# Faciomaxillary Trauma

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An Initiative of drtbalu's Otolaryngology online

# About This Book

This e book covers various traumatic lesions involving the face. Face is the most exposed region of the human body. A face is to a human what a cover is to a book. Facial trauma not only causes severe morbidity and mortality, it also causes severe psychological impact on the patient. With the current craze for contact and high speed sports facial injuries are becoming more and more common. It is really a daunting task to manage a patient with faciomaxillary trauma as it demands a lot on skill on the part of the treating surgeon.

Managing a patient with faciomaxillary trauma is a multidisciplinary task. It calls for lot of interaction between doctors of varying specilities. During the initial phases maintaining the airway along with stopping bleeding takes precedence over other things. These patients need to be reassessed periodically till a decision on the optimal management modality is arrived at.

This book covers this entire topic from the perspective of an otolaryngologist because the author himself is an otolaryngologist. There could be some controversial management modalities described in this book, and this is purely due to the fact that the book is actually an otolaryngologist's perception. Corrective surgeries described are also discussed from an otolaryngologist's perspective.

Topics discussed in this book include:

Fracture Nasal bones

Fracture Zygoma

Fracture Maxilla

Fracture Naso-orbital-complex

Fracture frontal bone

Fracture mandible

# About the Author

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# Fracture Nasal Bones

Introduction:

Treatment of nasal bone fractures was first recorded 5000 years ago during the early Pharonic period in Ancient Egypt. Edwin Smith Papyrus describes repositioning of deviated nasal bones with fingers / elevators, insertion of splints and application of external dressings.

Studies reveal that Isolated fractures of nasal pyramid account for about 40% of all facial fractures. Fractures of nasal bones are commonly associated with fractures of other facial bones. Delay in managing these patients could lead to facial cosmetic deformities. Managing these patients happens to be the common job of otolaryngologist.

Fractures involving nasal bones are common because:
1. Nose happens to be the most prominent portion of the face
2. Increasing number of road traffic accidents
3. Increasing incidence of domestic violence
4. Increase in the number of individuals taking part in contact sports

Relatively little force is required to fracture the nasal bones. The force could be as low as 25-75 pounds / square inch. Young men are twice as likely to sustain fracture of nasal bones than women. Fractures of nasal bones are common in the age group of 15-30 years. Compound comminuted fractures are more common in the elderly who are more prone to falls.
Children are more likely to sustain cartilaginous injury because they have a
greater proportion of cartilage to bone. Cartilage provides increased protection from fracture.
Children's bones are also more elastic than adult bones. Green stick fractures are common in children (fracture without displacement)


Deviation of external contour of nose following fracture of nasal bone

# Anatomy of Nasal bones

Nasal bones are paired bones (marked in red) in the figure.  Both these bones project like a tent on the frontal process of maxilla. In the midline they articulate with one another. Just under this midline articulation lies the nasal septum.

Superiorly the nasal bones are thicker where it articulates with the nasal process of frontal bone. This area is stable and firm. Nasal bone fractures commonly occur at the transition zone between the proximal thicker and distal thinner portions. This zone precisely corresponds to the lower third of the nasal bone area.

The outer surface of nasal bones is concavo-convex from above downwards and convex from side to side. It is covered by Procerus and nasalis muscle. It is perforated at its centre by a foramen through which runs a small vein. The inner surface is concave from side to side and is traversed from above downward by a groove for the passage of a branch of nasociliary nerve.

Articulations of nasal bones:

Nasal bones articulates with 4 bones.
Frontal
Ethmoid
Opposite nasal bone
Maxilla

Laterally nasal bones articulate with the fronto nasal process of maxilla

# Types of Injuries to Nasal Bones

Type I injury:

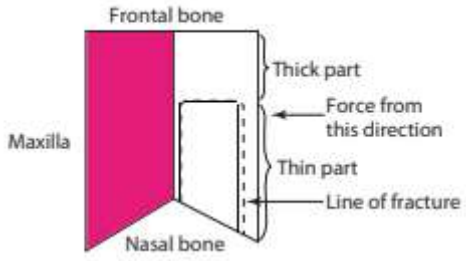
Fractures due to this type of injury does not extend behind the imaginary
line drawn from the lower end of nasal bone to the anterior nasal spine.
In this type of injury the brunt of the attack is borne by lower cartilaginous portion of the nasal cavity and the tip of the nasal bones. This type of injury may cause avulsion of upper lateral cartilages and occasionally posterior dislocation of septal and alar cartilages.

Type II injury:

This type of injury involves the external nose, nasal septum and anterior
nasal spine. Patients with this type of injury manifest with gross deviations involving the dorsum of the nose including splaying of nasal bones, flattening of dorsum of nose and loss of central support of the nose.

Type III injury:

This injury involves orbit and intracranial structures.



# Classification & pathophysiology

Nasal fractures have been classified in a number of ways:

Nature of injury
Extent of deformity Pattern of fracture

Nature of injury:

Most fractures result from laterally applied forces. Greater force is required to fracture the nose with a blow directed from the front
as the nasal cartilages behave like shock absorbers.

Extent of deformity:

A 5 point grading system has been developed for the extent of lateral deviation of the nasal pyramid.

Grade 0 - Bones are in perfect alignment
Grade 1 - Bones deviated less than half the width of the bridge of the nose
Grade 2 - Bones deviated half to one full width of the bridge of the nose
Grade 3 - Bones are deviated greater than one full width of the bridge of the nose
Grade 4 - Bones almost touching the cheek

Pattern of fracture:

Nasal fractures can be subdivided into three broad categories:

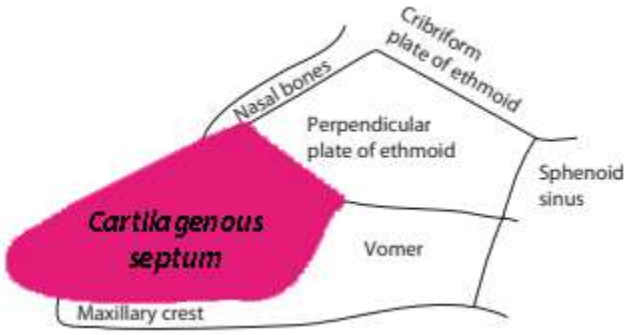
Class 1 fractures

Class 2 fractures

Class 3 fractures

This classification has practical utility as each category of fracture requires a different treatment approach. Because of the
close association between nasal bone and the cartilaginous portions of nose and nasal septum it is unusual for pure nasal bone fractures without affecting these structures.

It should be stressed that the tendency of the nasal septum to heal by fibrosis which causes bizarre deviations like "C" "S" etc.




Class I Fracture:

This type of fracture is also known as Chevallet fracture.
This is caused due to low to moderate degrees of force and the extent
of deformity is usually not marked.
Simplest form of class 1 fracture is depressed fracture of nasal bone.
The fractured segment usually remains in position due to its inferior attachment to the upper lateral cartilage which provides an
element of recoil. The nasal septum is not involved.

Class 1 fractures tend not to show gross lateral displacement of the
nasal bones and may not even be perceptible.
Deformity generally results form a persistently depressed fragment which is due to impaction of the flail segment beneath the residual nasal bone.

In children these fractures may be of green stick variety, and significant nasal deformity may only develop at puberty when nasal growth become accentuated.
In more severe variant both nasal bones and septum are fractured. The fracture line runs parallel to the naso maxillary suture ipsilateral to the side of the applied force to a point approximately two thirds along the length of the nasal bone, where the bone becomes much thicker.

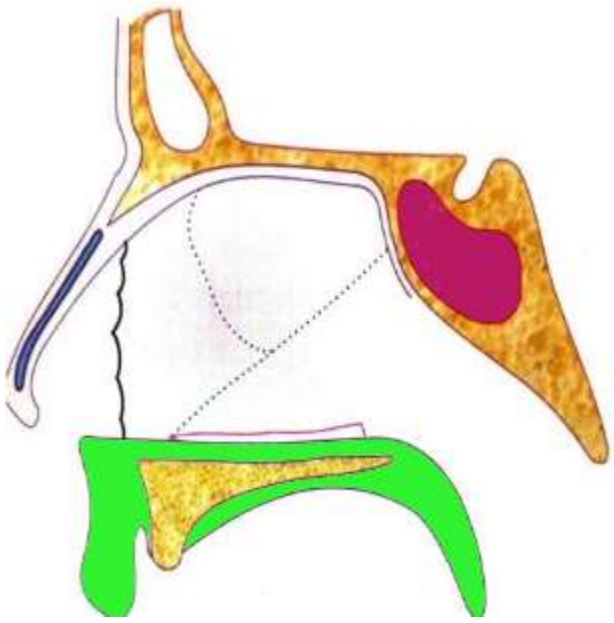


Image showing class 1 fracture

Class 2 fractures:

This is also known as Jarjaway fracture.
The pattern of deformity is determined by the direction of force applied. A frontal impact tends to comminute the nasal bones and cause gross flattening and widening of the dorsum. Lateral impact produces a high deviation of nasal skeleton.

Class 2 fractues are caused by greater force and are associated with significant cosmetic deformity. In addition to fracturing of the nasal bones, the frontal process of the maxilla and septum are also involved. The adjacent ethmoidal labyrinth and orbital structures remain intact.

If the nasal dorsum is deviated laterally greater than half the width of the nose then associated septal fracture (Grade 2 deformity) should also be present. Septal fracture dislocations tend to happen at points of weakness. These points of weakness is at the point of insertion of quadrangular cartilage inserts into the cartilaginous dorsum, the bony septum and the maxillary crest. Both the nasal bone and septal fractures need to be reduced together in order to achieve a satisfactory cosmetic result.

Quadrangular cartilage could appear dislocated from the bony septum due to C shaped fracture that extends from the quadrangular cartilage beneath the nasal tip, posteriorly through the perpendicular plate of ethmoid to the anterior border of vomer and then forward through the lower part of perpendicular plate of ethmoid into the

inferior part of the quadrilateral cartilage.

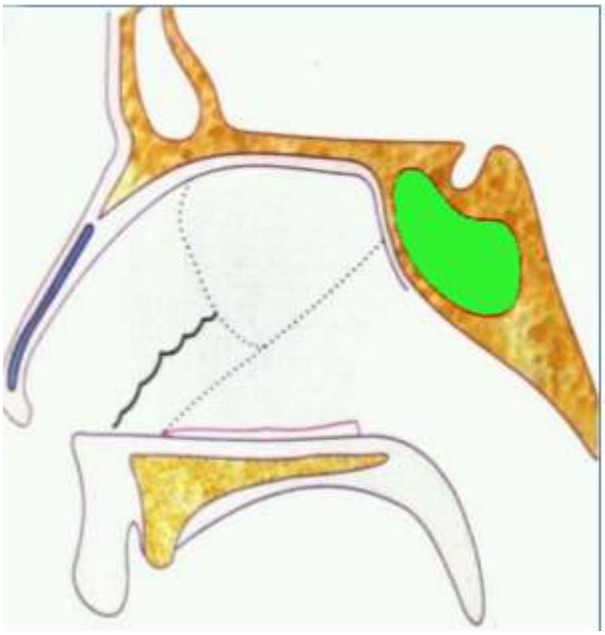


Image showing Class 2 fractures

Class 3 fracture:

Class 3 fractures are caused by high velocity trauma. They are also termed naso-orbitalethmoid fractures. Often associated with fractures of maxillae. The external buttresses of the nose give way and teh ethmoid labyrinth collapses on itself. This causes the perpendicular plate of the ethmoid to rotate and the quadrilateral cartilage to fall backwards.

Two categories of class 3 fractures have been identified:

Raveh type I - Anterior skull base, posterior wall of frontal sinus and optic canal remain intact
Raveh type II - There is disruption of posterior frontal sinus wall, multiple fractures of the roof of ethmoid and orbit extending posteriorly to the sphenoid and parasellar regions. Multiple dural tears, CSF leak, pneumocranium and cerebral herniation could complicate this type of injury.

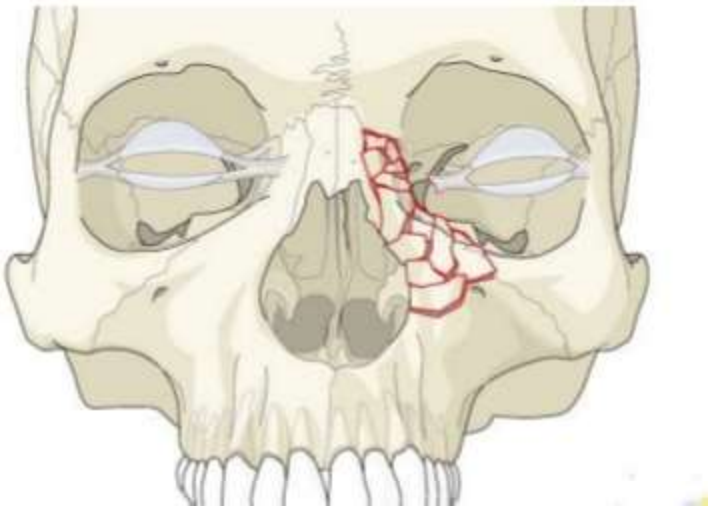


Image showing class 3 fracture

Pig like deformity of the nose is seen in class 3 fractures. There is telecanthus, which may be exaggerated further by disruption of medial canthal ligmament from the crest of the lacrimal bone.

# History & Clinical Features

The following history should be elicited:

History of injury
History of nasal obstruction
Persistent pain indicates the presence of septal hematoma
Enquiry about change in shape of nose
History of previous injuries to nose and face
History of epiphora
History of diplopia
History of loose teeth
History of watery rhinorrhoea
History of anosmia
History of altered bite / trismus

If oedema is present it prevents accurate assessment then it should be deferred till swelling subsides.

Clinical pointers towards diagnosis of fractures of nasal bone:

Injuries middle third of face
History of bleeding from nose following injury
Oedema over dorsum of nose
Tenderness and crepitus over nasal bone area
Eyelid oedema
Subcutaneous emphysema involving eyelids
Periorbital ecchymosis

Key issues during patient examination:

Deviation depression and step deformities of nose
Mobility, crepitus and tenderness over nasal bone area
Generalized swelling
Skin / mucosal laceration
Septal fracture/hematoma/abscess/ perforation

Clinicians are more interested in knowing:

1. Location of fracture site (like sidewall, dorsum, or the entire nasal bone)
2. To know whether the fracture involves the right nasal bone / left nasal bone or both sides
3. Whether there is any displacement of the fractured fragments (medial / lateral), presence of absence of comminution.
4. To identify the presence of concurrent fractures to other facial bones / nasal septum.

When there is the presence of fractures involving other facial bones / severe fractures of nasal septum it is prudent to perform open reduction.

# Pathophysiology

The following points should be borne in mind before attempting to understand the pathophysiological factors that lead to fractures involving nasal bones.

1. Nasal bones and underlying cartilage are susceptible for fracture because of their more prominent and central position in the face.

2. These structures are also pretty brittle and poorly withstands force of impact.

3. The ease with which the nose is broken may help protect the integrity of the neck, eyes, and brain. Thus it acts as a protective mechanism.

4. Nasal fractures occur in one of two main patterns- from a lateral impact or from a headon impact. In lateral trauma, the nose is displaced away from the midline on the side of the injury, in head-on trauma, the nasal bones are pushed up and splayed so that the upper nose (bridge) appears broad, but the height of the nose is collapsed (saddle-nose deformity). In both cases, the septum is often fractured and displaced.

5. The nasal bone is composed of two parts: A thick superior portion and a thin inferior portion. The intercanthal line demarcates these two portions. Fractures commonly occur below this line.

6. Nasal bones undergo fracture in its lower portion and seldom the upper portion is involved in the fracture line. This is because the upper portions of the nasal bone is supported by its articulation with the frontal bone and frontal process of maxilla.
7. Because of the close association between nasal bone and the cartilaginous portions of the nose, and the nasal septum it is quite unusual for pure nasal bone fractures to occur without affecting these structures. If closed reduction alone is performed to reduce nasal bone fractures without correction of nasal septal fractures, this could cause progressive nasal obstruction due to uncorrected deviation of nasal septum. This is because of the tendency of the nasal septum to heal by fibrosis which causes bizarre deviations like “C” “S” etc. Since nose is the most prominent portion of the face, its supporting bony structures have low breaking strength the naso ethmoidal complex fractures when exposed to forces of about 80 grams. This fact was demonstrated by Swearinger in 1965.

# Clinical Examination

This should include careful examination to rule out deformities involving nose and middle third of face. Clinical photograph of the patient should be taken in order to document the deformity. Patient should be quizzed regarding the presence of deformities in the area prior to injury. Acute injury photographs will help the surgeon to convince the patient that
fracture reduction has been done in an appropriate manner. Studies reveal that nearly 30% of the patients 9 are not satisfied with the post reduction outcome.

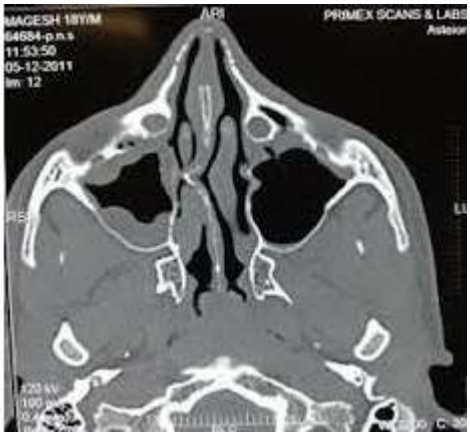
Radiology:

According to Sharp X-rays of nasal bone fails to reveal fractures in nearly 50% of the patients.
X-ray of nasal bone has very minimal role in the diagnosis of fractures involving the nasal bones. CT scan of nose and sinuses helps in identifying fractures involving other facial bones and in Lefort II and Lefort III fractures. Ultrasound using 10 MHz probe gives a clear view of the nasal bone area thereby facilitating easy identification of fractures. It also has the advantage of nil radiation hazard to the patient. Many images can be taken without any problem. It is also cost effective. According to Lee the accuracy of ultrasound in identifying fracture nasal bone was close to 100% while for conventional radiographs it was close to 70%.

X-ray Nasal bone showing fracture line

# Management

This includes investigations and treatment.  Ideal imaging modalilty in diagnosing fracture nasal bone is CT scan. This is important not only for the diagnosis of fracture nasal bone but also to identify other bony injuries associated with it.




Axial CT of nose and sinuses showing buckling of nasal septum due to fracture nasal bone

If fractures of nasal bones are left uncorrected it could lead to loss of structural integrity and the soft tissue changes that follow may lead to both unfavourable appearance and function.

The management of nasal fractures is based solely on the clinical assessment of function and appearance; therefore, a thorough physical examination of a decongested nose is paramount. Patients with fractures involving nose will have intense bleeding from nose making assessment a little difficult. Bleeding must first be controlled by nasal packing. These patients also have considerable amount of swelling involving the dorsum of the nose, making assessment difficult. These patients must be conservatively managed for at least 3 weeks for the oedema to subside to enable precise assessment of bony injury.

According to Cummins Fracture reduction should be accomplished when accurate evaluation and manipulation of the mobile nasal bones can be performed; this is usually within 5-10 days in adults and 3-7 days in children 11. Reduction is ideally performed immediately after injury before oedema sets in. If oedema has already set in it is prudent to wait for it to subside because it is difficult to ascertain adequacy of reduction in the presence of oedema

1. Closed reduction
2. Open reduction
3. Conservative management

Closed reduction:

This is the most preferred treatment modality in all acute phases of fractured nasal bones.
Even if large deviations are seen closed reduction can be attempted prior to rhinoplasty as this would simplify the task of the plastic surgeon.

Indications for closed reduction according to Bailey:

1. Unilateral / Bilateral fracture of nasal bones
2. Fracture of nasal septal complex with nasal deviation of less than half of the width of the nasal bridge

Closed reduction can be performed under local / general anaesthesia. This decision should be made by the surgeon taking the patient into confidence. There is no difference in the results produced between surgeries performed under local anaesthesia and general anaesthesia. Patients seem to tolerate fracture reduction under local anaesthesia.

Preoperative profile photograph of the patient is a must. This will give a general idea about adequacy of reduction.

Local anaesthesia:

This requires a thorough understanding of innervation of nose. Innervation of nose:
For effective administration of local anaesthesia a complete understanding of sensory innervation of nose and nasal cavity is a must. Innervation of nose can be divided into:

1. Innervation of mucosa within the nasal cavity
2. Innervation of external nose and its skin covering

Sensory innervation of external nose:

External nose and its skin lining is innervated by ophthalmic and maxillary divisions of trigeminal nerve.
Superior aspect of the nose is supplied by – Supratrochlear and Infratrochlear nerves (branches of trigeminal nerve) and external nasal branch of anterior ethmoidal nerve.
Inferior and lateral parts of the nose – is supplied by infraorbital nerve.

1. Superior inner aspect of the lateral nasal wall is supplied by anterior and posterior ethmoid nerves
2. Sphenopalatine ganglion present at the posterior end of middle turbinate innervates the posterior nasal cavity
3. Nasal septum is supplied by anterior and posterior ethmoidal nerves. Sphenopalatine ganglion also contributes to the sensory supply to the nasal septum via its nasopalatine branch.
4. Cribriform plate superiorly holds the olfactory special sensation fibers.

Both topical and infiltrative anaesthesia is used for reduction of nasal bones. 4% xylocaine topical is used to pack the nasal cavity. 4% xylocaine mixed with 1 in 100000 adrenaline is used to pack the nasal cavity. This not only anaesthetizes the nasal cavity mucosa but also causes shrinking of the turbinates making instrumentation easier. Both nasal cavities are packed. The amount of 4% xylocaine used should not exceed 4 ml as the toxic dose is about 7 ml of 4% xylocaine. It must be borne in mind that 2% xylocaine is also going to be used as infiltration anaesthesia. One cotton pledget soaked in 4% xylocaine is inserted just under the upper lip and held in position for a couple of minutes.

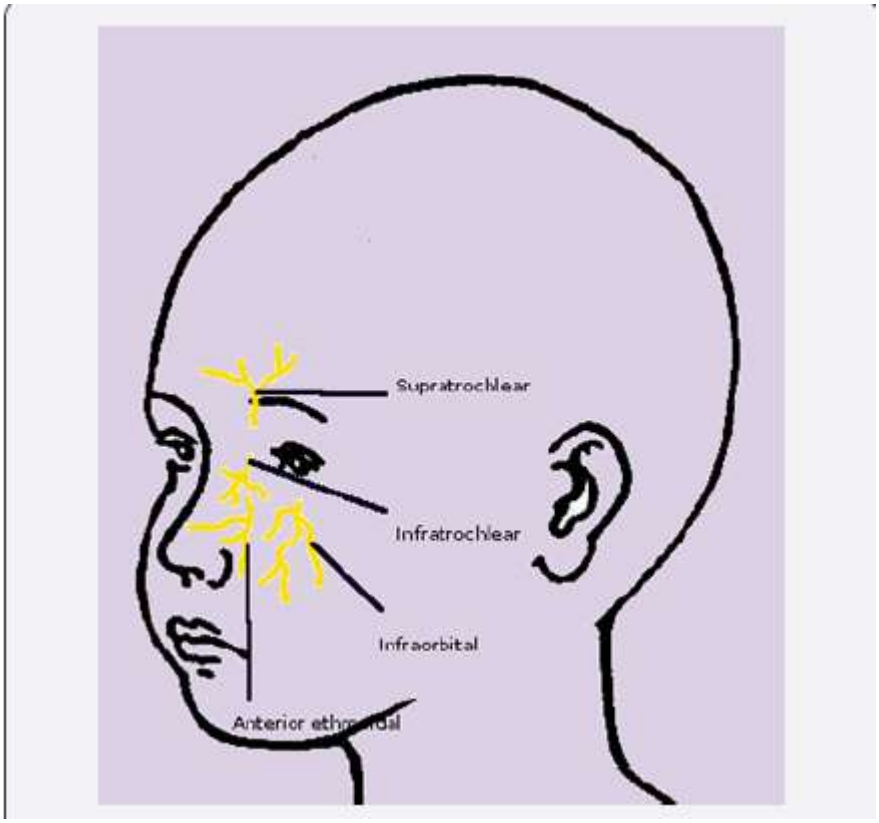



Image showing innervation of external nose

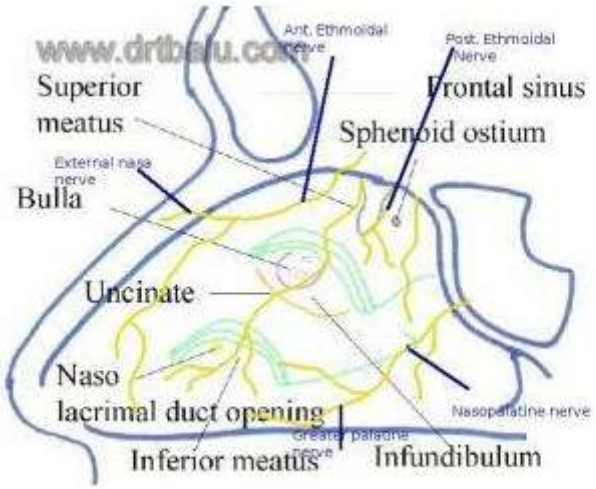



Image showing innervation of lateral nasal wall

Infiltration:

2% xylocaine is infiltrated in the following areas:

1. Through the intercartilagenous area over the nasal bones
2. Over the canine fossa

Most of class I fractures can be reduced by closed reduction and immobilization using Plaster of Paris cast. In majority of cases digital pressure alone is sufficient for the job.

If the fractured fragments are impacted then a Welsham's forceps will have to be used to disimpact and reduce the fractured nasal bone. In the event of using Welsham's forceps to disimpact the nasal bone, there will be extensive trauma to the nasal mucosa causing epistaxis. The nasal cavity of these patients must be packed with roller gauze, with application of an external splint to stabilise the bone. In these patients it is also imperative to elevate the collapsed nasal septum using Ash forceps.

Disimpaction of nasal septum


Digital pressure applied to position the nasal bone

After successful reduction the nasal cavity should be packed with antibiotic ointment impregnated gauze.

Open reduction:

Indications:
1. Extensive fractures associated with dislocation of the nasal bones and septum
2. Deviation of nasal pyramid of more than half of the width of the nasal bridge.
3. Fracture dislocation of caudal septum
4. Open fractures involving the nasal septum
5. Persistent nasal deformity even after meticulous closed reduction

Open reduction is preferred for all class III nasal bone fractures. The problem here is even though the nasal bones can be reduced the adjacent supporting bones (components of the ethmoidal labyrinth) do not support the nasal bones because of their brittleness. It is always better to reconstruct and stabilise the anterior table of the frontal bone so that other parts of nasal skeleton can derive support from it. Formerly transnasal wires were used to fix the nasal bones, but with the advent of plates and screws the whole scenario has undergone a dramatic change.

Ellis procedure of management of Class III fractures:
Aims of the procedure include:
1. Provision of adequate surgical exposure to provide an unobstructed view of all components of the fracture.
2. The medial canthal ligament should be identified. This is rarely avulsed and is usually attached to a large fragment of bone. Once identified the ligament should be reattached and secured to the lacrimal crest. This step will avoid the future development of telecanthus.
3. Reduction and reconstruction of medial orbital rim. This can be achieved by use of transnasal 26 gauge wires. If plates are used they should be very thin otherwise they will become conspicuous once the wound has healed.
4. Reconstruction of medial orbital wall and floor with bone grafts
5. Realignment of nasal septum
6. Augmentation of dorsum of the nose by the use of bone grafts
7. Accurate soft tissue readaptation should be encouraged by placing splints.

Complications of nasal bone fracture:

1. Cosmetic deformity (saddle nose, pig snout deformity). This is actually common in patients who have septal hematoma following injury to nasal bones.
2. Persistent septal deviation
3. CSF leak
4. Orbital oedema / complications
5. Nasal block / compromise of nasal functions

Nasal injuries in children:

Children's nose is mostly cartilaginous in nature containing small bones that are soft and more compliant more capable of absorbing forces due to injury. It is also a common fact that birth trauma could be the cause for septal deviations in these patients. Septal hematoma is more common in children 13. In children it is better to avoid open reduction
procedures and stick to closed manipulation techniques. Digital manipulation is the best technique. While attempting to perform digital reduction manipulation the surgeon should be aware that the feel of bone snapping back into place is not evident in children. Careful visual assessment of the shape of the nose is a must to ascertain adequacy of reduction.

# Fracture zygoma

Introduction:

Zygoma plays a vital role in maintaining facial contour. This is because the facial contour is directly influenced by underlying bony architecture. Fracture and dislocation of this bone not only causes cosmetic defects but also disrupts ocular and mandibular functions too. The zygomatic region is a prominent portion of the face next only to the dorsum of the nose.

This predisposes this bone to various trauma. The bony architecture of this bone is rather unique, it enables it to withstand blows with significant impact without being fractured. At the most it gets disarticulated along its suture lines. Fractures can involve any of the four articulations of zygoma which include zygomatico-maxillary complex, zygomatic complex proper, orbitozygomatic complex. Fractures involving zygoma should be repaired at the earliest because it can cause both functional and cosmetic defects.

Important functional defects involving this bone is restriction of mouth opening due to impingement on the coronoid process. It is hence mandatory to diagnose and treat this condition properly. It is also important to reduce this fracture and fix it accurately, because skeletal healing after inadequate reduction can cause reduced projection of malar region of the face leading on to cosmetic deformities. Accurate assessment of position of the fractured bone should be performed in relation to skull base posteriorly and midface anteriorly. This assessment is very important before reduction is attempted to ensure accurate reduction of the fractured fragments.

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Zygoma plays a vital role in maintaining facial contour Zygomatic region is a prominent portion of the face next only to the dorsum of the nose predisposing this bone to trauma.

Fractures can involve any of the four articulations of zygoma which include zygomatico maxillary complex, zygomatic complex proper and orbitozygomatic complex.

Fractures involving zygoma should be repaired at the earliest as it can cause both functional and cosmetic defects
One important functional defect due to fracture zygoma is restriction of mouth opening due to impingement on the coronoid process..

Cosmetic deformity as a result of fracture right zygoma

Importance of facial buttresses in fracture of middle third of face:

The buttress system of midface is formed by strong frontal, maxillary, zygomatic and sphenoid bones and their attachments to one another. The central midface contains many fragile bones that could easily crumble when subjected to strong forces. These fragile bones are surrounded by thicker bones of the facial buttress system lending it some strength and stability.

Components of Buttress system:

For better understanding the components of the facial buttress system have been divided into:

1. Vertical buttresses
2. Horizontal buttresses

Vertical buttress:
These buttresses are very well developed.

They include:
1. Nasomaxillary
2. Zygomaticomaxillay
3. Pterygomaxillay
4. Vertical mandible

Majority of the forces absorbed by midface are masticatory in nature. Hence the vertical buttresses are well developed in humans.

Horizontal buttresses:
These buttresses interconnect and provide support for the vertical buttresses.
They include:
1. Frontal bar
2. Infraorbital rim & nasal bones

3. Hard palate & maxillary alveolus

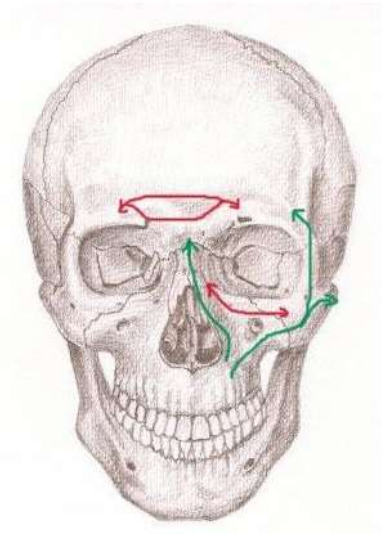


Image showing facial buttress system

Classification of zygoma fracture:

Leefort classification:

1. Non displaced – Symptomatic treatment. No reduction necessary
2. Displaced – Closed reduction is necessary
3. Comminuted – Open reduction is necessary
4. Orbital wall fracture – If ocular symptoms predominate it should be attended first. After oedema subsides then open reduction can be attempted.
5. Zygomatic arch fracture – Open reduction with stablization using micro plates / wiring

Knight & North classification:

This classification suggested by Knight etal in 1961 helped to determine prognosis and optimal treatment modality for these individuals.

Group I fractures:
In these patients fracture lines in zygoma could be seen only in imaging. There is absolutely no displacement. These patients could ideally be managed conservatively by observation and by asking the patient to eat soft diet.

Group II fractures:

This group includes isolated fractures of the arch of zygoma. These patients present with trismus and cosmetic deformities.

Group III fractures:

This include unrotated fractures involving body of zygoma.

Group IV fractures:

This involves medially rotated fractures of body of zygoma.

Group V fractures:

This involves laterally rotated fractures of body of zygoma. This type of fracture is very unstable and cannot be managed by closed reduction. Open reduction will have to be resorted to.

Group VI fractures:

This is complex fracture. It has multiple fracture lines over the body of zygoma. This condition is difficult to manage by closed reduction. Open reduction and microplate fixation is indicated in these patients. This type of fracture should not be managed by closed reduction alone because the presence of oedema / haematoma would mask the cosmetic deformity giving an impression that reduction has occurred. After reduction of oedema and followed by the action of masseter the fractured fragment may distract making the cosmetic deformity well noticeable.

Mason's classification of fracture zygoma:

Mason 6 etal used CT imaging to classify various forms of fracture zygoma. CT imaging provides the most accurate information about facial skeleton. Fractures involving facial bones, their positions, whether it is displaced or not can be clearly seen in CT scan images.

Mason classified fractures involving zygoma into:

1. Low energy injury
2. Medium energy injury
3. High energy injury

Low energy injury:

Low energy fractures involving zygoma involves minimal or no displacement of fractured fragments. In this group of patients fractures are commonly seen in the frontozygomatic suture line.

This area is very stable and hence fractures involving this area can be treated conservatively.

Middle energy injury:

Fracture zygoma due to middle energy injury causes fractures of all its supporting buttresses. There may be mild to moderate displacement and comminution. These patients invariably need eyelid / intraoral approach for adequate reduction and fixation of fracture.

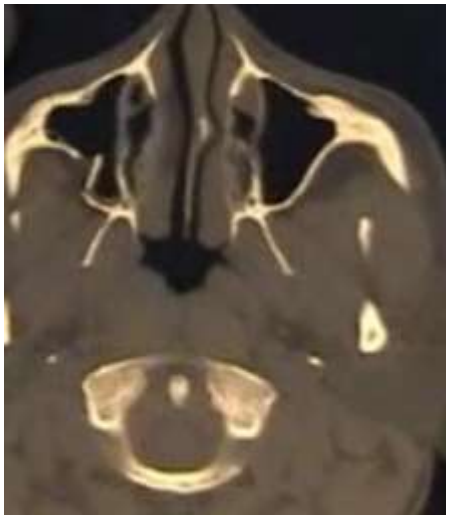
High energy injury:
This injury frequently causes Lefort fractures. These patients have difficulty in opening their mouth. Repair of fractures involving this area should be carried out through multiple approaches which include:

Bicoronal approach
Intraoral approach
Eye lid approach

Studies reveal that primary bone healing allows quicker and stronger bone formation than callous healing. Rigid fixation of fractured fragments promote primary healing in preference to callous formation.
While performing open reduction it should be borne in mind that Titanium plates are preferred to biodegradable ones when the process of reduction leaves small gaps between fractured fragments.
Clinical features:

1. Anaesthesia / Paraesthesia of that side of the face
2. Inability to open the mouth
3. Flattening of zygomatic area
4. Diplopia
5. Subconjunctival haemorrhage
6. Eye lid oedema
7. Periorbital haemorrhage
8. Lateral canthal dystopia
9. Ipsilateral epistaxis
10. Buccal sulcus haematomas
11. Enopthalmos in orbital floor fractures

Opthalmic examination is a must if any of the opthalmic manifestations of fracture of zygoma is seen. In the presence of ruptured globe, retinal detachment and traumatic optic nerve atrophy management of ophthalmic manifestations take precedence over fracture reduction procedure.



Axial CT image of nose and sinuses showing fracture of zygoma with medial displacement

Orbital exploration is indicated in the following circumstances:

1. Severe comminution
2. Displacement of orbital rim
3. Displacement of greater than 50% of the orbital floor with prolapse of orbital contents into the maxillary sinus
4. Orbital floor fracture of greater than 2 cm2
5. Combination of inferior and medial orbital wall fractures
6. Suspected involvement of orbital apex

Isolated zygomatic arch fracture:
This fracture can be managed easily without the necessity of internal fixation / splinting if reduction is performed within the span of 72 hours following injury. Fractures involving zygomatic arch can cause inability of movement of mandible. These fractures can be reduced using Gillie's temporal approach or Dingman's. supraorbital approach. Other approaches include Buccal sulcus approach.

Ruler test:
This is a rather useful clinical test to identify patients with fracture of zygoma. Two rulers are used as shown in the figure below to perform this test. These rulers are placed in front of the ears. Ruler is found to deviate on the side of fracture.

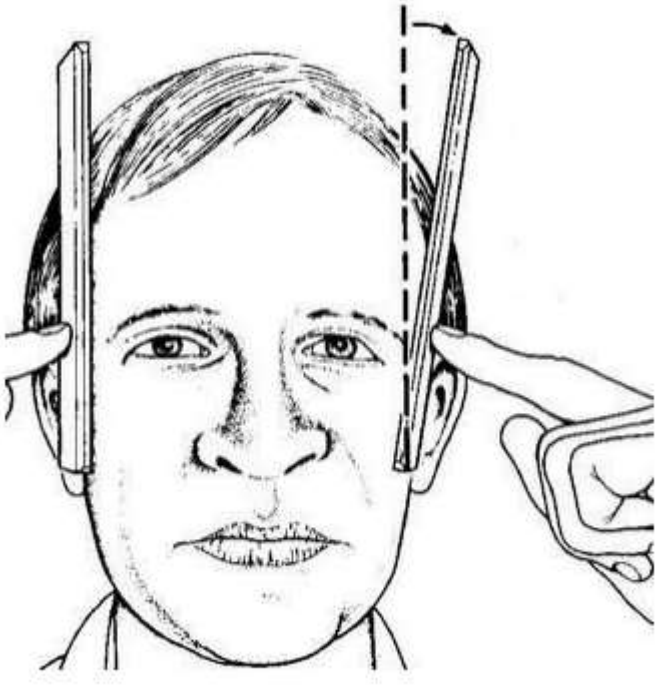


Figure showing ruler test being performed

Management:
CT scan is diagnostic and should be obtained in al cases with subjective diplopia.

Minimally displaced fractures may be managed conservatively and patients should not blow their nose for a period of 3 weeks. Patient should be reviewed after 10 days when swelling has resolved.

Displaced fractures require reduction with / without fixation.

| Approach | Indication | Advantage | Disadvantage |
|---|---|---|---|
| Gillies | Medially displaced body fractures, zygomatic arch fractures | Elevating site distant from fixation site | Requires skin incision, may be conspicuous in the bald patient |
| Dingman | Medially displaced body fractures | Uses common skin incision to that of frontozygomatic access | May be difficult to plate frontozygomatic suture and elevate simultaneously<br>Incision may become stretched |
| Poswillo hook | Posteriorly displaced fractures<br>Not arch fractures | Good mechanical advantage, quick, only one suture required | Access point of hook is prominent on the lateral cheek prominence and may be noticeable |
| Keen | Medially displaced fractures, arch fractures | Avoids cutaneous scars | Does not address displacement at the frontozygomatic suture<br>Elevation and plating at this site are difficult simultaneously<br>Theoretical contamination of the fracture site with oral microorganisms |
| Coronal | Laterally displaced arch fractures | The only approach for this rare fracture | Extensive surgical exposure |

Gillie's technique of reducing fracture zygoma:
Small incision is made over temporal area superficial temporal artery is avoided.

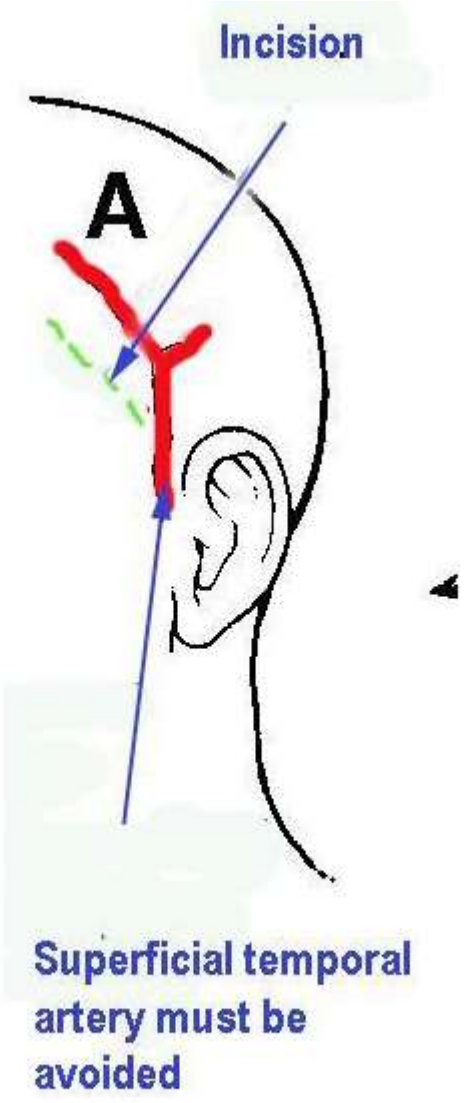
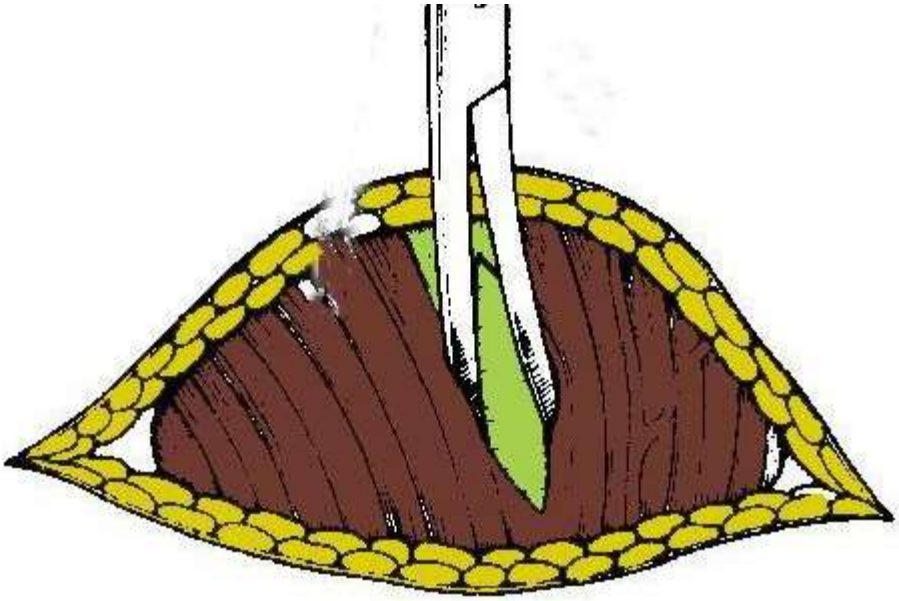
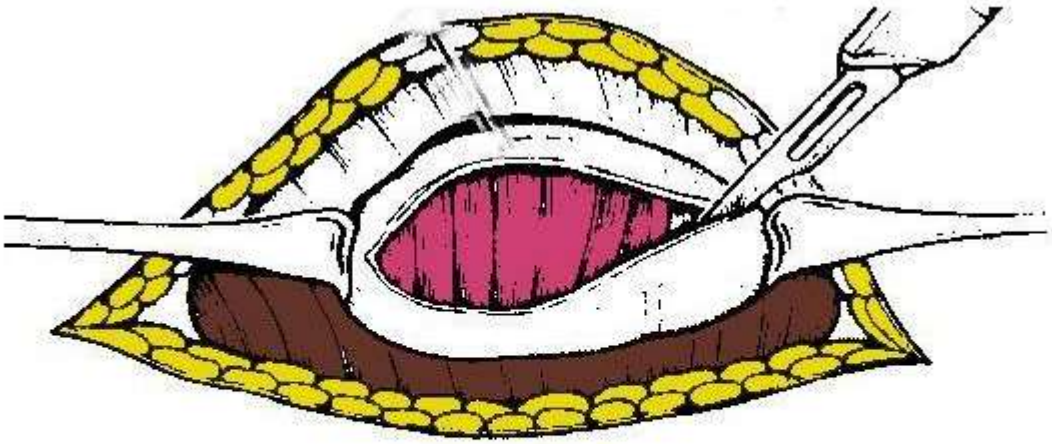


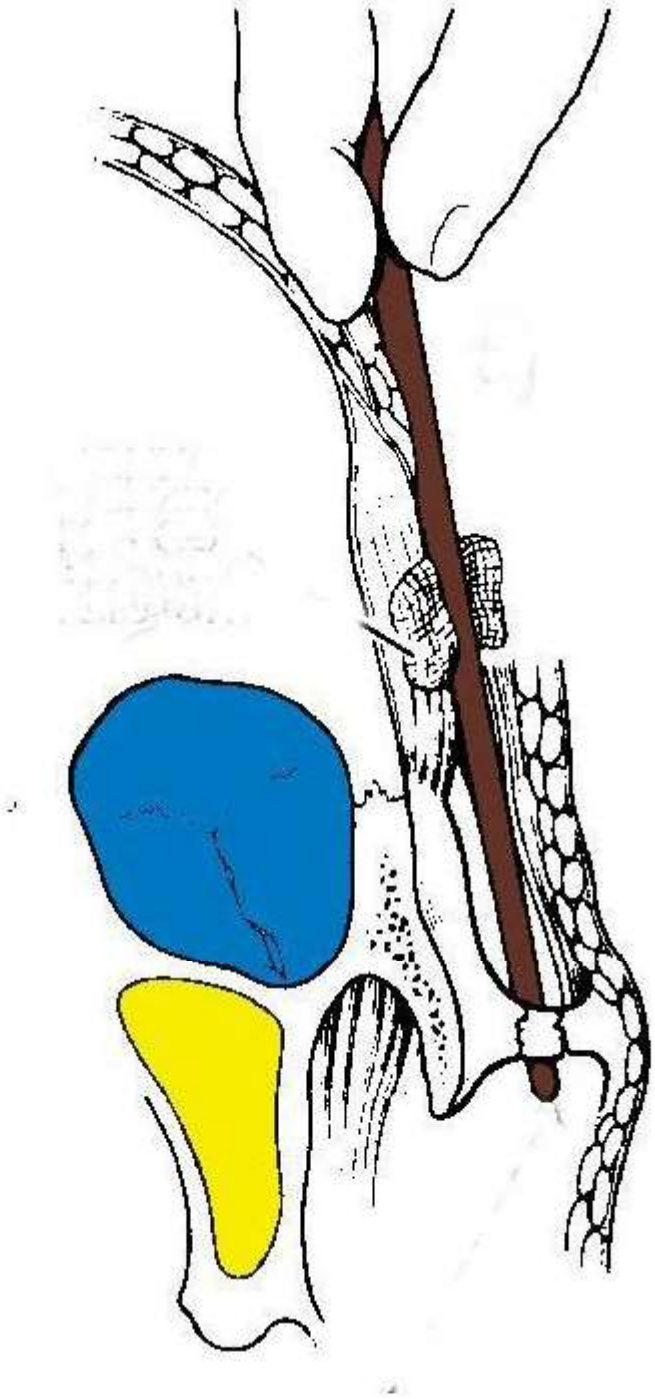

Figure showing incision for Gillies procedure



Auricularis superior muscle is cut along the line of its muscle fibers



Temporalis fascia is cut with a knife



Periosteal elevator is inserted through the incision and the fractured fragment is elevated. A gauze piece is used as a leverage

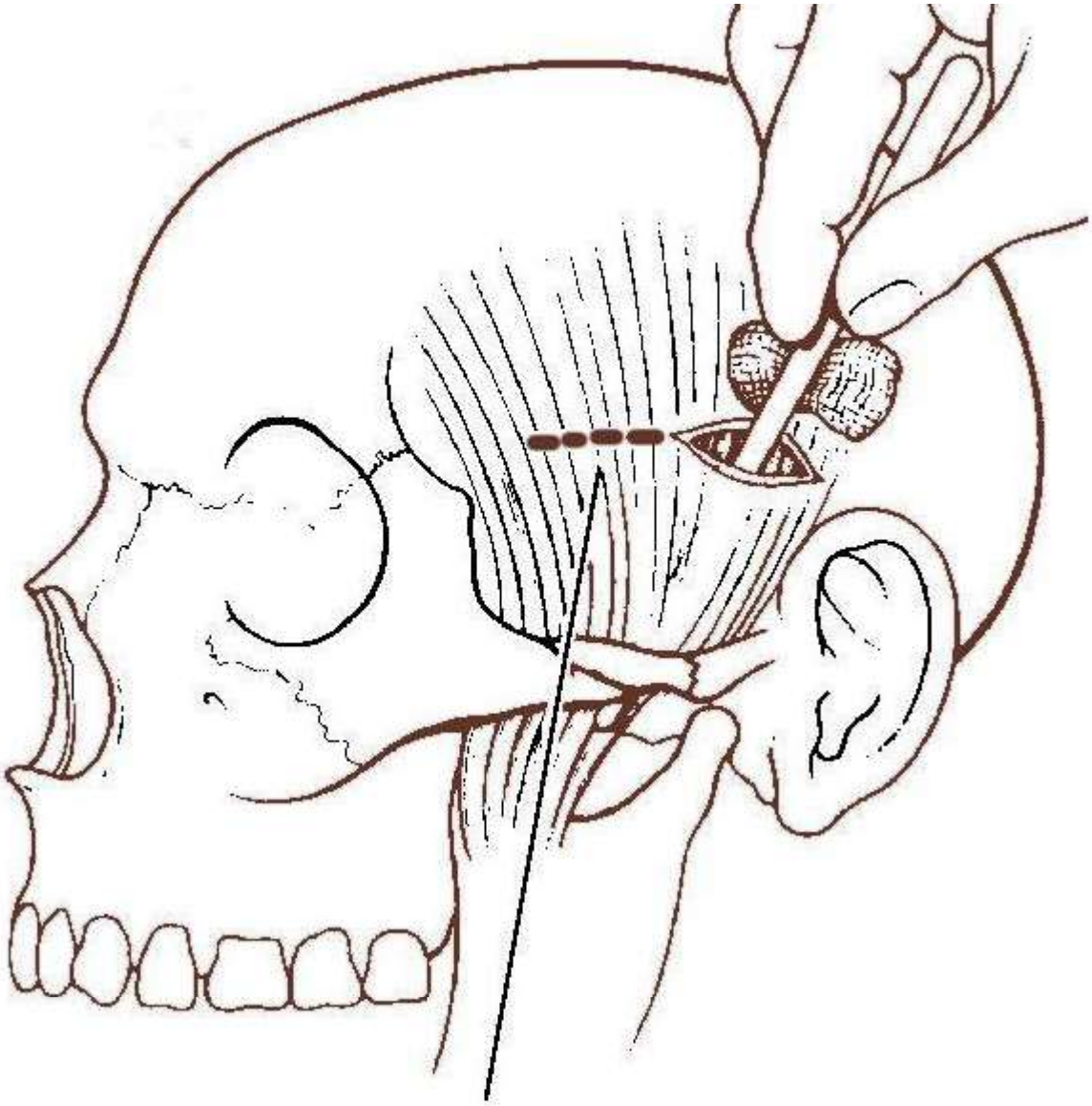


Figure showing fracture arch of zygoma being reduced.

Zygomatic complex fratures:

These fractures are invariably managed by open reduction with two point / three point fixation.

Surgical procedure is performed usually after 4- 6 weeks following injury. If fractures are more than 3 months old then osteotomy will have to be performed. Bone grafts need to be used to perform accurate repair. Usually two point fixation is sufficient in majority of patients. Two point fixation involves microplate fixation at zygomati-co-frontal and zygomatic arch areas. When using microplates for zygomatico-frontal area care should be taken to position it slightly posteriorly so that untoward subcutaneous projection of the plate can be avoided.

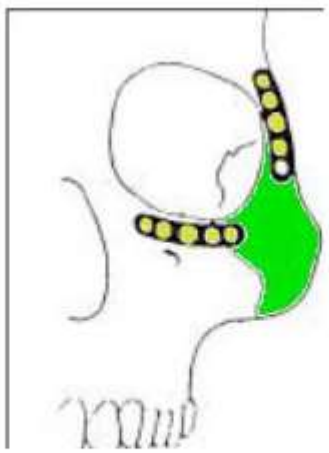
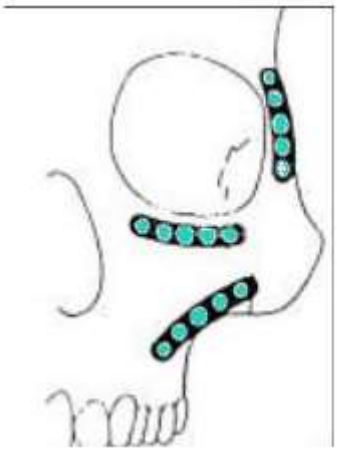


Figure showing two point fixation points

Two point fixation is sufficient in a majority of patients. Rarely when fracture is extensive and associated with lateral displacement of fractured fragments three point fixation need to be resorted to.

Bicoronal approach may be used to approach this area for open reduction purposes. Eye brow incision / transconjunctival incisions can also be used to access this area.



As shown in the figure three point fixation includes fixing

1. Frontozygomatic suture
2. Infraorbital rim
3. Zygomatico maxillary buttress

In our analysis only 2 of the 82 patients studied needed two point fixation. All the other patients were managed either conservatively or by closed reduction.

POSWILLO HOOK:

The point of application of the hook is the intersection of a line drawn vertically from the lateral orbital margin and a horizontal line drawn from the inferior margin of the nose. The hook is inserted through a stab incision and the zygoma lifted back into position.

INTRA-ORAL OR KEEN APPROACH:

A mucogingival incision is made in the buccal sulcus in the molar/premolar region. An elevator may be passed behind the zygomatic body to elevate the fracture.

Picture showing reduction being performed via intraoral route

Classification of zygomatico-maxillary complex fractures:

Zingg's classification:

Zingg in 1992 had separated zygomatico-maxillary complex into three types:
1. Type A
2. Type B
3. Type C
Type A :
This type is associated with one component of the tetrapod structure.

This type is subdivided into three subgroups:

Type A1 zygomatic arch alone is fractured.
Type A2 fracture of lateral orbital wall

Type A3 fracture of inferior orbital rim

Type B fracture:
This type of fracture involves all 3 buttresses. Also known as Tripod fracture. This fracture will have to be treated by two point fixation / three point fixation techniques.
Type C fracture:
These are comminuted fractures involving zygoma.

Orbital floor is the weakest component of the zygomatic-maxillary complex.
Type A3, B and C are associated with fracture of the floor of orbit with risk of injury to orbital contents.

Post operative care:

Patient should not blow their nose for first 12 hours.
Retrobulbar hemorrhage should be looked out for the signs of which include:
Decreased visual acuity
Diplopia
Ophthalmoplegia
Proptosis
Tense globe
Dilated pupil
Loss of direct light reflex

# Blow out Fracture

Orbital floor fractures were first described by MacKenzie in Paris in 1884 . Smith was the first to describe entrapment of inferior rectus between the fracture fragments. He was also the first to coin the term “Blow out fracture”. Blow out fracture causes an increase in the intraorbital volume, this causes enopthalmos. Entrapment of inferior rectus muscle causes
diplopia. These patients usually report to an opthalmologist since orbital signs and symptoms are predominant. Shere etal in their study conclude that nearly 14% of blow out fractures are caused by contact sports in a military population.

Blow out fracture is defined as a clinical syndrome in which there is fracture of orbital walls with intact rim. When rim is not involved it is known as pure orbital blow out fracture. If orbital walls and rims are also involved in the fracture then it is known as impure orbital blow out
fracture.

The exact description of the fracture and the terminology (blow out fracture) was first coined by Converse and Smith. It was infact Smith who first described inferior rectus entrapment in between the fractured fragments, causing decreased ocular mobility.

Classification:

Orbito zygomatic
. Naso - Orbito - Ethmoid (NOE)
. Internal blow out
. Complex ( Any of the above combinations)

Etiology:

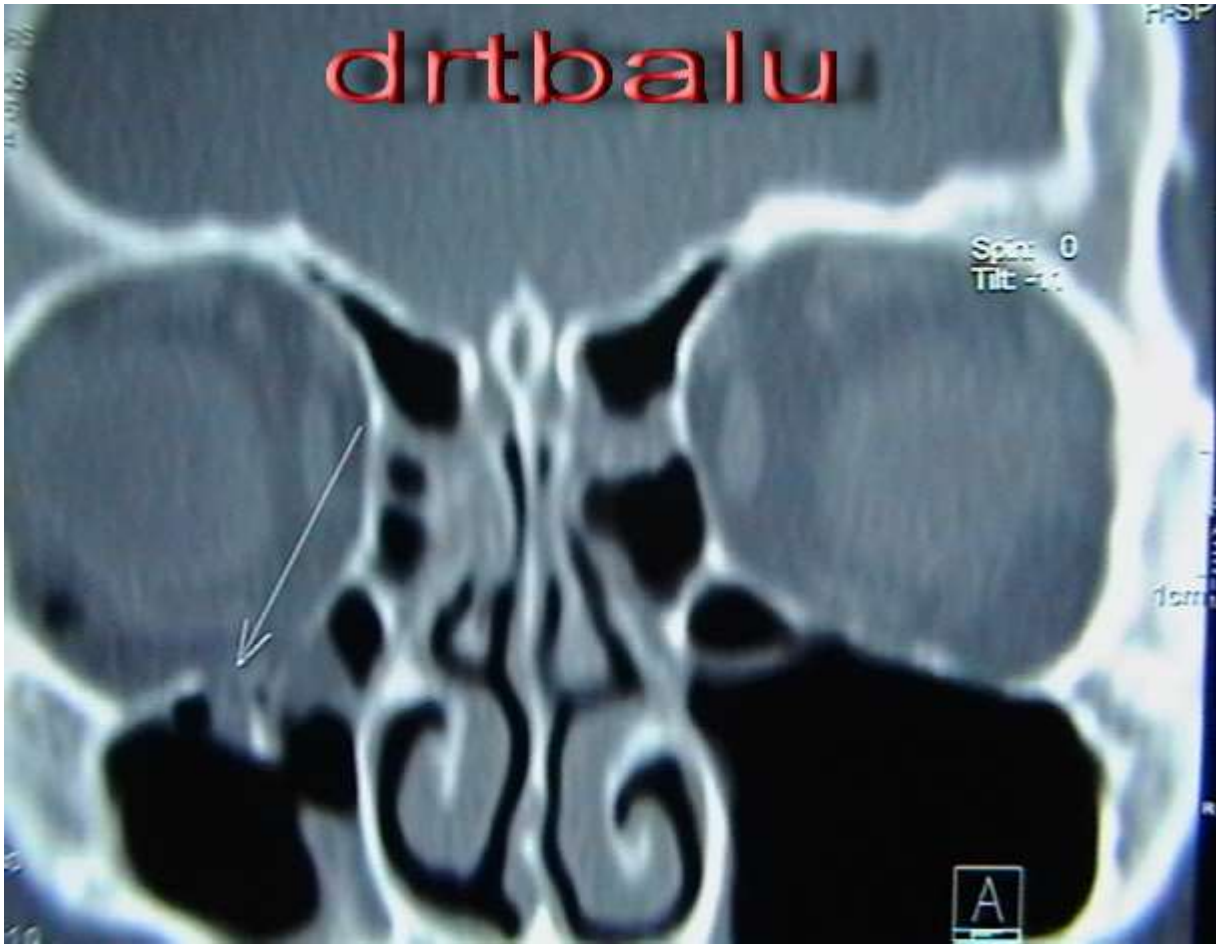
Orbital fractures are commonly caused by road traffic accidents. Pure blow out fractures involving the orbit are sustained by impact injuries to orbit and upper eyelid caused by an object which is fairly large enough to cause fracture and does not penetrate the orbit. These types of injuries are common in boxers, base ball players, cricket players etc.

The exact mechanism causing blow out fracture is yet to be elucidated. Two theories have been going around for quite sometime. They are:

1. Buckling theory
2. Hydraulic theory

Buckling theory: This theory proposed that if a force strikes at any part of the orbital rim, these forces gets transferred to the paper thin weak walls of the orbit (i.e. floor and medial wall) via rippling effect causing them to distort and eventually to fracture. This mechanism was first described by Lefort.

Hydraulic theory: This theory was proposed by Pfeiffer in 1943. This theory believes that for blow out fracture to occur the blow should be received by the eye ball and the force should be transmitted to the walls of the orbit via hydraulic effect. So according to this theory for blow out fracture to occur the eye ball should sustain direct blow pushing it into the orbit.




Coronal CT paranasal sinuses showing blow out fracture (Classic tear drop sign)

Clinical features:

Intraocular pain
. Numbeness of certain regions of face
. Diplopia
. Inability to move the eye
. Blindness
. Epistaxis
Patient may also show signs of:
. Enophthalmos
. Oedema
. Haematoma
. Globe displacement
. Restricted ocular mobility
. Infraorbital anesthesia
Proptosis in these patients is sinister because it indicates retrobulbar / peribubar hemorrhage.

Full ophthalmic examination is a must.

Pupillary dysfunction associated with visual disturbances indicate injury to optic nerve and it is an emergency. Patient must be taken up for immediate optic nerve decompression to save vision.

White eyed blow out fracture:

In paediatric patients the bony elasticity allows the fracture to open and close back into position, tightly trapping the periorbital tissues / extraocular muscles. This clinical presentation is referred as the white eyed blow out fracture which involves a history of periorbital trauma. In white eyed blow out fracture, ischemia can cause permanent damage to the involved EOM with resultant Volkmann contracture of extraocular muscles. White eyed blowout is a surgical emergency and warrants operative intervention within 24 hours of injury.

Indications for repair:

1. Diplopia within 30 degrees of primary gaze
2. Extraocular muscle entrapment
3. Enophthalmos greater than 2mm

Applied anatomy of infraorbital wall:

In adults the orbital floor is contributed by maxillary, zygomatic and palatine bones. It is infact the shortest of all the orbital walls. It does not reach up to the orbital apex, but terminates at the level of posterior edge of maxillary sinus. It is infact the weakest portion of the orbital walls made still more weak by the infra orbital groove.


Image showing blow out fracture of right orbit

Timing for surgical intervention:

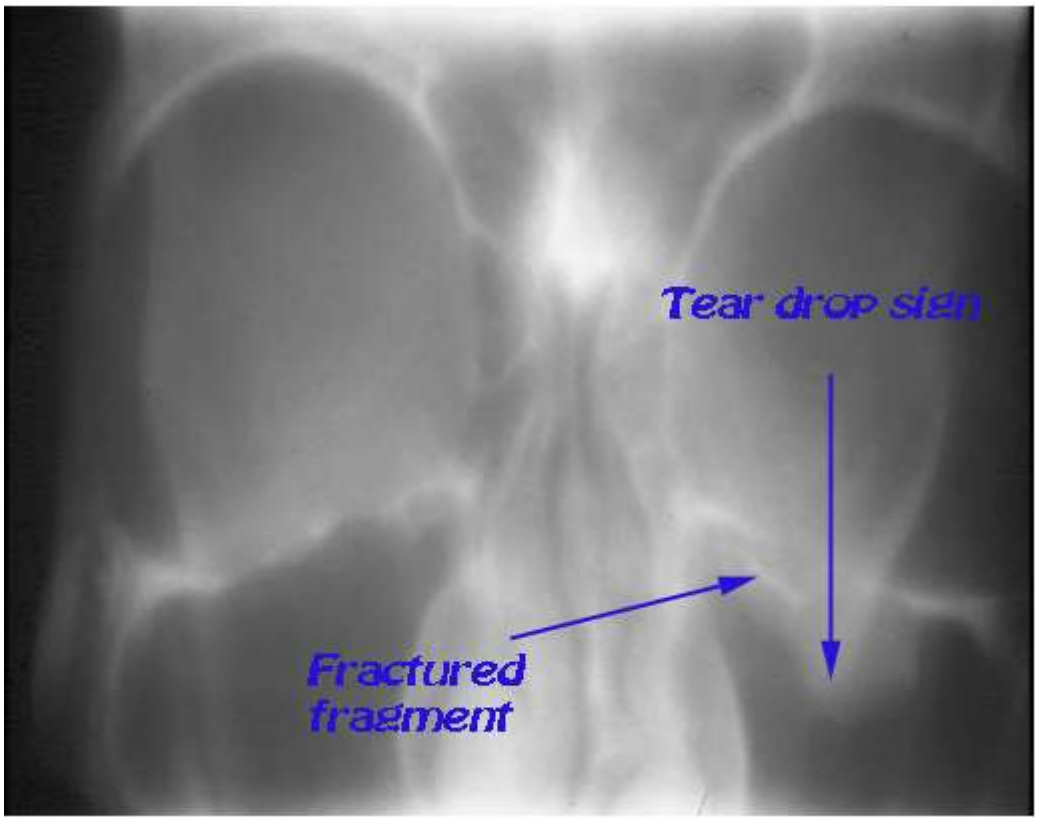
This is highly controversial. Some of the authors prefer a waiting period of atleast 2 weeks for the oedema to resolve before proceeding with surgical reduction of the fracture.

Early intervention is indicated only in white eyed blow out fracture which is common in children. In children the bones are flexible and does not break easily but bends. Significant amounts of orbital tissue may get entrapped in between the fractured fragments causing a compromise in their blood supply. This condition is known as the white eyed blow out fracture. These patients should under go immediate reduction.

Forced duction test should be performed to evaluate extraocular muscle entrapment. The examiner uses forceps to grasp the conjunctiva near the attachment of the inferior rectus muscle and attempts to move the globe through a full range of motion. Because of potential significant discomfort, this should be performed under sedation or anesthesia.

Investigations:

CT PNS is diagnostic. Fracture could be clearly seen through which orbital fat protruding.
This is also known as the classic tear drop sign. This also helps in identification of other associated orbital and skull base injuries.




X-ray Paranasal sinuses Water's view showing blow out fracture of left orbit showing tear drop sign

Surgical Management of Blow out fracture:

The main aim of surgery is open reduction and fixation of the fractured fragments.
The main support for the anterior projection of eye ball comes from the posterio medial and posterio lateral walls of the orbit. These areas diverge like a fan / cupped hand holding the globe forwards.
Both these walls are paper thin and are commonly damaged in blow out fractures. It has been clinically shown that repair is easy if these supporting walls are intact. If this key area is involved, it should be reconstructed first.


Image showing Caldwell Luc surgery being performed

Complications of blow out fracture:

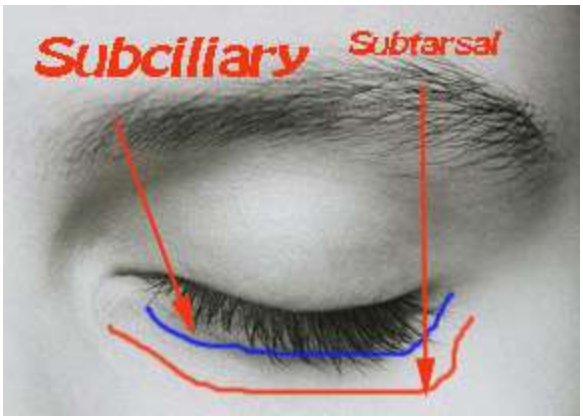
1. Herniation of orbital fat into maxillary sinus
2. Orbital emphysema
3. Bleeding into maxillary sinus
4. Entrapment / rupture of ocular muscles
5. Ischaemic muscle contractures
6. Cellulitis
7. Diplopia

Surgical access to the floor of the orbit:

Orbital floor can be accessed by any of the following incisions:

1. Subciliary / lower blepharoplasty
2. 2nd crease / subtarsal
3. Transconjunctival

The major advantage of these incision is that it is cosmetically acceptable. There is also no risk of lower eyelid shortening or inversion.




The incision is made through skin only. The skin is reflected down by blunt dissection until it is free from the pretarsal portion of the orbicularis oculi muscle. The muscle fibers of orbicularis oculi are spread to expose the periosteum of the lateral border initially. The submuscular dissection is continued till the orbital septum is seen. Care must be taken not to incise / damage the orbital septum as it can cause troublesome prolapse of orbital fat.

Damage to orbital septum can also lead to lower eye lid shortening.
Infra orbital rim is now identified. Periosteum is incised and the prolapsed contents of the orbit is elevated to visualise the floor of the orbit. The fracture can now be visualised. It can be reduced and immobilised using micro plates and screws.

Transconjunctival approach:

In this method the lower eye lid is pulled forward. To increase the laxity a lateral canthotomy should be performed.
Two methods can be performed via this incision. 1. Preseptal method and 2. Retroseptal method.

Preseptal method: In this method incision is made at the edge of the tarsal plate to create a space infront of the orbital plate to reach the orbital rim.
Retroseptal method: In this method an incision is sited 2mm below the tarsal plate to reach the orbital rim. The major advantage of this procedure is there is virtually very minimal scar formation. It is very quick to
perform and involves no skin, muscle dissection. The only disadvantage is the limitation of access to the medial portion of the orbital floor.
In cases of blow out fractures involving the medial portion of the floor of the orbit Caldwel luc procedure can be performed to reduce the fracture fragment. Nasal endoscope can be introduced through the caldwel luc fenestra to improve visualisation

In cases of extensive destruction of the floor of orbit then reconstruction of the floor must be resorted to using implants. These materials include autologous bone grafts and titanium plates / meshes.

# Naso-orbito-Ethmoid Fracture

Naso-orbito-ethmoid fractures involve the anatomical confluence of the nose, orbits and ethmoids. This is a highly complex area where injuries are often overlooked. Recosntruction at a later date is extremely difficult.

| Classification | |
|---|---|
| Type I | Single large central fragment bearing the canthal ligaments |
| Type II | Fragmentation of the central fragment, medial canthal ligaments attached to bone |
| Type III | Comminution of the central fragment with no bone attached to canthal ligaments |

Signs & symptoms:

Loss of nasal projection
Tipping up of the end of the nose.
Splaying of nasal root and telecanthus indicates gross comminution.
Blunting of the canthal angle and movement of medial canthus can be elicited by displacement of lateral palpebral ligament.

Management:

Type I fractures can be stabilized using miniplates. Surgical access is via a coronal flap, intraorally and lower eyelid incisions.
Type II and III fractures are repaired with miniplates, but require a transnasal canthopexy to reduce telecanthus and hold the position of medial canthal ligament. This is done by plates / wire. Lacrimal integrity should be assesed pre and peri operatively and stented primarily if damaged.

# Fracture Frontal Bone

Introduction:

Fractures of frontal bone is rare because of its protected location.
It is protected from trauma by the nasal pyramid prominence.
Frontal bone fractures is dangerous because of its proximity to brain and orbit and the cosmetic defects it can produce.

Frontal bone fractures can cause:
Meningitis
Mucopyocele
Encephalitis
Cerebral
abscess
It should be borne in mind that all cases of fractures involving frontal bone should be considered as a potential head injury and should be managed similarly because of its close proximity to the brain.

Classification of frontal bone Fracture:
Anterior table fracture
1. with / without displacement
2. with / without outflow tract injury
Posterior table fracture commonly occurs in combination with anterior table fracture
1. with / without displacement
2. with / without dural injury / CSF leak
3. with / without outflow tract injury

Displacement is considered to be present if it is about the width of one table of the frontal bone.


Coronal CT image showing fracture of right frontal bone

Anatomy of Frontal sinus:

Among the para nasal sinuses frontal sinus shows the maximum variations. It could be absent in 5% of individuals. Drainage channel of frontal sinus is highly variable.

Posterior wall: corresponds to the anterior wall of the anterior cranial fossa.
Floor: is formed by the upper part of the orbits. Frontal sinus appear very late in life. In fact they are not seen in skull films before the age of 6.
The sinus drains into the anterior part of the middle meatus through the fronto nasal duct.

Frontal outflow tract shows conglomeratization of air cells.

Types of frontal sinus air cells include:
I – Type I frontal cell (a single air cell above agger nasi)
II – Type II frontal cell (a series of air cells above agger nasi but below the orbital roof)
III – Type III frontal cell (this cell extends into the frontal sinus but is contiguous with agger nasi cell)
IV – Type IV frontal cell lies completely within the frontal sinus


Fracture frontal bone clinical photograph

Clinical features of frontal sinus fractures:

Clinical presenting features:

These include:
1. Cosmetic defect
2. Headache
3. CSF leak (in patients with posterior table fractures)

Assessment of patient with injury to frontal sinus:

1. All suspected patients should undergo a complete ophthalmic examination to rule out injury to the eye.
2. All these patients must undergo CT scan of brain and skull for compete evaluation
3. The patient's consciousness should be monitored carefully to rule out intracranial complications
4. Other associated injuries must be looked for because the force necessary to cause fracture of frontal bone is enormous.

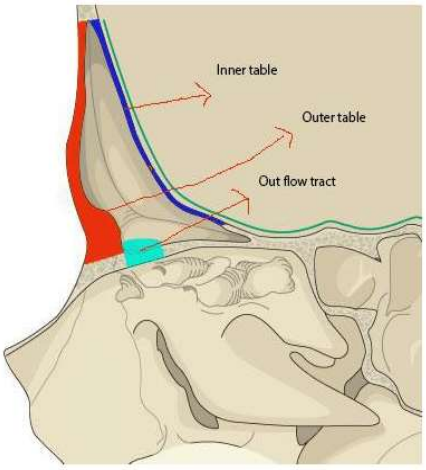
Treatment goals:
1. Protection of intracranial structures
2. Control of CSF leak
3. Prevention of late complications like secondary mucoceles
4. Deformity correction

Anterior table fractures:
Caused by low energy trauma. Displaced fractures cause cosmetic defects.
Isolated non displaced fracture of anterior table can be managed conservatively by observation. It there is displacement of fractured fragments then open reduction with internal fixation is needed.
If there is associated damage to frontal outflow tract then frontal sinus obliteration is needed. While performing open reduction with internal fixation care should be taken to avoid entrapment of mucosa within the bone fragments as this could cause mucocele formation at a later date. CT scan need to be performed to assess frontal sinus outflow tract.

Three vital areas that should be addressed while managing fractures of frontal bone:
1. Anterior table
2. Posterior table. Associated with CSF leak
3. Frontal sinus outflow tract

Tips for frontal bone fracture repair:

1. All depressed fractures of more than one table width should be reduced
2. Titanium mini plates are very useful with good success rate
3. In comminuted fractures titanium mesh is ideal




Parameters that should be focussed during frontal bone repair

# Fracture Midface

Introduction:

Maxilla acts as a bridge between the skull base superiorly and the dental occlusal plane inferiorly. This bone is associated intimately with oral cavity, nasal cavity and orbits. This makes maxilla an important structure both functionally and cosmetically.

Fractures of midfacial skeleton can be subdivided into lateral (zygmomatic) or central (maxillary, nasal and nasorbitoethmoidal fractures.

Clinical features:

Malocclusion
Reduced sensation over infraorbital nerve distribution
Swelling over cheek.
Panda facies due to circumorbital ecchymosis

Axial CT of nose and sinuses showing fracture of maxilla

Classification of middle third of face fractures:

Le Fort I fractures (horizontal) also known as Guerin's fracture /floating fractures may result from a force of injury directed low on the maxillary alveolar rim in a downward direction. It separates the palate from the remainder of the facial skeleton. The fracture extends from the nasal septum to the lateral pyriform rims, travels horizontally above the teeth apices, crosses below the zygomaticomaxillary junction, and traverses the pterygomaxillary junction to interrupt the pterygoid plates.

Le Fort II fractures (pyramidal/Subzygomatic fractures) may result from a blow to the lower or mid maxilla. Such a fracture has a pyramidal shape and extends from the nasal bridge at or below the naso-frontal suture through the frontal processes of the maxilla, inferolaterally through the lacrimal bones and inferior orbital floor and rim through or near the inferior orbital foramen, and inferiorly through the anterior wall of the maxillary sinus; it then travels under the zygoma, across the pterygomaxillary fissure, and through the pterygoid plates.

Le Fort III fractures (transverse/Suprazygomatic fracture), also termed Craniofacial Dysjunctions/"Dish-Face"deformity, and may follow impact to the nasal bridge or upper maxilla; usually as a consequence of superiorly-directed blows to the nasal bones.

Image showing Lefort type of fractures

Management:

Airway patency to be ensured
Control of bleeding
Treatment of hypovolemia
Patient should be placed in 30 degree head up position to encourage drainage of blood, saliva and CSF away from the airway.

After patient stabilizes then CT scan needs to be performed

DEFINITIVE MANAGEMENT

Goals of treatment –

1) Precise anatomical reduction to cranial base above and to the mandible below.
2) Stable fixation of reduced fragments
3) Preservation of blood supply to fractured site.
4) Restoration of function.

REDUCTION OF MAXILLA

1. Manual reduction.
2. Reduction with wires.
3. Reduction using disimpaction forceps.
4. Reduction by means of traction(elastics)

Closed reduction can be done in

1) Non displaced fracture
2) Grossly comminuted fractures
3) Fractures exposed by significant loss of overlying soft tissues.
4) Edentulous maxillary fractures
5) In children with developing dentition.

Open reduction to be done in

1) Displaced fractures
2) Multiple fractures of facial bones
3) Fractures of edentulous maxilla with severe displacement.
4) Edentulous maxillary fracture opposing an edentulous mandibular fracture.
5) Delay of treatment and interposition of soft tissues between non-contacting displaced fracture segments.
6) Specific systemic conditions contraindicating IMF.

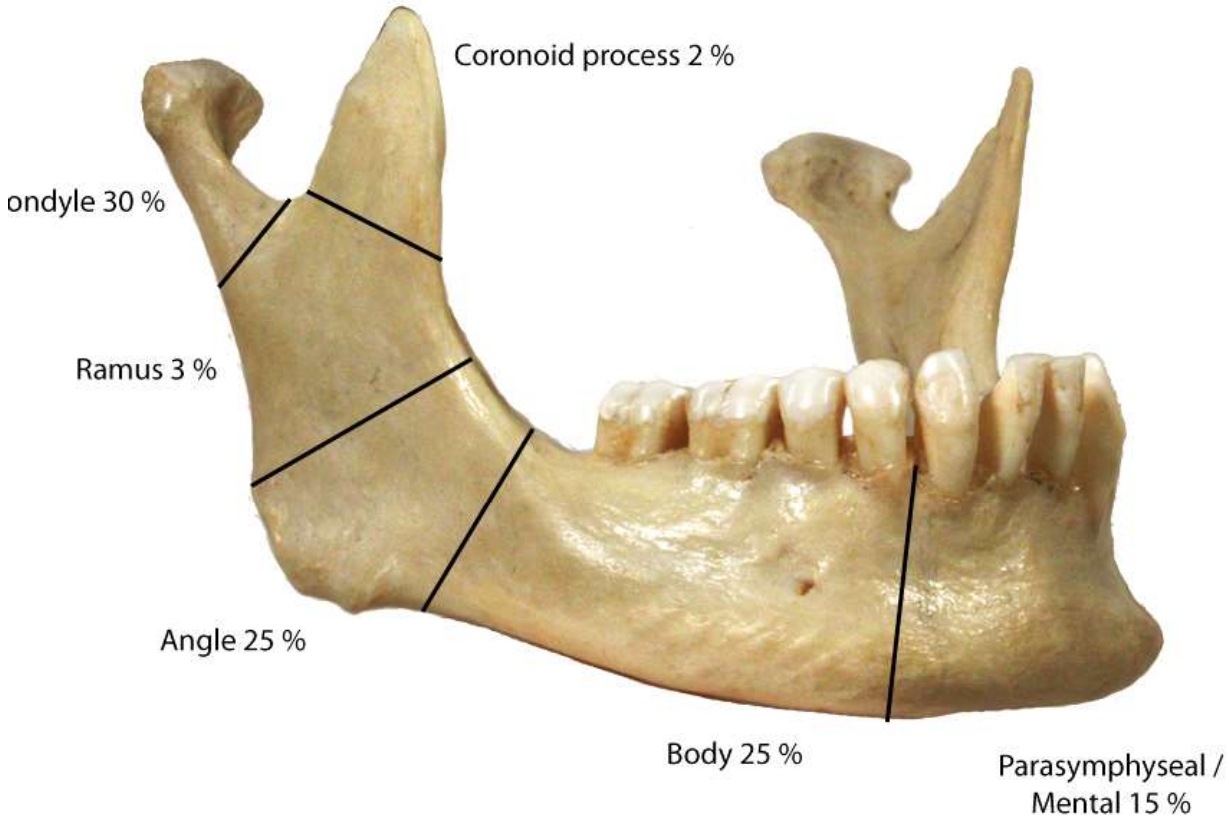
# Fracture Mandible

Introduction:

Mandible a parabolic shaped bone with complex articulation that consists of
paired synovial joints (TM joints). Movements of this joint in part is guided by the dental occlusion.
Fracture mandible requires accurate reduction, adequate fixation and immobilization.

Common use of miniplates and extended subperiosteal exposure of the craniofacial skeleton has made closed reduction techniques a thing of the past.

Mandible will fracture when subjected to direct and indirect force. The type of fracture depends on the direction and magnitude of the applied force and whether the teeth ar in or out of occlusion at that time.
Fractures occur at points of potential weakness where the bone is relatively thin. The angles of mandbile may be weakened by unerupted wisdom teeth, the parasymphysis by the long root of lower canine and the condylar neck by its slender anatomy. It is also common for the mandible to fracture at more than one place. This can happen at the parasymphysis (site of direct violence) and condylar neck (site of indirect violence). Displacement of fracture depends on the pull of attached muscles.




Signs & Symptoms:

Depends on the site of fracture.

Fractures of the body, angle and symphysis are associated with:
1. Step deformity palpable externally / intraorally
2. Asymmetry of lower dental arch and derangement of the occlusion
3. Pain and paradoxical movement and crepitus on distraction of fractured fragments
4. Hematomas in the buccal sulcus / floor of the mouth
5. Blood stained saliva
6. Anesthesia of lower lip

Fracture of condylar neck is associated with:

1. Tenderness over TM joint
2. Deviation of the jaw towards the injured side on opening the mouth
3. Deviation of jaw to the fractured side at rest with an anterior open bite secondary to gagging of the molar teeth in fracture dislocation
4. Symmetrical anterior open bite in bilateral fractures of the necks of the condyles.

Closed reduction techniques:
Intermaxillary fixation can be used in undisplaced fractures with no neural deficits, in those who want to avoid complex surgery, and in unilateral condylar fractures. A simple tie wire is placed around the teeth on either side of a displaced fracture can reduce pain, bleeding from bone ends. This makes nursing easier in the hours / days before a planned open reduction and internal fixation is performed.

Intact dental arch:
Eyelet wires can be used. It is rather simple to use and is possible in those situations where there are two adjacent teeth in contact. Main disadvantage is that it is difficult to combine eyelet wires with elastic traction and it can be awkward to thread wire through tight interdental contact points.

Incomplete dental arch:
Arch bars can be used. An arch bar is a strip of metal that is wired to each jaw using several individual teeth. The bar may be prefabricated using a model made from preoperative dental impression. Arch bars can span short gaps within each jaw, but will not cope with large gaps or when there is no posterior tooth. Arch bar provides a simple means of stabilizing more complex fractures by providing indirect fixation.

Intermaxillary bone pins:
This is a rapid method of intermaxillary fixation. A mono-cortical screw is placed through the mucosa between the canine and the first molar on side of the jaw. The screws are then wired together or connected with elastic bands. It is important to ensure that the path of the screw is the bone and the dental roots area are avoided. These specially designed screws are brittle and care should be takne when inserting them as they could break.

Internal fixation:

Intraoral incision:
When possible bone plates should be placed through an intraoral approach. Mucogingival incisions are made so that the resultant flap includes the periosteum. It is essential that a sufficient cuff of mucosa is raised so that the plate is completely covered after closure.
Mental nerve should be protected.

Extraoral incisions:

External incisions are used for the lower border of the mandbile and condylar neck. Lower border plates are ideal when there is gross comminution or tissue loss. They are also preferable in fractures of grossly resorbed edentulous mandible. In these situations, it is better to use bicortical screws and thicker plate that can provide superior fixation. The incision is made two finger breadths below the lower border of the mandible in order to avoid damage to the mandibular branch of facial nerve. Condylar fractures are difficult to manage.