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Original Research Article

Mandibular fractures at a tertiary health care facility: a pilot study

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ABSTRACT

Background: Facial trauma patients were analyzed to determine the incidence, type, presentation, management, and outcome of fractures of the mandible.
Methods: The 61 patients admitted in the trauma units of Dayanand medical college Ludhiana were analyzed prospectively during a period of two years (January 2010-December 2012).
Results: In patients with multiple fractures, the common combination included zygoma and mandible (35.2%) and Le Fort II, mandible and nasoethmoid (41.2%). Out of 35 patients with mandible fractures, 8 had bilateral and 27 had single fractures making a total of 43 fractures. The body of mandible. 46.5% followed by the angle 34.8%, symphysis 9.3%, and parasymphysis 4.6% ramus and condoyle in 2.3% each were seen. Of the single mandibular fractures, the body and angle were almost equally affected in 48% and 44% cases, respectively. Isolated fracture of symphysis and parasymphysis was seen in 3.7% cases each. Isolated fracture of the ramus or condyle was not seen in any case. Half of the angle fractures were treated by wiring while shown in 1/4th each, plating and external fixation was used for treatment. Almost half (6/13) of fractures of the body were treated with external fixation. All bilateral fractures were treated with bone plating.
Conclusions: Road traffic accidents are the major cause of these fractures. Mandibular fractures are commonly associated with fractures of other facial bones. The fracture line commonly seen is in the body of mandible, followed by the angle.

Keywords: Mandibular fracture, Incidence, Angle, Body, Symphysis

INTRODUCTION

Of all kinds of injuries, face is the most commonly affected area (83%) and most injuries result from unarmed and non-penetrating injuries (more than 70%) (Greene).[1] In his study conducted on 678 patients, 46% had multiple fractures. Mandibular were most common affecting 57%, 38% had mid face fractures, 12% zygomatico maxillary complex fractures, 9% orbital blow-out, 7% nasal and 5% isolated Le Fort. Of the mandibular fractures, most occurred at the angle (35%) followed by the paras-ymphysis (25%) and the body. Approximately 20% of the facial traumatic injuries are pan facial involving upper, middle and lower face.

The maxillofacial fractures are the result of diverse type of injuries. Depending upon the geographical region, the most common etiological factors are vehicular accidents (Sawhney et al) or direct assault (Khan).[2,3] The remaining injuries can be attributed to industrial and sports related accidents or to gunshot injuries.

The treatment of facial fractures has undergone a sea change since the earliest description almost 5000 years ago. Maxillary injuries at that time were separated into simple fractures that could be successfully treated and

more complex fractures that lead to death. Although surgeons subsequently have been able to minimize the life-threatening risks associated with mid-facial trauma, deformity and prolonged disability still continue to plague patients sustaining complex facial fractures Wenig.[4]

The goals of treatment of complex facial injuries include the restoration of bony form (dental occlusion) as well as facial form (appearance). However, controversy exists concerning the treatment i.e. the best surgical approach and techniques for repair versus the correct timing for repair required to achieve these goals Wenig.[4]

The various methods of fixation of facial fractures include the use of wiring, plating and external fixation.

Traditionally, management of facial injuries involved the use of some form of intraoral fixation in combination with external fixation. It was felt that this would provide good control of the midfacial segments in all three dimensions while controlling the tendency towards retrusion.[5] The advantages of external fixation cited include its usefulness in patients who are edentulous or those who are found to have neglected dentition to which it would be difficult to attach suitable intraoral fixation. External pin fixation does not require prolonged operating time nor is it very challenging. In addition, mouth opening is maintained, thereby leaving the pharynx and airway accessible. On the negative side, the fixation apparatus is cumbersome and the transcutaneous pin placement sometimes produces noticeable scars in prominent areas. Pin fixation can be employed in fractures both of maxilla and mandible and those with gross communition or bone loss.

Wires have been used for either internal craniofacial fixation or open reduction and interosseous fixation. Internal craniofacial fixation is the conventional method of treatment of fractures of the midface in which the mobile portions of the midface are suspended to the more superior stable portions of the cranium using subcutaneous wires. This procedure offers the advantages of rapid, uncomplicated and inconspicuous stabilization. No sophisticated equipment is required except a wire passing awl and the treatment is inexpensive. However, the stabilization is non-rigid and intermaxillary fixation must be maintained. Fracture alignment is done by approximation and subtle displacement may contribute to residual deformity. Open reduction and direct interosseous fixation of the fractured elements is an easy and inexpensive method but this is not rigid and intermaxillary fixation is always required.

Contemporary thinking emphasizes the advantages of fracture treatment that allows for early restoration of function and re-establishment of craniofacial skeleton that maintains soft tissue expansion. Such treatment necessitates the early exposure of all fractures segments. In the absence of contraindicating factors, the mainstay of treatment for all of the maxillary fractures is open reduction and internal fixation of the fragments. This is best achieved by bone plating. Mini-plate osteosynthesis has become popular over the last decade. This method has the great advantage of providing rigid fixation and obviates the need for other forms of internal or external fixation. This is especially useful when local factors preclude the use of interdental fixation.

Since the airway is not encumbered, postoperative safety is improved. But the application of multiple bone plates is time consuming and quite expensive requiring special costly equipment and special technical expertise.
In view of the differences in various treatment modalities of maxillofacial fractures, the present study was undertaken to find the best method of treatment.

Among the causes of nasal fractures, Mayell observed that accidents accounted for 37%, flights 26%, work 22% and sports injuries and falls 15%.[6] He found male to female ratio 3.5:1. Further observed that in assault group 70% patients admitted were taking alcohol.

Johnson observed that there was no dental injury or mandibular fracture or fracture of middle face in persons who used seat belts in cars.[7]

Aim

Aim of study was to determine incidence, type, presentation, management and outcome of mandibular fractures.

METHODS

61 patients admitted in the ETHNS and maxillofacial, trauma units of Dayanand medical college Ludhiana were prospectively studied during a 2-year period, (Jan 2010-Dec 2012).

The patients were randomly selected and those who satisfied the under mentioned criteria were included in the study.

Inclusion criteria

Isolated fractures of the mandible and associated fractures of the mandible were included in the study.

Exclusion criteria

Patients with head injury and GCS less than 4, patients on ventilator support and patients declared dead on admission in the casualty were excluded.

Statistics

All statistical calculations were done using Statistical Package of Social Sciences (SPSS) 17 version statistical program for Microsoft windows (SPSS Inc. released

2008. SPSS statistic for windows, version 17.0, Chicago). Ethical approval of the study was taken from the institutional ethics committee.

Ethical approval

The study was approved by the institutional ethics committee.

RESULTS

In patients with multiple fractures, common combination included zygoma and mandible 6 cases (35.2%) and Le Fort II, mandible and nasoethmoid 1 case (41.2%).

Table 1: Distribution of multiple fractures, (n= 17).

Fractures	Total, n (%)	Male	Female
Le fort II + mandible + nasoethmoid	7 (41.17)	5	2
Zygoma + mandible	6 (35.2)	4	2
Le Fort III + mandible + nasoethmoid	1 (5.8)	1	-
Le fort II + Le Fort III + mandible + nasoethmoid	1 (5.8)	1	-
Zygoma + Nasoethmoid	1 (5.8)	1	-
Zygoma + Le Fort + alveolar	1 (5.8)	1	-
Total	17	13	4

Table 2: Status of mandibular fractures type of fracture number of patients.

Fractures type	N
Isolated mandibular fractures	35
Single sided mandibular fractures	27
Bilateral mandibular fractures	8
Associated + isolated mandibular fractures	43

The 35 patients had isolated mandibular fractures, 8 had bilateral and 27 had single fractures. 43 mandibular fractures were associated with associated with fractures of other facial bones.

Table 3: Distribution of mandibular fractures, (n=43).

Site of fracture	N	Percentage (%)
Body	20	46.6
Angle	15	34.8
Symphysis	4	9.3
Para-symphysis	2	4.6
Ramus	1	2.3
Condyle	1	2.3
Total	43	100

The body of mandible was involved in the maximum number of cases i.e., 20 cases, (46.5%) followed by the angle in 15 cases, (34.8%) symphysis in 4 cases (9.3%), para-symphysis in 2 cases (4.6%) and the ramus and condyle in 1 case (2.3%) each.

Table 4: Different types of bilateral mandibular fractures, (n=8).

Site of fracture	N	Percentage (%)
B/L body	3	37.5
Angle + symphysis	2	25
Angle + opposite para-symphysis	1	12.5
Ramus + symphysis	1	12.5
Condyle + body	1	12.5
Total	8	100

The commonest involvement was of the mandibular body on both sides 3 cases (37.5%). The angle and symphysis were fractured in 2 cases (25%) of bilateral mandibular fractures. In one case each, the symphysis/ ramus and condylar/ body were fractured. In one case, the mandible showed fracture of the angle and opposite para symphsis.

Table 5: Distribution of single mandibular fractures, (n=27).

Site of fracture	N	Percentage (%)
Body	13	48.14
Angle	12	44.44
Symphysis	1	3.7
Para-symphysis	1	3.7
Ramus	-	-
Condyle	-	-
Total	27	-

In the single mandibular fractures, the body and angle were almost equally affected in 13 cases (48 .14 %) and 12 cases 44% cases respectively. Isolated fracture of symphysis and parasymphysis was seen in 1 case (3.7%) each. Isolated fracture of the ramus or condyle was not seen in any case.

Table 6: Symptoms and signs of mandibular fractures.

Symptom/ sign	N	Percentage (%)
Pain or paradoxical movement or crepitus	30	85
Palpable step deformity	28	80
Malocclusion	17	48.5
Trismus	15	42
Blood-stained saliva	12	34.2
Asymmetry of lower dental arch	7	20
Anesthesia in mental nerve distribution	5	14.2

Commonest signs were crepitus 30 cases (85%) and palpable step deformity 28 cases (80%). Malocclusion and trismus were seen in 17 cases (48.5%) and 15 cases (42%) of the patients respectively.

Table 7: Treatment modalities in fractures of mandible.

Site of fracture	N	Plating	Wiring	Ext. fixation
Body	13	4	3	6
Angle	12	3	6	3
Symphysis	1	1	-	-
Para-symphysis	1	1	-	-
B/L body	3	3	-	-
Angle + symphysis	2	2	-	-
Angle + paras-symphysis	1	1	-	-
Ramus + symphysis	1	1	-	-
Condyle + body	1	1	-	-
Total	35	17	9	9

Half of the angle fractures were treated by wiring while shown in 1/4th each, plating and external fixation was used for treatment. Almost half 6/13 of fractures of the body were treated with external fixation. All bilateral fractures were treated with bone plating.

DISCUSSION

Management of mandibular fractures

The methods for treatment of mandibular fractures include:

Closed reduction techniques

Lntermaxillary fixation (IMF)/ mandibular maxillary fixation (MMF): In a cooperative dentate patient wiring can be undertaken under local anesthesia. In the partially dentate patient, preformed arch bars or sectional silver cap splints can be used to link the dentition into a functioning unit. Lntermaxillary fixation is then applied by means of wire or elastic bands (Gleeson).[8] The above methods of fixation are only applicable to fractures of the tooth-bearing parts of the mandible. They will not provide adequate immobilization for fractures of the condyle, ramus or for some unfavorable fractures of the angle or posterior body.

Classical indications for closed reduction (MMF) include grossly comminuted fractures which heal better with the periosteum intact. A fracture with significant loss of soft tissue or fractures in an edentulous patient are also indications for treatment with MMF. Open reduction can lead to damage of the developing teeth in children. Condylar fractures treated with open reduction, can lead to damage to TMJ. MMF is contraindicated in epileptics, alcoholics, psychiatric and frail patients who cannot tolerate their jaw wired shut (Quinn).[9]

Splints in maintenance of IMF: According to Manson, acrylic plints are useful in maintaining IMF and in the continuity of the maxillary or mandibular dental arch.[10] Segments of missing teeth can be compensated for with a suitably designed maxillary or mandibular splint. An acrylic splint is occasionally placed to facilitate dental occlusion, while plate and screw fixation of a fracture is being employed and it is then removed. The acrylic splint is a strong thin, easily fabricated splint that provides excellent stabilization.

External fixation: External direct fixation was developed and used extensively during World War II for controlling fractures (Gillies, Rushton and Walker, Clouston and Walker) but has declined in popularity with the introduction of modern antibiotics which permit intra-oral and extra-oral approaches for direct transosseous fixation (Rowe and Killey).[11-14] However, external pin fixation remains a popular technique for controlling complex mandibular fractures (Khedroo).[15] External fixation can be used in combined fractures of both mandible and maxilla, those with gross comminution or bone loss, for .example pathological fractures, gunshot wounds and in cases with atrophic edentulous jaws or osteomyelitis (Gleeson).[8]

According to Manson, the indications for external fixation include multiply fractured mandible in which interosseous or inter-fragment wires do not provide sufficient stability.[10] Fractures in the edentulous mandible can also be treated with immediate mobilization. In mandibular fractures demonstrating complications of non-union or infection, the mandibular fragments can be stabilized at a point remote from the wound or fracture site. Mobilisation can be accomplished. In some cases, wiring of the jaws is contraindicated and the presence of an external pin appliance accomplishes fracture immobilization. Roger Anderson popularized the use of external pin fixation device. At present, the most popular technique involves use of a Morris biphasic fixation appliance.

Anderson reported the use of an external appliance to treat fractures of the shaft of the femur. Similar appliance was used for reconstruction of mandible when tumor excision was planned.[16] The converging pin technique of Roger and Anderson appliance was applied by Converse and Waknitz to fractures of the mandibular angle.[17] Two pins are placed in each remaining mandibular fragment, each pin converging with its twin at an angle of approximately 70 degrees. The pins are usually inserted side by side along a line parallel to the lower border of the mandible or one above the other in the region of the angle. Each pin is carefully passed through the skin and soft tissues and is drilled into the bone, penetrating both

the outer and inner cortical plates. After the fragments are returned to their normal position, the connecting portion of the appliance is adjusted and the joints are locked to secure fixation.

Open reduction techniques

Classical indications for open reduction include malocclusion despite MMF, a displaced unfavorable fracture through angle, body or symphysis and multiple fractures of the facial bones. Malunion after closed reduction is treated with osteotomies and ORIF.

Various methods of open reduction include: a). Trans osseous wiring and b) Plate and screw fixation.

Trans osseous wiring: This can be performed with simple wires, figure of eight wires or high wires. It has particular advantage in controlling the edentulous posterior fragment, comminuted fractures which are compound externally and in multiple fractures for stabilizing the lower border of mandible (Gleeson).[8]

Plate and Screw fixation: The use of plating through the intraoral approach is simple and direct and provides a mechanical advantage over wiring techniques (Chuong and Donoff).[18]

This method of osteosynthesis may be used for most mandibular fractures, for many zygomatic fractures and many central midface fractures of Le Fort I and II types (Worthington and Champy).[19]

Plate and screw fixation results in an anatomic reduction with absolute immobility. Thus, it is unforgiving in that the occlusion cannot be changed by rubber band therapy. The indications for plate and screw fixation of mandibular.

Fractures by open reduction are: a) Complex fractures with comminution, b) Fractures with extreme displacement which are subject to rotation (comminuted parasymphyseal fracture with bilateral sub-condylar fractures), c) Fractures in the edentulous jaws exhibiting displacement and d) The desire to avoid intermaxillary fixation in the post-operative period.

It has particular advantage in controlling the edentulous post fragment, comminuted fractures which are compound externally and in multiple fractures for stabilizing the lower border of the mandible (Gleeson).[8]

The various plate and screw fixation methods are: a) Dynamic compression plates (DCP): Can be used for most of the body, angle and symphyseal or para-symphyseal fractures (Quinn Jr).[9] The insertion and tightening of screw in the compression hole forces the fragments together along the plane determined by the screw in the oblong hole. Oblique fractures are not always suitable for compression plating. In such cases compression can be achieved with lag screws which engage the lingual plate through a buccally prepared hole. Neither compression plates nor lag screws need to be removed unless they become infected. DCP is particularly useful when prolonged immobilization of the jaws would be better avoided in epileptics, the aged and in body fractures associated with fractures with TMJ. Plating is only contraindicated in cases with gross contamination or wounds that will not close, b) Lag screws: A lag screw is not a special screw; the term merely refers to the use of the screw to achieve compression by using the gliding hole in the outer cortex, c) Luhr self-tapping system: In these cases, a hole is drilled equal to the minor diameter of the screw, d) Champy system and e) AO system.

Complications of osteosynthesis

The complications encountered by Philip and Champy are few and are often related to undue delay between the time of injury and the time the osteosynthesis is performed.[20] When there is marked contusion or contamination, wound dehiscences may be seen. Similarly, breakdown of incision lines may result when definitive treatment has been delayed and particularly when appropriate antibiotic treatment has not been provided during that delay period. It is therefore, preferable to perform osteosynthesis within the first 12-24 hours whenever possible.

They further reported that cellulitis, abscess formation and delayed infections are likewise commonly related to delay in starting treatment, inadequate wound care, poor oral hygiene and lack of antibiotic therapy. When wound dehiscences occur, it is not usually necessary to remove the exposed plates. On the contrary, provided the mouth is kept clean and irrigated.

Frequently, the patient is protected with antibiotics; most fractures will progress to satisfactory union even though the plate is partially exposed to the mouth.

Minor occlusal discrepancies may be seen, although they are rare. By selective occlusal grinding after healing is complete, these may be eliminated. Major occlusal discrepancies indicate a faulty osteosynthesis. If detected early enough, the procedure may be repeated and corrected but if detected late a corrective osteotomy may be necessary.

According to Kellman and Schilli the rigidity of fixation although obviously advantageous when successful, becomes a source of anguish when the repair is suboptimal.[21] The bone position cannot be readjusted by manipulating the IMF or by halo fixation. If the positioning is unsatisfactory enough to warrant repair, a secondary surgery will be required to accomplish this. Thus, the technique itself is very demanding on the experience and expertise of the surgeon. This drawback may lead some surgeons to avoid this technique,

particularly in some of the most complex situations.
Other disadvantages include the need for removal of stainless-steel implants. This has led to the use of vitallium and titanium implants in some systems. The plates can lead to cold intolerance in colder climates, causing patient discomfort and necessitating removal. The implants and equipment are also quite expensive, and training is required to learn to apply the implants.

In a study by Greene et al on 802 patients of facial injury, it was reported that the complication rate was higher for mandible fractures than any other site.[1] Treatment with rigid internal fixation was only correlated with increased complication rate in mandible fractures where rigid internal fixation carried a 27.6% complication rate, compared with 11% for closed reduction with IMF. Infection rates were elevated. Hospital stay was likewise increased in rigid internal fixation of mandible fractures.

The routine use of open reduction and miniplate fixation is generally safe but is not totally without morbidity. Infective complications associated with miniplates range from 0.5-1.5%. Miniplates may dislodge, migrate or extrude and use of miniplates may result in local touch or cold hypersensitivity. Aesthetic problems related to plate and scars resulting from access incisions are not uncommon. Infra-orbital edema is commonly seen following infra orbital incisions for ORIF (O'Sullivan et al).[22]

Management of condylar fractures

The aim is to produce a functional result either by creation of a pseudoarthrosis or bony reunion of the condyle.

According to Zide and Kent, absolute indications for open reductions of condylar fractures are:[23] a) Displacement of condylar head into middle cranial fossa, b) Inadequate occlusion after 1 week of closed reduction or inability to open mouth with associated X-ray evidence of a fracture segment blocking the pathway of condylar neck movement, c) Lateral extra capsular displacement of condyle, d) Foreign body in the joint capsule and e) Open ramus fractures in which rigid fixation and early mobilization would decrease fibrosis, as in a shotgun wound.

Open reduction can be done with direct interosseous wiring (Henay and Messer) wiring with a drill guide (Peters et al), K-wire or pin fixation (Stephenson et al), simple realignment without fixation (Raveh et al) complete removal and replacement of the segment (Boyne) and bone plate osteosynthesis (Klosch).[24-30]

Wiring and plating places the main trunk of the facial nerve at risk of considerable trauma. However, IMF for 10 days is usually sufficient to establish a functional jaw relationship by Gleeson.[8]
Condylar fractures most often are treated with MMF only. If no displaced, this is left in place for 3 weeks followed by elastics for 2 weeks. If displaced the patient will need 6 weeks of MMF by Quinn Jr.[9]

Management of orbital blow-out fractures

The most common type of orbital blows out fracture involves the inferior wall or floor, probably because the floor of the orbit is inherently weak as a result of its thinness and the dehiscence caused by the infraorbital canal by Manson.[10]

Although double vision is the most frequent complaint of the patient, this 1s not an indication for surgery itself. Double vision may be caused by hematoma, edema and neurogenic factors.

Indications for operation are: Limitation of forced rotation of the eyeball, radiographic evidence of extensive fracture and enophthalmos or significant globe positional change.

For isolated blow out fractures, it is not necessary to operate immediately particularly if post traumatic edema, retinal detachment or other significant globe injuries such as hyphaema are present. On the other hand, major significant orbital fractures are best treated with early surgical intervention.

There is a wide choice of methods for repairing the orbital floor. Transconjunctival and sub ciliary approaches are described by Gleeson.[8]

According to Manson, the eyelid or conjunctival approach preferred because it facilitates the disengagement of any entrapped or prolapsed orbital tissues under direct vision.[10] The author recognizes that the approach through the canine fossa and maxillary sinus is indicated in many blow-out fractures as an adjunct to the eyelid or conjunctival approach. It is helpful as a means of removing bone fragments from the sinus cavity and is important in the management of comminuted fractures of the maxilla and other bones of the midfacial area. More significant defects need to be grafted with bone or supported by silastic. Occasionally, these may need to be supported by antral packs by Gleeson.[8]

CONCLUSION

Road traffic accidents are the major cause of these fractures. Mandibular fractures are commonly associated with fractures of other facial bones. The fracture line commonly seen is in the body of mandible, followed by the angle.

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