

PAN-FACIAL FRACTURES – REVIEW OF LITERATURE AND CASE SERIES

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Abstract

Background: Fractures involving multiple bones of the facial skeleton constitute Pan facial fractures. Such fractures require a well-planned specialized treatment due to the challenge it poses for reconstruction. Restoration of function and aesthetics are the utmost important objectives of Pan facial fracture management. To achieve this, two most common approaches for management of Pan facial fractures are proposed which are "Bottom up and inside out" or "Top down and outside in".

Case series and follow up: We present 2 cases of Panfacial trauma where the proposed methods were followed for treating these injuries and were followed up postoperatively for pain, oedema, occlusion, and healing.

Conclusion: In the present-day scenario, due to high velocity accidents, the patterns of fractures are so varied that it's difficult to follow a definite pattern for sequencing and organizing the repair of Pan facial fractures. Improved modified exposure techniques and fixation methods and advanced hard tissue and soft tissue grafting have significantly improved the treatment of Pan facial fractures. The aim of this paper is to analyse principles that determine the choice of method of treatment and its outcome.

Key words: Bottom-up inside out, Top-down outside in, Pan facial fracture.

Introduction

The term 'Pan facial' is used commonly to describe fractures which are complex in nature due to the multiple bones involved and whose degree of fragmentation makes the reconstruction of the original facial architecture challenging. There is loss of all anatomical landmarks which aid in guiding the start of reconstruction of the facial skeleton. This holds good, particularly in fractures interrupting maxillary or mandibular bones where evidently stable occlusion as a guide is lost. In these cases, occlusal realignment through inter-maxillary fixation (IMF) is near impossible, and logical sequencing is required to achieve correct realignment of the bony framework of the face. Pan facial fractures occurs due to severe forms of trauma such as high velocity trauma which involve road traffic accidents and gun-shot injuries to face. Trauma of this nature involves fractures of the mandible, maxilla, and zygomaticomaxillary complex (ZMC) at the same time and usually accompanying the naso-orbito-ethmoid (NOE) and frontal bone.⁽¹⁾ Also associated with these fractures are soft tissue injuries and loss of bony landmarks. If not addressed and intervened at the earliest, Pan facial fractures can lead to severe post-traumatic deformities and disabilities like malocclusion, dish face deformity, facial asymmetry and enophthalmos. Hence, early intervention of such injuries is of great importance whenever possible.

CASE SERIES

Case Report I

A 37-year-old male patient reported to the casualty at D.A.P.M.R.V Dental college with a history of road traffic accident (RTA). There was history of loss of consciousness for two hours. He also gave a history of nasal bleeding, ear bleed and episodes of vomiting. On examination, he had multiple facial injuries. Glasgow coma scale was 7/15 at the time of admission. He had other associated co morbidities involving extremities. Investigations included a computed

tomography (CT) scan of brain and face. CT scan brain revealed cerebral concussion of brain. CT scan face showed frontal bone fracture, bilateral ZMC fracture, NOE fracture, dentoalveolar fracture of maxilla, Le fort 1 fracture, mandibular symphysis fracture. [Figure 1 A-B]

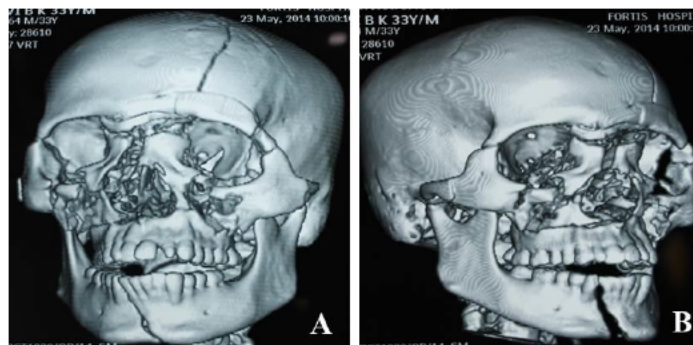


Figure 1 – CT Face suggestive of Pan facial fracture.

Clinical examination revealed a gross facial asymmetry. He suffered from multiple lacerations across left supra-orbital region, bridge of the nose, right infra-orbital rim, and upper lip. The face had a flattened appearance on the left side. Dorsal part of the nose was depressed. Telecanthus was evident. Occlusion deranged and subconjunctival ecchymosis was seen. Mobile dentoalveolar fragment was observed.[Figure 2]

For the surgical treatment, we preferred to use "Bottom to top and out to in" approach. Under tracheostomy, general anaesthesia was achieved. Arch bar was secured from right to left first molars in both the arches. Mandibular symphysis fracture was exposed using circum-vestibular incision. Mental nerve was identified, dissected and preserved. Anatomical reduction was done and fixation was carried out using two 4-holed with gap 2 mm titanium mini-plates and screws to build a foundation for the midface.



Figure 2 – Pre-operative clinical photograph

Maxilla was exposed using upper circum-vestibular incision. The Le Fort I fracture was identified, reduced and stabilized using two 4-holed with gap 1.5 mm L-shaped titanium miniplates and screws and two 2-holed with gap 1.5mm titanium miniplates and screws. The supraorbital rim was exposed; fracture line was identified and reduced. The fracture was stabilized using a 1.5 mm titanium orbital plate. [Figure 3]



Figure 3 - Supraorbital rim Fracture-Reduction and fixation.

Gillies temporal approach was used to elevate and reduce the left arch fracture. Left frontozygomatic suture exposed via lateral brow incision, reduced and stabilized using a 2-holed with gap 1.5mm titanium miniplate and screws. Bilateral infraorbital rims exposed using infraorbital incision. Following that, infraorbital rims of both sides were reduced and stabilized using 1.5 mm orbital titanium miniplate and screws. NOE complex was exposed using open sky (H-shaped) incision, reduced and stabilized using a 2-holed with gap 1.5 mm plate and screws. [Figure 4 A-B]



Figure 4 - Bilateral infraorbital rim Fracture-Reduction and fixation



Figure 5 – NOE Fracture - Reduction and fixation.

In this case, we maintained the width of the midface by reducing the ZMC on both sides and then reduced and fixed NOE fracture.[Figure 5]



Figure 6 - Post-Operative clinical photograph.

Case Report II

A 24-year-old female reported to the casualty at D.A.P.M.R.V. Dental college with a history of fall from the 2nd floor of a building. There was history of loss of consciousness for half an hour associated with epistaxis.

GCS was 12/15 with no neurological deficit. She had other associated comorbidities involving extremities.

Investigations included CT scan of brain and face. No evidence of brain injury was reported. CT scan face showed fracture of left ZMC, anterior wall of maxilla on the left side, fracture of the left body and the left angle of the mandible. These fractures were suggestive of a Pan facial injury. [Figure 7]

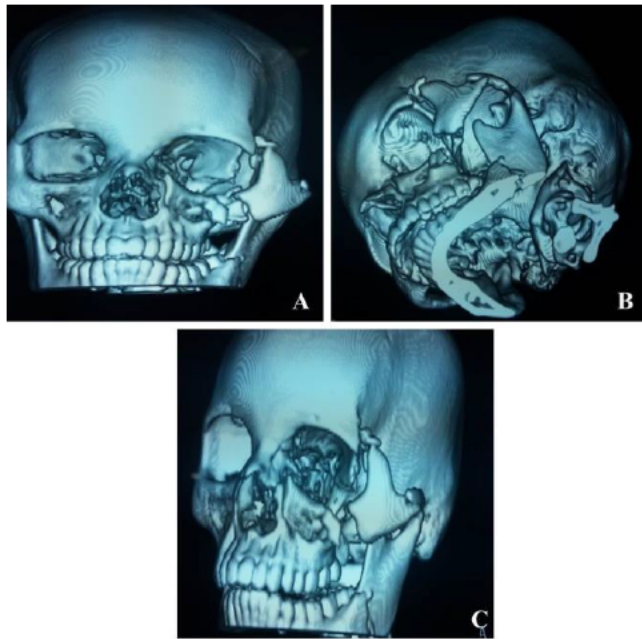


Figure 7 - A, B, C - CT Face suggestive of Pan Facial Fracture

Clinical examination revealed a gross facial asymmetry with flattening of face on left side. Telecanthus was evident. Occlusion derangement and subconjunctival ecchymosis seen. Vision was tested by Snellen's chart and found left eye to be blind. [Figure 8]



Figure 8 - Pre-operative Clinical Photograph

In this case, we preferred "bottom to top and out to in" approach. Under naso-tracheal intubation, general anaesthesia was achieved. Arch bars were secured to upper and lower arches. Angle of the mandible exposed using modified ward's incision. Anatomical reduction done and fixation carried out using 4-holed with gap 2mm L-shaped titanium miniplates and screws to build a base for midface.

Maxilla on the left side was exposed using a circum-vestibular incision. Maxilla was reduced and plated using a 4-holed with gap 1.5mm L-shaped titanium miniplate and screws. First via Gillies temporal approach, the zygomatic arch was reduced. Left infraorbital rim and orbital floor exposed using infraorbital incision. [Figure 9]



Figure 9 - Infraorbital rim Fracture-Reduction and fixation.

The herniated orbital contents were teased out gently and floor of orbit was reconstructed with titanium mesh. Also, forced-duction test was performed to confirm the activity of the inferior rectus muscle. Fractures reduced and reconstructed using this approach. [Figure 10]



Figure 10 - Post-Operative clinical photograph

Discussion

Pan facial injury management is complicated and challenging, because its sequelae not only includes loss of bony and soft tissue landmarks but also affects the function and facial aesthetics associated with it. A definite classification for Pan facial fractures has not been described in the literature. Conceptually, the facial skeleton can be divided into the upper and lower face at the LeFort I level.⁽²⁾ The upper face can be divided further into the frontal (frontal bone, supraorbital rims, and frontal sinus) and upper mid-facial (zygoma and NOE complex) areas, and the lower face into the occlusal (maxillary and mandibular alveolar processes) and mandibular (horizontal and vertical sections of the mandible) areas. A Pan facial fracture may be considered when three out of these four segments are involved.^(2,3)

Broadly, there are two schools of thought with regards to sequencing of repair of Pan facial injuries. First being "out-in, bottom-top" and the second one "in-out and top-bottom".

Considering these buttresses as the pillars of foundation, maxillary and midface reconstruction can be achieved.⁽⁴⁾ Near exact repositioning of the maxilla in its correct anteroposterior position in relation to cranial base and reconstruction of vertical and horizontal projections of the maxilla are obtained if these buttresses are stable. Following that, occlusion can be re-established and repair of the central upper midface can be achieved. This technique, although emphasizing the importance of controlling facial width, recognizes that the central face, in particular, the NOE area, is the most difficult region to reconstruct. NOE region being an aesthetic zone, is one of the primary focuses of visual attention in human interaction, and is easily noticeable and extremely difficult to repair secondarily. While addressing lateral midface first risks compounding small unavoidable imperfections in central midface reduction, with this in mind, frontal and NOE repair precedes the reduction and fixation of lateral zones including the zygomatic arches and orbital rims.

In cases of severely comminuted injuries, the approach includes division of the facial skeleton into component units that are reconstructed individually and then connected to each other and to the cranium via stable buttresses. Important contributions of each individual component to the critical dimensions of facial width, projection and height should duly be recognized. Key contributors to the central facial width are the NOE complex, the palate, and the mandibular arch. The frontal bone, zygomatic arches, malar eminences, and mandibular angles dictate lateral facial width. The antero-posterior dimensions are guided by the frontal bar, fronto-nasomaxillary buttresses, zygomatic arches, and the mandible from the angle to the symphysis on both the sides. The frontal bone, midface buttresses, and mandibular angles and condyles contribute to facial height.⁽⁵⁾

Management of Pan facial injury begins with a proper diagnosis through careful clinical examination and imaging. The face is examined visually and clinically, with close attention to patterns of oedema, soft tissue lacerations, ecchymosis, facial asymmetry, trismus, and malocclusion. Bony step deformities, crepitation, areas of tenderness, and mobilized midfacial fragments are assessed through thorough extra oral and intra oral palpation. Careful inspection and palpation of the NOE region, the palate, and the orbit is necessary to avoid overlooking injuries in these areas. Ophthalmologic and neurosurgical consults are obtained to rule out any concomitant injuries.

Following the diagnosis, the goal of the treatment, as with all facial fractures, is to restore both the function and the original facial contours. To achieve this goal, various management approaches have been proposed including “bottom to top” or “top to bottom”, “inside-out” or “outside-in”.^(6,7)

In the 1980s and early 1990s, craniofacial surgeons popularized the principles of wide exposure and the direct visualization for fracture alignment. These principles, developed for cranial surgery, were applied to Pan facial

fractures and influenced their order of repair surgeons began reconstruction with the frontal bone and proceeded into the midface, using the upper face as a template for the lower face.⁽²⁾

Many surgeons prefer the mandible as a foundation on which the occlusion is reconstructed first. A mandible reconstructed properly will re-establish lower facial width and projection, and posterior facial height.^(1, 8) For cases where the maxilla and mandible have fractures that interrupt the geometry of the dental arches, reducing and stabilizing the hard palate as a guide for mandible reconstruction also can be used.⁽²⁾

Reduction of zygomatic arch and malar projection as the first step in treatment is done to re-establish the “outer facial frame,” and provide upper facial width and projection before NOE, maxillary, and mandibular reconstruction.⁽⁶⁾ If there is an involvement of skull bone fracture, sequencing should start from the mandible and proceed cranially to achieve optimal results. If there is remarkable comminution of mandible sequencing should start cranially and proceed downward.

Although the order of repair is not critical, results are optimized if central midfacial width and projection are prioritized after occlusion and stable adjacent buttresses have been established.⁽⁹⁾ Neither one of these techniques will achieve optimal result in every situation, rather approach that goes from known to unknown and stable to unstable is certainly more accurate.⁽¹⁰⁾ Following bony reductions, maintaining soft tissue relationship is vital.

Follow - Up

Both the patients were reviewed post-operatively for healing of extraoral and intraoral wounds, oedema, pain and occlusion. During the first month of post-operative period patients were placed on heavy elastics following light elastics for 4 weeks. Arch bars were removed after 8 weeks of surgery. Post-operative occlusion achieved was satisfactory in both the patients. Extra-oral and intra-oral wounds healed well. Oedema and pain subsided in 4-5 weeks. Paraesthesia in the left infraorbital region was observed for case 2 which improved over 4 months.

Conclusion

Pan facial trauma can appear intriguing and difficult to treat. The actual treatment involves a conglomeration of many smaller procedures that have a common place in the treatment of maxillofacial injuries. Adhering to a treatment protocol and treating each fracture as a unit enables the surgeon to obtain reproducibly aesthetic and functional results. However, an organized, yet flexible approach can also achieve uniform anatomic reduction of fractures. Development of a step-by-step treatment plan prior to surgery and adherence to the general principles of maxillofacial trauma simplify the treatment of these patients considerably.

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