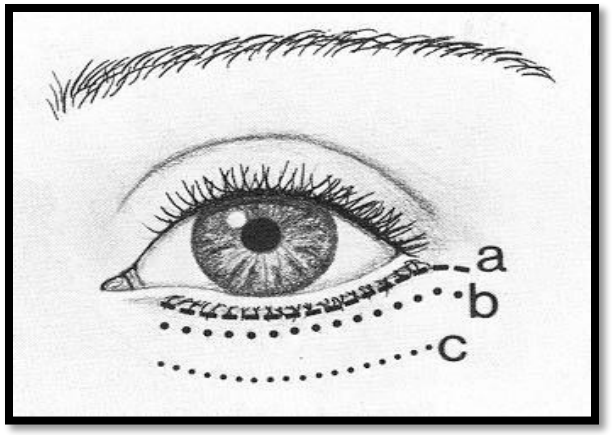


Lower Eyelid Approaches

a) **Subciliary / Blepharoplasty Incision**

b) **Subtarsal Incision**

c) **Infraorbital Skin Crease Incision**



Infra-orbital Incision:

- Incision placed just over infraorbital rim
- Periosteal incision *placed 3mm inferior to rim,* not made too far inferior to avoid injury to infraorbital nerve and vessels
- Access to Infraorbital rim, orbital floor & walls, frontal process of maxilla

Advantages :

- Incision is simple, since it is a direct and short approach.
- Avoids orbital septum & periorbital fat.
- There is almost non-existing post-operative ectropion.
- Incision can be extended medially or laterally .

Major disadvantage is that a visible scar.

Subtarsal Incision

- Access to the infraorbital rim and orbital floor.
- Incision in natural skin crease at or below level of tarsus, half distance b/w lash margin and orbital rim
- Extends laterally and inferiorly as in skin crease
- Starts – skin with orbicularis oculli muscle
- Stops –at orbital septum.

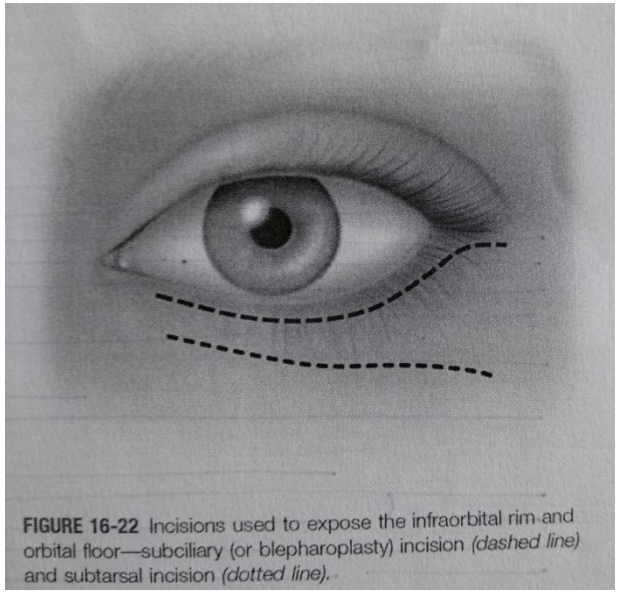
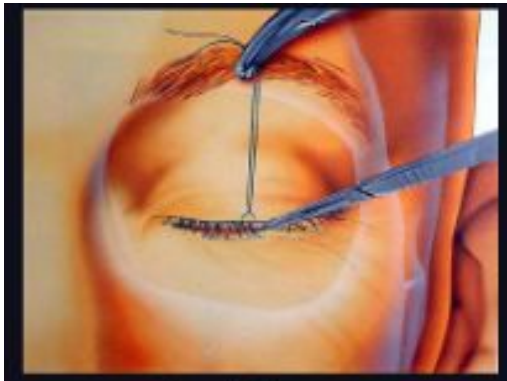
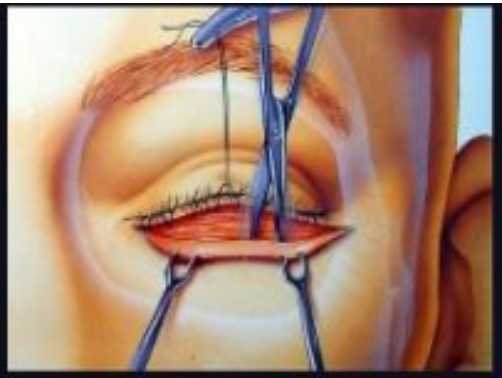


FIGURE 16-22 Incisions used to expose the infraorbital rim and orbital floor—subciliary (or blepharoplasty) incision *(dashed line)* and subtarsal incision *(dotted line)*.

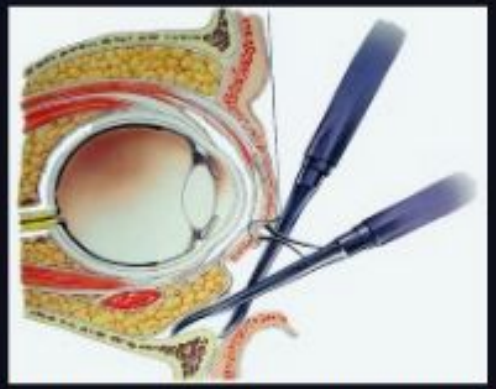


Incision

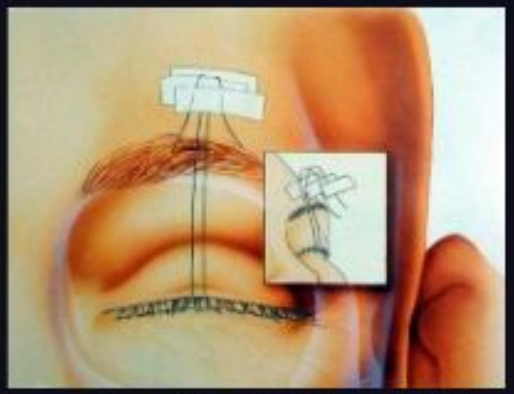


Subcutaneous dissection of skin, leaving pretarsal portion of orbicularis muscle

Dissection between orbicularis oculi muscle and orbital septum



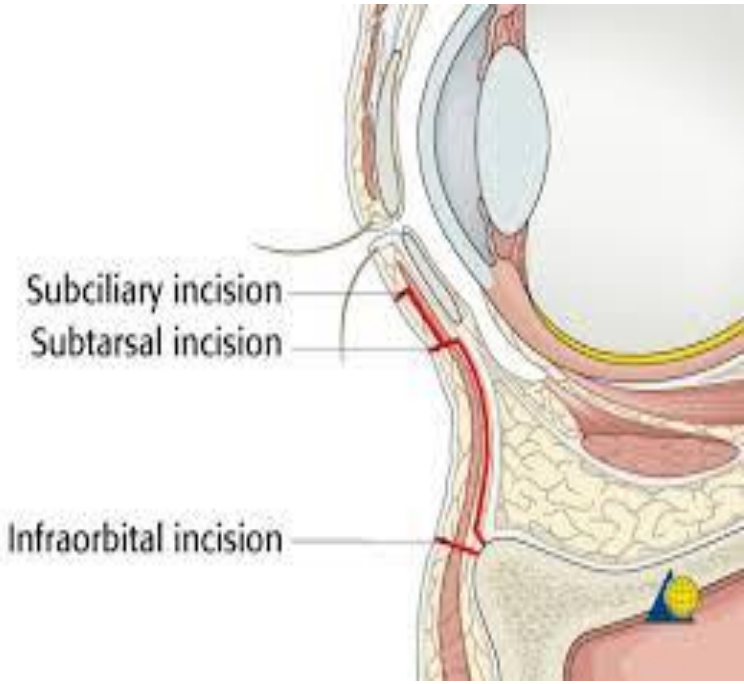
Subperiosteal dissection of anterior maxilla and orbital floor. Note that the periosteal elevator entering the orbit



Lower eyelid suspensory suture placed at completion of surgery. Taking care to engage the tarsal plate

Advantages :

- Relatively easy.
- Scar is imperceptible.
- Minimal complications.



Subciliary Incision/ Blepharoplasty

- Incision 2mm inferior to gray line of lower eyelid

- Can extend 1-1.5 cm laterally in natural crease inferior to lateral canthal ligament

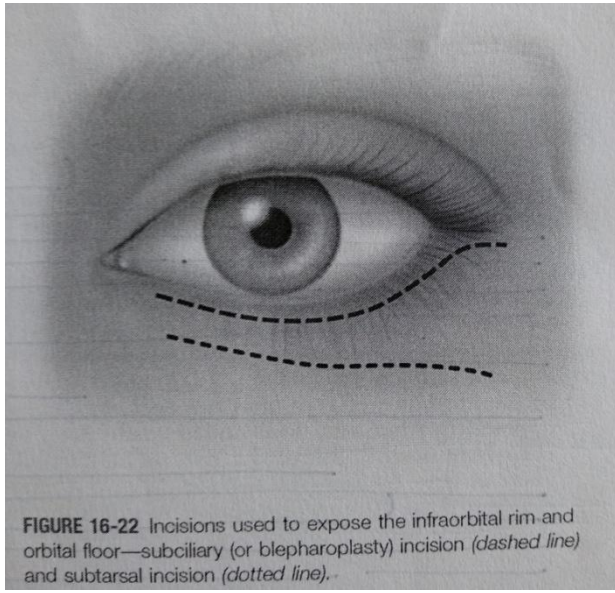


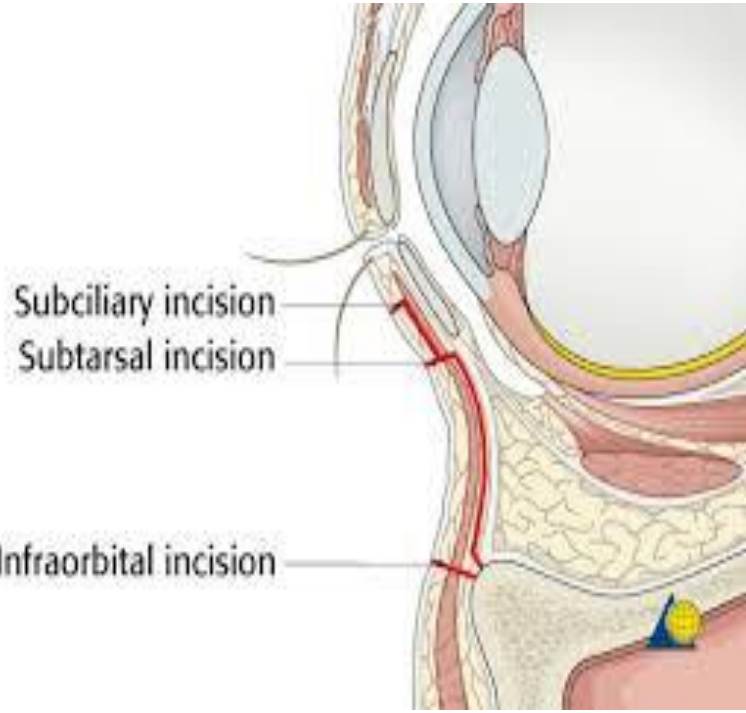
FIGURE 16-22 Incisions used to expose the infraorbital rim and orbital floor—subciliary (or blepharoplasty) incision *(dashed line)* and subtarsal incision *(dotted line)*.

Advantage

- Imperceptible scar

Disadvantages

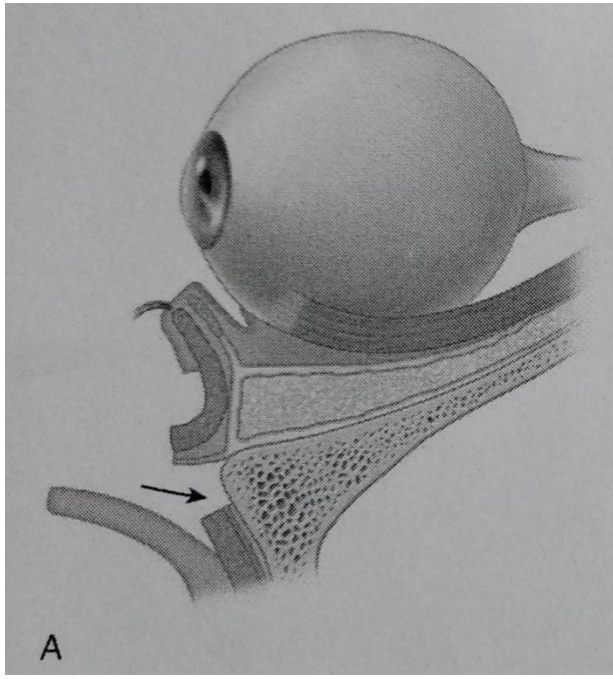
- Technically difficult.
- Higher risk of postoperative ectropion exists.



Dissection technique

Option 1

Dissect b/w skin and muscle until the orbital rim is reached, at which point another incision through muscle and periosteum to bone is made



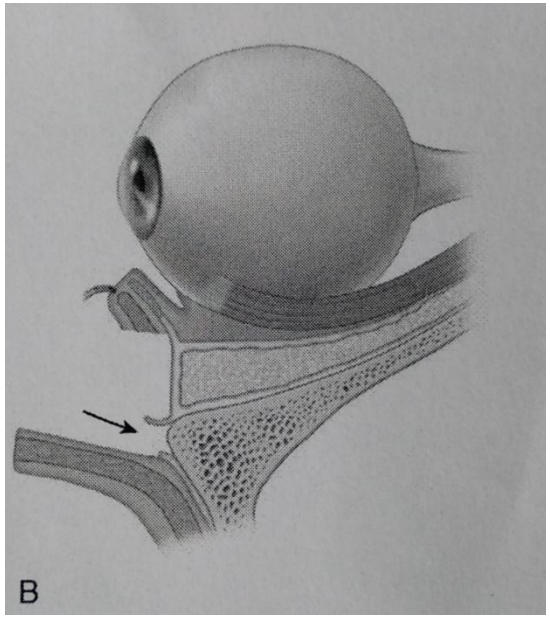
DISADVANTAGES

1. Leaves an extremely thin skin flap.
2. Technically difficult flap to elevate, and accidental "button-hole" dehiscence can occur.
3. Darkening of the skin in this area following healing.
4. Ectropion

Option 2

Incise through muscle at the same level as skin incision and dissect down just anterior to orbital septum to the orbital rim.

Periosteal incision made 3-4mm below infraorbital rim



ADVANTAGES:

- Technically less difficult, care must be taken not to violate orbital septum
- The skin and muscle flap , maintains a better blood supply.
- No pigmentation of the lower lid

DISADVANTAGES:

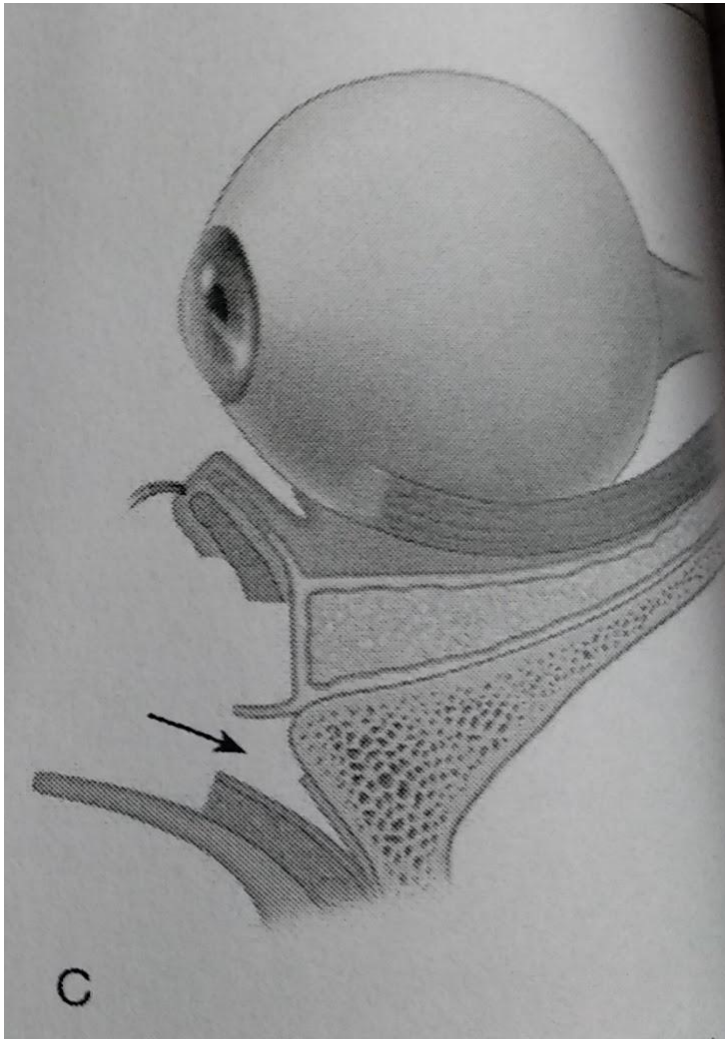
- Thin orbital septum can be easily violated - periorbital fat herniation

Option 3

- *Combination of first 2 methods*

- *3-4 mm skin undermined before dissection through orbicularis oculi muscle to orbital septum,which is then followed inferiorly*

- *Incision is then made through periosteum 3-4mm inferior to infra orbital rim*

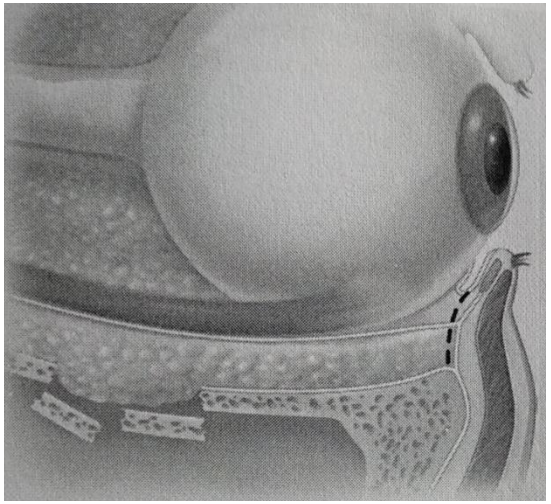


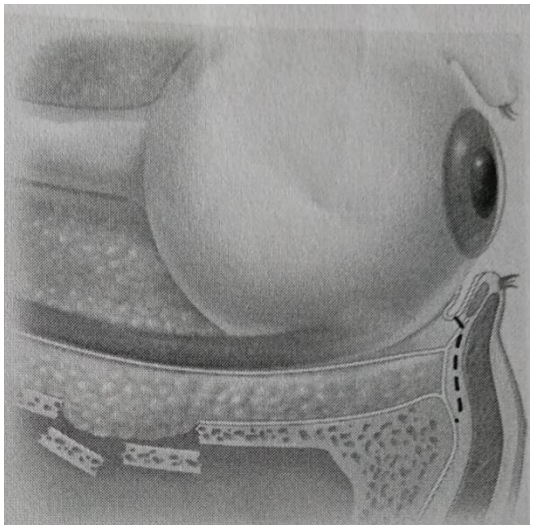
ADVANTAGES:

- Simplest of the three and avoids the disadvantages of the others.
- Leaves 4-5mm strip of muscle attached to the lower tarsus (for it to remain functional)
- Help maintaining the position of the lower eyelid on the globe.

Transconjunctival approach

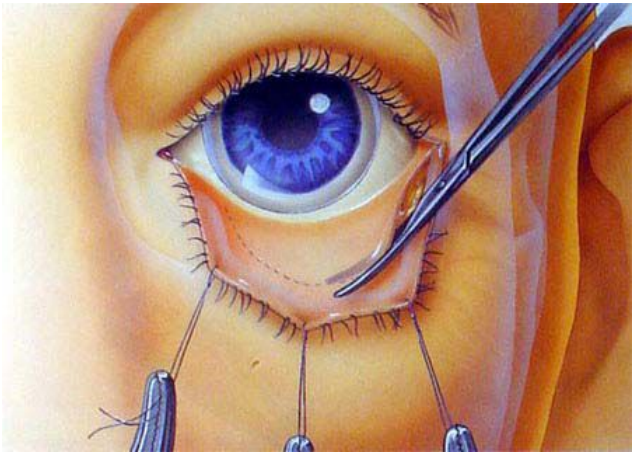
- Inferior fornix approach- Bourguet, 1928
- Converse et al added lateral canthotomy for improved lateral exposure
- Transconjunctival retroseptal incision: Tenzel, Miller
- Transconjunctival preseptal incision:Tessier





ADVANTAGE

- No skin or muscle dissection is necessary
- Rapid.



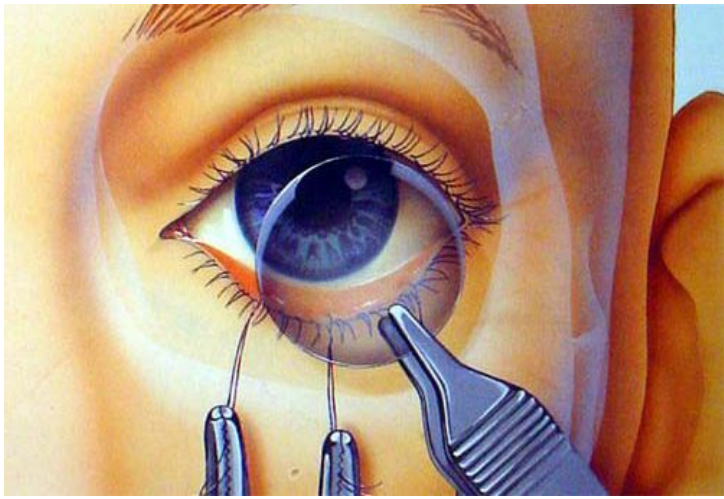
DISADVANTAGE

- Limited access to the infraorbital rim and orbital floor when not used in conjunction with a lateral canthotomy.

Technique

STEP 1

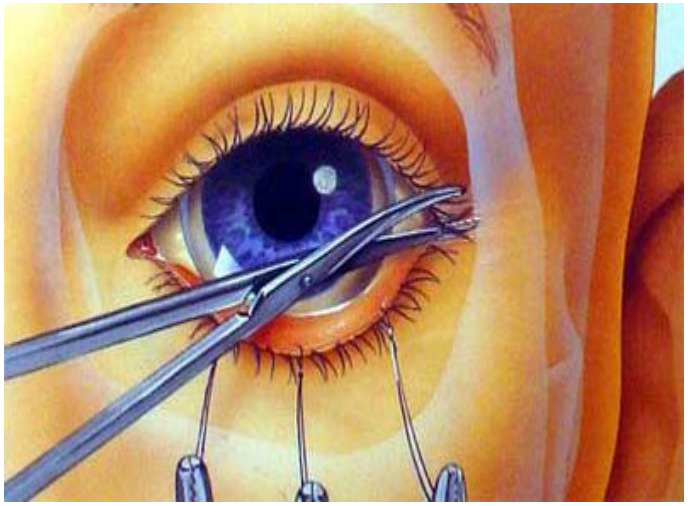
Protection of the cornea with corneal shield



STEP 2

LATERAL CANTHOTOMY

- Inserting one end of a sharp iris scissor into the lateral palpebral fissure and cutting through a horizontal direction.
- Scissor inferiorly to transect inferior portion of lateral canthal tendon.

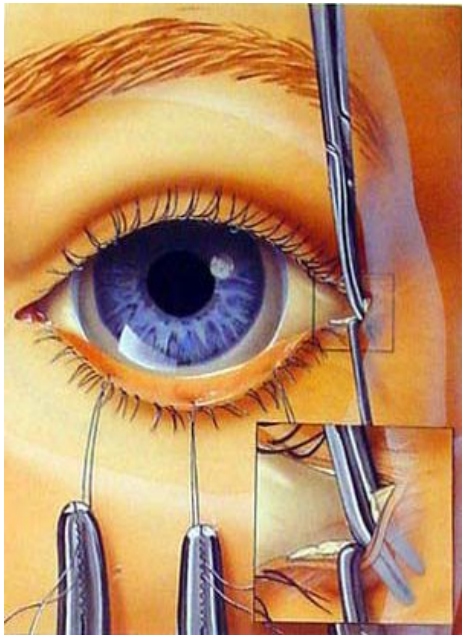


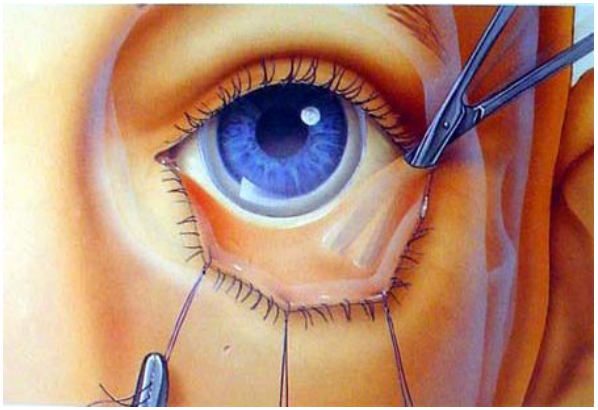
STEP 3

- Performing inferior cantholysis to release lower eye lid.

STEP 4

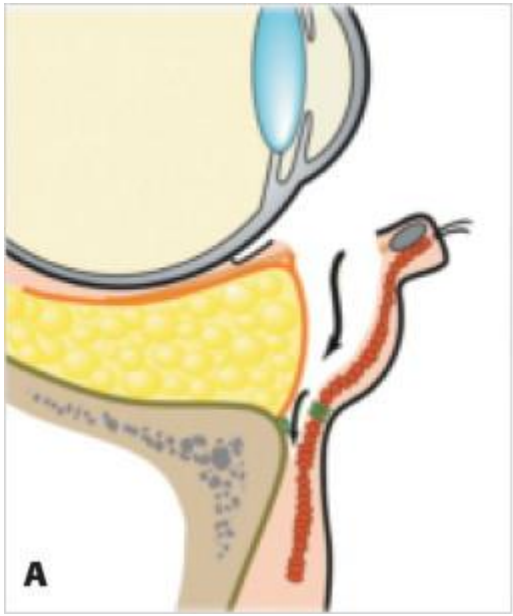
- Undermining conjunctiva medially upto the lacrimal puncta.
- Conjunctival incision.





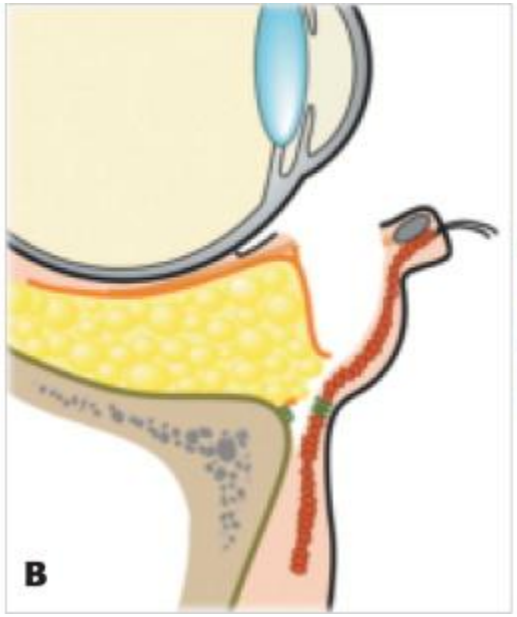
STEP 5

- Blunt dissection towards orbital rim performed with scissors, while lower lid retracted anteriorly



STEP 6

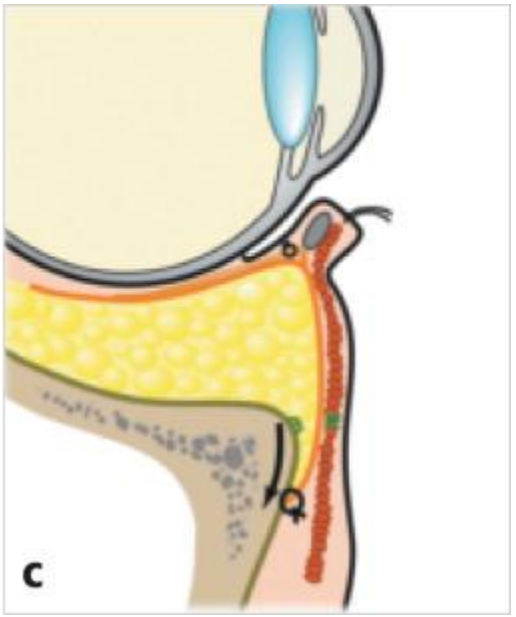
- Subperiosteal dissection of orbital contents



STEP 7

- Inferior limb of lateral canthal tendon and tarsal plate sutured to inner aspect of lateral orbital rim with 4-0 slow resorbing sutures

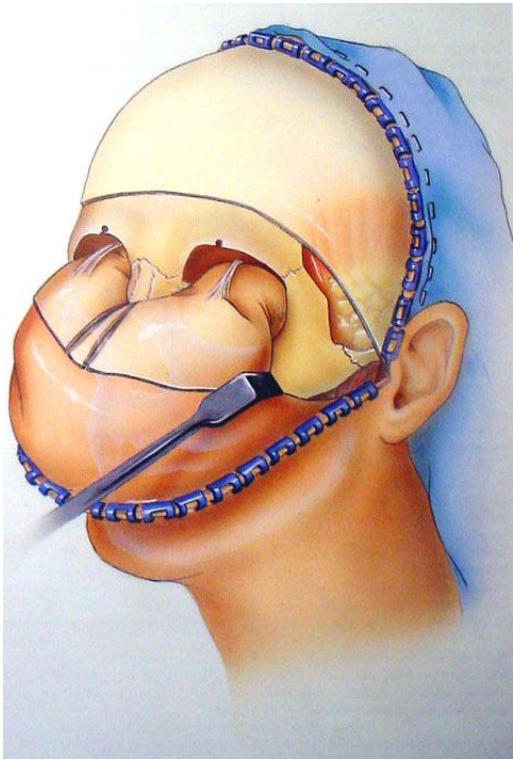
- Transconjunctival incision sutured with 6-0 gut sutures



CORONAL APPROACH

ADVANTAGES

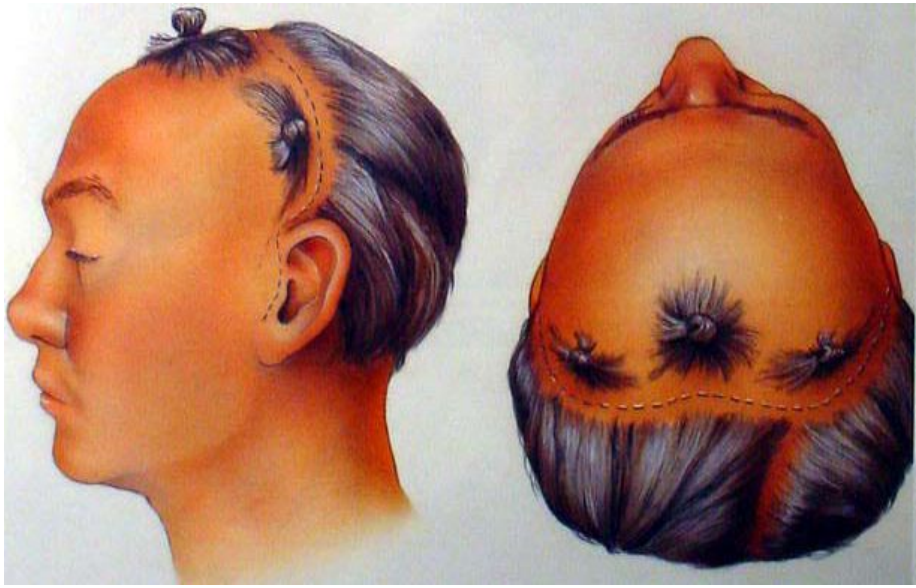
1. Excellent access to the orbits, zygomatic bodies, and zygomatic arches
2. Useful incision where there is comminution of the supraorbital and lateral orbital rims, and zygomatic body and arch.
3. The scar is hidden.



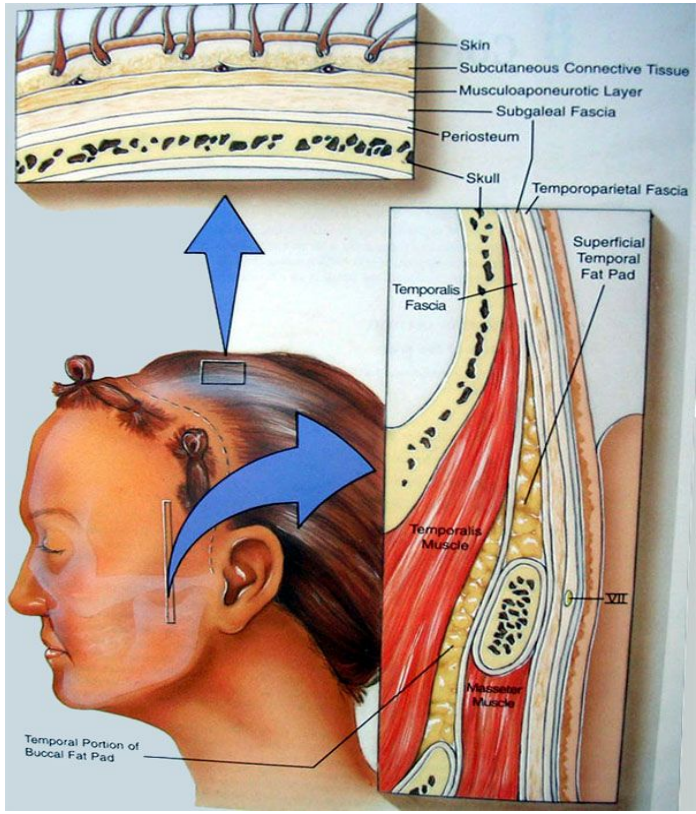
Technique

INCISION

- From preauricular region to other
- 2 cm strip of hair removed in vicinity of incision
- Consider amount of inferior access required

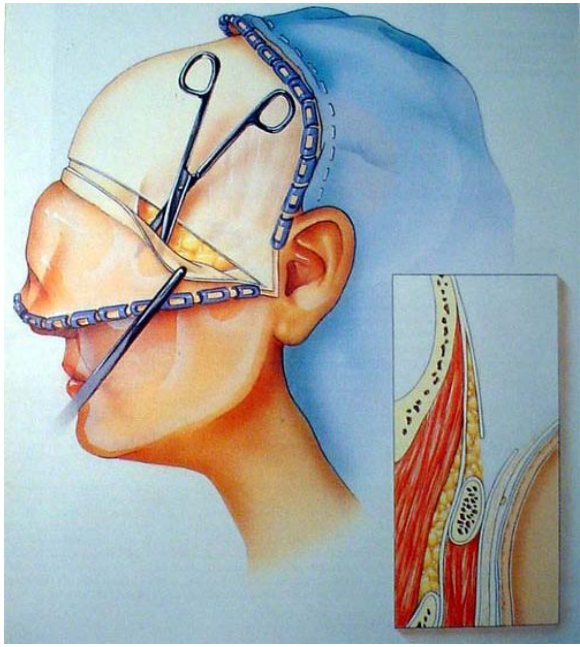


- No.10 blade
- Incision made through skin subcutaneous tissues and galea
- Ranley clips
- Finger dissection

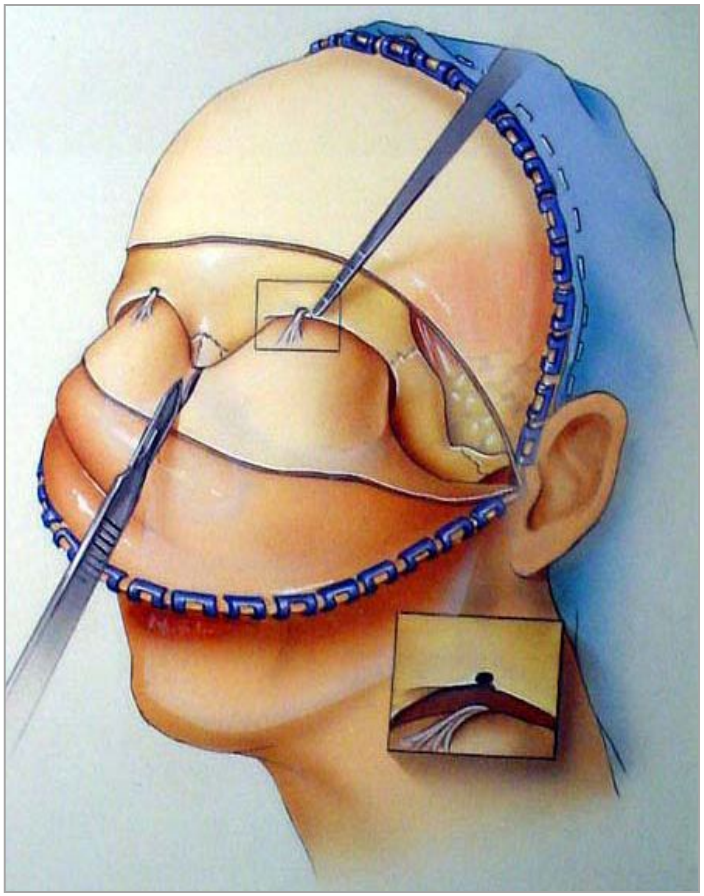


- Incise sup. layer of temporalis fascia 2cm superior to the zygomatic arch.

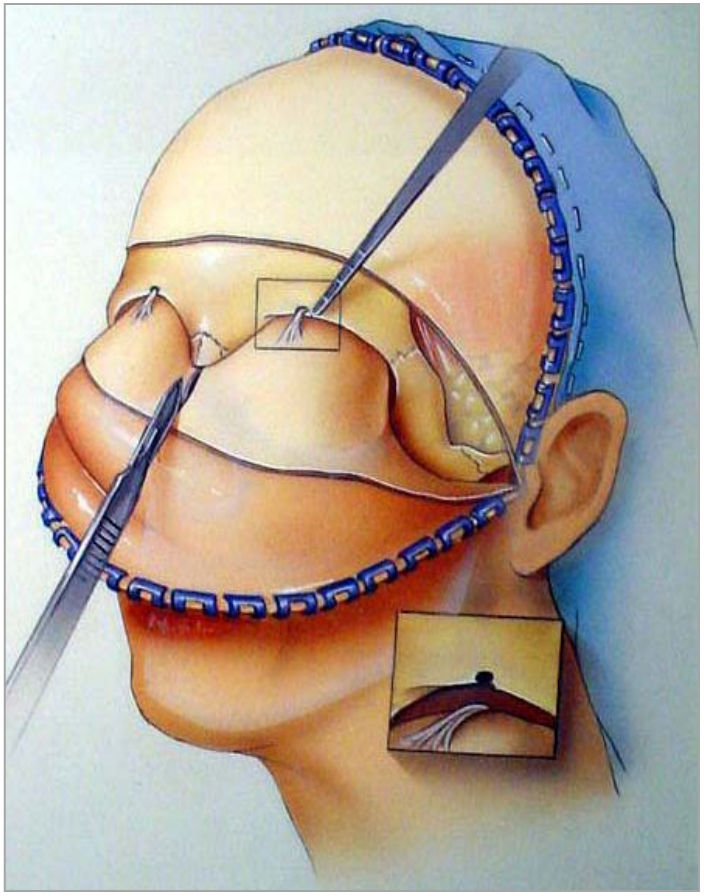
- Begin at root of zygomatic arch and moving antero-superiorly.

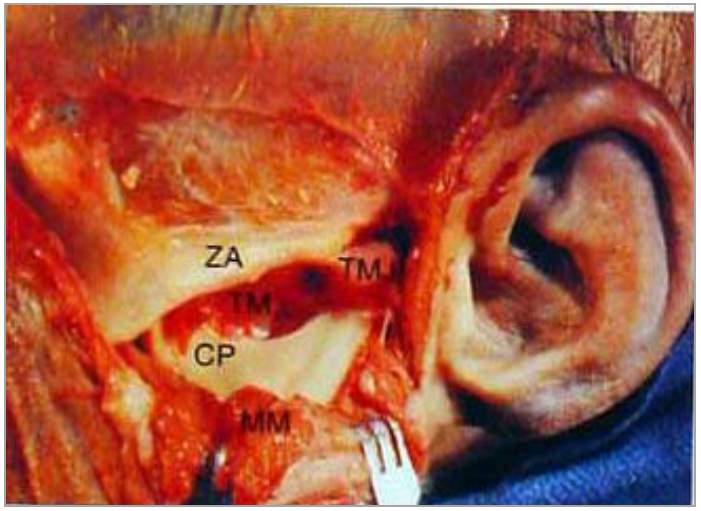


- From the root of the zygomatic arch periosteal incision is made along the superior aspect of the arch and is exposed subperiosteally.
- Pericranium - incised across the forehead and down the lateral orbital rim.



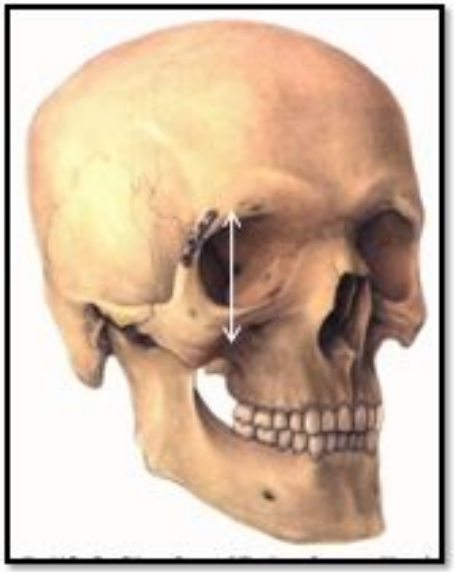
- The periosteal incision of the lateral rim is connected to the zygomatic arch.
- Gives access the F-Z region, orbital margins, zygomatic bodies and arch.
- Closure in two layers.





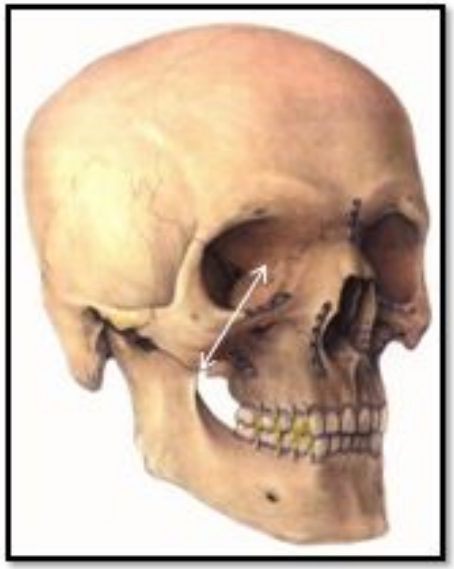
PURPOSE OF FIXATION

Lateral orbital rim



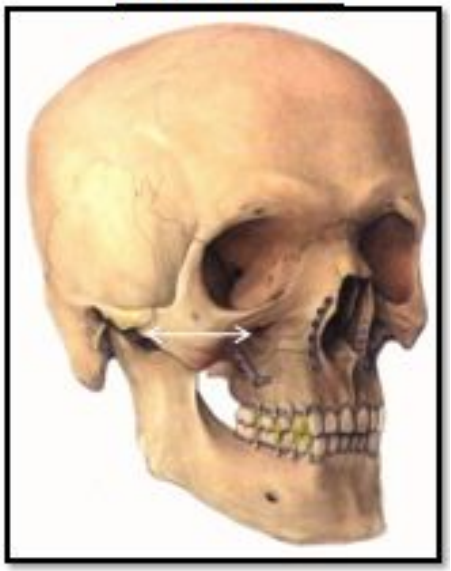
Vertical Height

Buttress of zygoma



Malar Projection

Infraorbital rim and buttress



Facial width & orbital volume

SEQUENCE OF FIXATION

For Middle energy Fractures:

- 1st temporarily stabilize the FZ # with wire.
- 2nd plate the buttress & infraorbital region
- 3rd replace the FZ wire with plate
- 4th orbital floor reconstruction if required

For High energy Fractures:

Zygomatic arch should be reconstructed first

GENERAL PRINCIPLES OF FIXATION

1. Use self-threading bone screws

2. Use hardware that will not scatter post-operative CT scans

3. Place at least two screws through the plate on each side of the fracture

4. Avoid important anatomic structures

5. Use as thin a plate as possible in the periorbital areas

6. Place as many bone plates in as many locations as necessary to ensure stability

7. If concomitant fractures of other midfacial bones exist, it will be necessary to apply fixation devices more liberally

8. In areas of comminution or bone loss, span the gap with the bone plate

1-Point Fixation

- L-, T-, Y- shaped miniplate
- Zygomatico-maxillary buttress provides sufficient stability in less severe injuries
- Can be done at F-Z region too

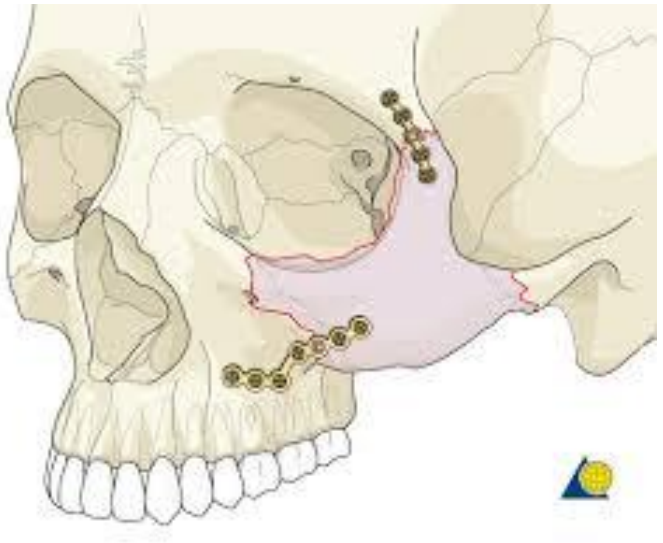
Drawbacks

- ❑External incision
- ❑Potential palpability
- ❑Lack of confirmation of reduction of remainder of zygoma

2-Point Fixation

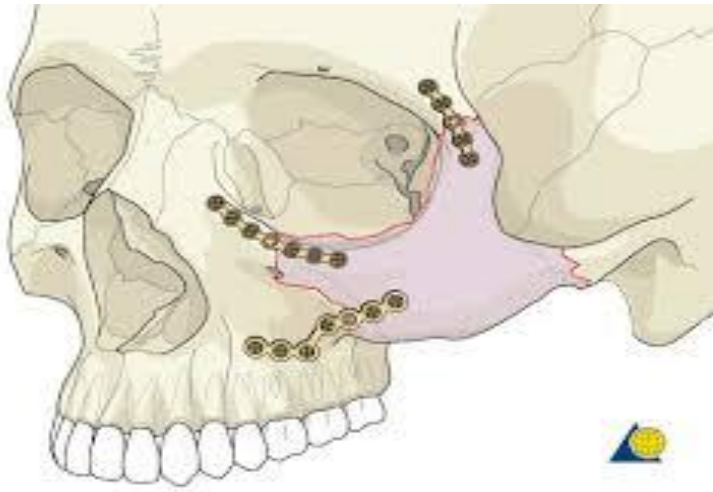
- First plate placed at F-Z region, or infraorbital rim (if exploration of orbital floor indicated)

- 2nd plate at Z-M buttress region



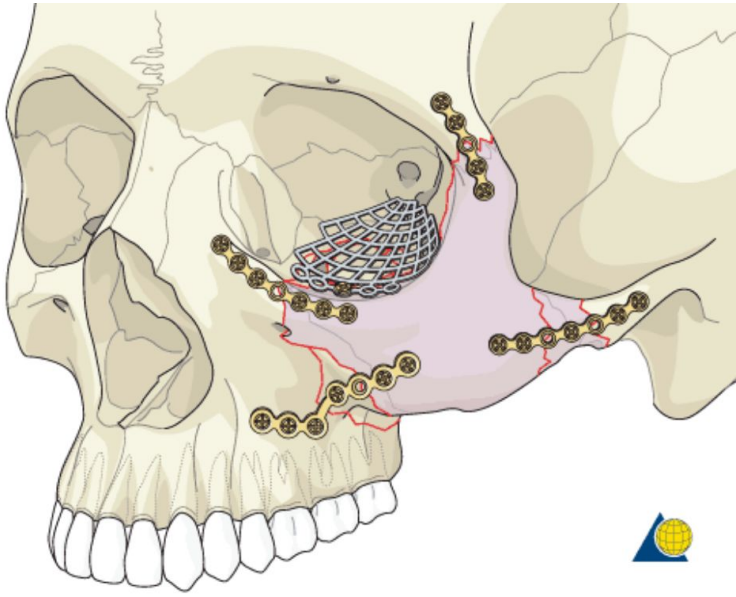
3-Point Fixation

- 1st plate at F-Z region
- 2nd plate at infraorbital region
- 3rd plate at Z-M buttress region



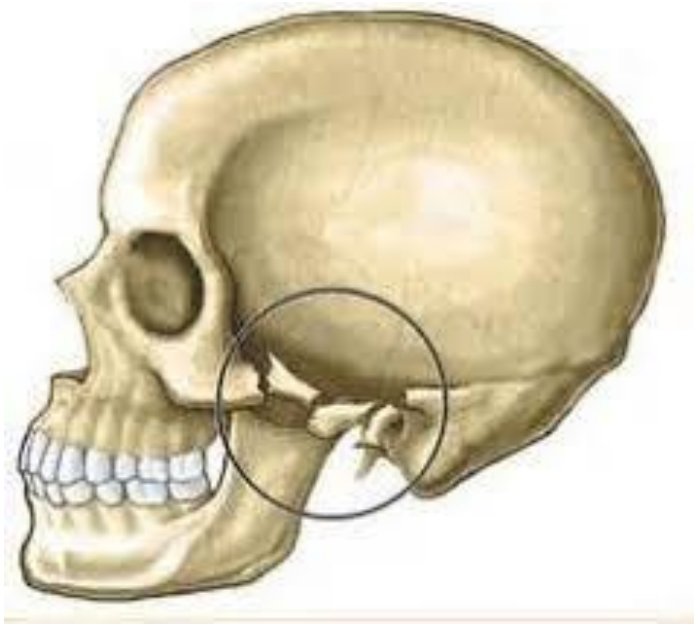
4-Point Fixation (With Orbital Reconstruction)

- Required in severely dislocated, communuted ZMC #
- 1st plate at F-Z
- 2nd plate at the ZM arch
- 3rd plate at the infraorbital rim
- 4th plate at the zygomatico-maxillary buttress
- Orbital floor is reconstructed using a titanium mesh



ZYGOMATIC ARCH FRACTURES

- Frequently results with fractures of entire ZMC
- Occurs when force is directly applied from lateral aspect of head
- Isolated arch # 10% of zygomatic injuries.



Signs & symptoms

- ❑ Flattening of the side of the face
- ❑ Trismus
- ❑ Reduced mouth opening
- ❑ Difficulty in shifting the mandible toward injured side

Need for stabilization

depends upon:

-Location of injury

-Number of fractures

-Displacement of segments

Stabilization

A large curved needle is used to pass heavy suture or wire around zygomatic arch.

Wires are then secured to a stable object such as a tongue blade and aluminium finger splints

PROTECTION

Oral airway

Aluminium finger splint material

Anatomic areas for determining proper reduction of ZMC fracture.

- Rotation of the zmc in the vertical axis is most easily determined by its alignment with the greater wing of sphenoid along the internal orbit.
- Zygomaticomaxillary butttress provides a sensitive indicator of malar projection.
- Smooth and continuous orbital margins confirm good reduction when # sites are not exposed.
- FZ suture is the worst indicator.

PEDIATRIC ZYGOMATIC COMPLEX FRACTURES

Reasons for low incidence

1. Prominence of calvarium
2. Relative retrusions of the midface.
3. Lack of development of the maxillary sinus.
4. Elasticity of facial bones
5. Thicker layer of adipose tissue
6. Suture lines are flexible.
7. Stability is increased by the presence of tooth buds within the jaws

Treatment

- Wire fixation is advocated in preference to RIF because wire placement requires much smaller incision and is less likely to injure the developing tooth buds

- Experimental studies have shown RIF application interferes with growth and results in facial deformity

COMPLICATIONS

Neurological

- Infraorbital Nerve Disorders,
- Zygomatico-facial nerve paresthesia

Ocular

- Persistent Diplopia
- Enophthalomos
- Exophthalmos
- Blindness
- Retrobulbar and Intra-orbital Hemorrhage,

Others

- Periorbital incision problems

(dehiscence, hematoma, seroma, ectropion)

- Implant extrusion, displacement, infection

- Malunion of zygoma

CONCLUSION

Since the gross shape of the face is influenced largely by the underlying osseous structure, the zygoma plays an important role in facial contour.

Disruption of zygomatic position also has great functional significance because it creates impairment of ocular and mandibular function.

Therefore, for both cosmetic and functional reasons, it is imperative that zygomatic injuries be properly and fully diagnosed and adequately treated.

REFERENCES

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- Oral & maxillofacial trauma – Raymond J Fonseca 4th ed
- Principles of Internal Fixation of Craniomaxillofacial skeleton-AOCMF
- Killey's fractures of the middle third of the facial skeleton