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Original Article

An Urban Center Study of Mandibular Fractures

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Abstract

Background: The mandible is reportedly the most common fractured bone in facial trauma. The purpose of our study is to assess the epidemiology of mandibular fractures, to study inferior alveolar canal type and its implication in management, to study the various treatment modalities applied, and to study the functional outcome of the treatment.

Materials and Methods: Between August 2016 and April 2017, 55 patients of mandibular fractures who reported to the Department of Plastic Surgery, Government Royapettah Hospital, Kilpauk Medical College, were included in this study. The methodology adopted comprises recording etiology, age and sex groups involved, mandibular region affected, investigations and treatment planning, status of inferior alveolar canal, preliminary and comprehensive treatment performed, pre-operative and post-operative occlusion, management of other injuries, post-operative assessment, and complications that occurred.

Results: Majority of the mandibular fractures were found to be in the 15-45 years age group, with predominance in 25-34-year-old males. Road traffic accidents were the most common cause of mandibular fractures. Most of the fractures occurred in the parasymphyseal region. Type – 2 alveolar canal was the most common variety in the study group. Closed technique maxillary-mandibular fixation was adopted in 11 patients and open technique in 28 patients. Endoscopic-guided fixation of mandibular fractures was done in 2 patients. There were 4 complications (10.2%) in the study group during the study period.

Conclusion: In this series, decision behind the technique of management is emphasized based on the site/s of fracture, patient general condition, and comorbidities. The type of inferior alveolar canal determines the site of placement of plates used for fixation of fractures. Endoscopic management of fractures has given us a new dimension for esthetic approach, avoiding external incisions and scars.

Key words: Alveolar canal, Endoscopic management, Fractures, Mandible

INTRODUCTION

The mandible is reportedly the most common fractured bone in facial trauma (Figure 1). The injury is found predominantly in males in the 25-34-year-old age group. Mandibular fracture management is mentioned throughout the history in various places. Few examples are Ancient Egypt: The Edwin Smith Treatise, Ancient Greece- Hippocrates, "Modern" Europe, America - Thomas Gunning and America – "Mr. Thomas." The primary causes of mandibular fractures are vehicular accidents and assaults.[1-7]

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These varies according to the geographic, socioeconomic status, and ethnic status of community. Other significant causes are falls and sporting injuries. In a large retrospective study of 2137 patients with mandibular fractures, reported 43% were caused by vehicular accidents, 34% were by assaults, 7% occurred as a result of fall, 7% were work related, 4% were by sporting injuries, and reminder has miscellaneous causes.[7-18]

Mandibular fractures are classified according to type of fracture, site of fracture, cause of fracture, and the presence of tooth in fracture fragments.[19-22] The effect of muscle action on the fracture fragments is important in the classification of angle and body fractures.[1] Angle fractures may be classified as vertically favorable or unfavorable and horizontally favorable or unfavorable (Figure 2). Different variations in the course of the inferior alveolar neurovascular bundle are described (Anderson and Kosinski 1991). The classification by Carter and Keen

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(1971) in the mandible is illustrated in Figure 2. In another larger study, the course of the inferior alveolar nerve (IAN) was evaluated from 3612 radiographs (Nortje *et al.* 1977). The radiographs were divided into four categories: (1) High mandibular canals (within 2 mm of the apices of the first and second molars), (2) intermediate mandibular canals, (3) low mandibular canals, and (4) other variations – these included duplication or division of the canal, apparent partial or complete absence of the canal, or lack of symmetry. Of the 3612 patients, 47% of the canals were high, 49% were low, and only 3% could not be fitted into the high or low canal categories. The main conclusion of this study was that the mandibular canals are usually, but not invariably, bilaterally symmetrical, and the majority of hemimandibles contain only one major canal.[1]

Classification of the topography of the IAN: I = the nerve has a course near the apices of the teeth, II = the main trunk is lowdown in the body, III = the main trunk is lowdown in the body of the mandible with several smaller trunks to the molar teeth, and IV = bifid mandibular canals or absent mandibular canal (Figure 3).

Figure 1: Normal anatomy of the mandible

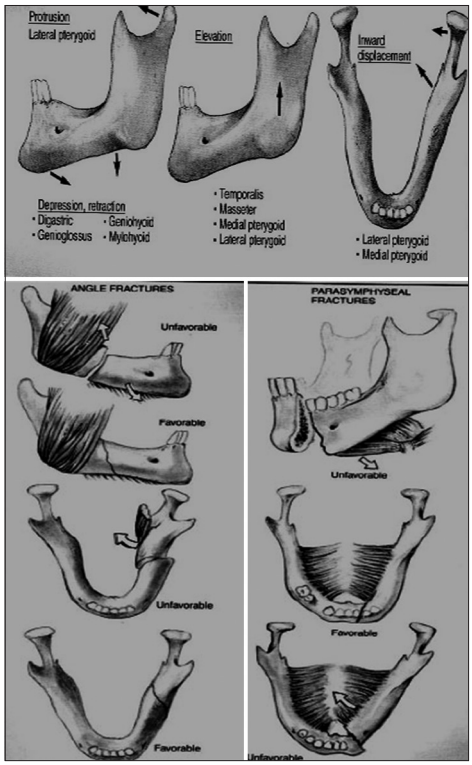

Figure 2: Forces acting on the mandible

MATERIALS AND METHODS

A detailed history regarding nature of injury and symptoms was obtained. A thorough physical examination was done to assess the general status of patient, other major and minor injuries, and site and number of fractures of the mandible.

Investigations were done which included X-ray skull AP/lateral view (Figure 4), X-ray mandible PA view and lateral view, orthopantomogram (Figure 5), and computed tomography (CT) scan with 3D reconstruction (Figure 6) as required.[8-14,23]

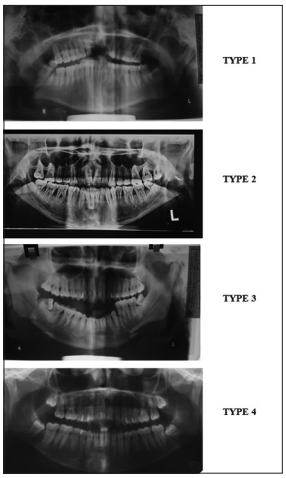

Figure 3: Types of inferior alveolar canal

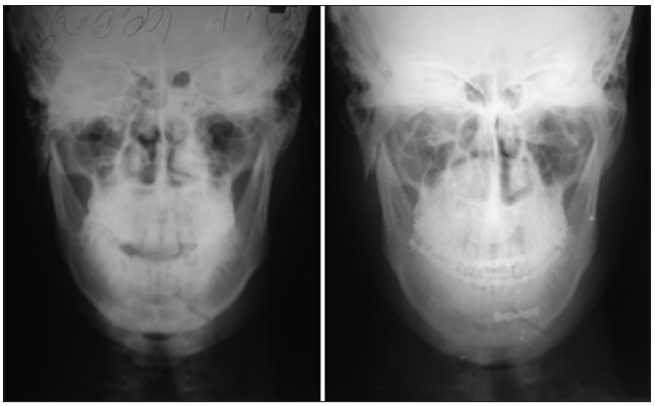

Figure 4: X-ray skull

If indicated and once the patient is fit for surgery, open reduction and internal fixation (ORIF) with miniplate and screws was done in the majority of patients who underwent surgery. Some patients with good occlusion, associated injuries were managed with maxillomandibular fixation (MMF) for 3-4 weeks.

About 20 patients were not operated due to varying reasons such as associated life-threatening head or chest wall injuries, patients who were not willing for surgery, or who have absconded from treatment.

RESULTS

The total number of patients treated during the study period at the plastic surgery department was 55.

Age-wise distribution of mandibular cancers is shown in Table 1.

Majority of the patients fall in the 15-45 age group forming 80% of total incidence. The age group 25-34 has the highest incidence of 46.3% in this study. In this study, the youngest patient was 7-year-old female and the oldest patient was 83-year-old male. These results are in comparison to a study by Ogundare *et al.*, which shows the highest incidence in 25-34 years age group in urban major trauma center.[3]

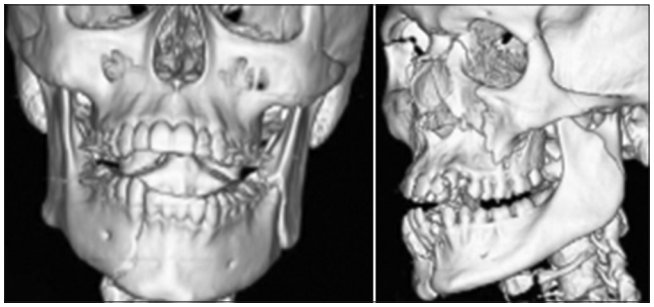

Figure 5: Computed tomography scan with 3D reconstruction

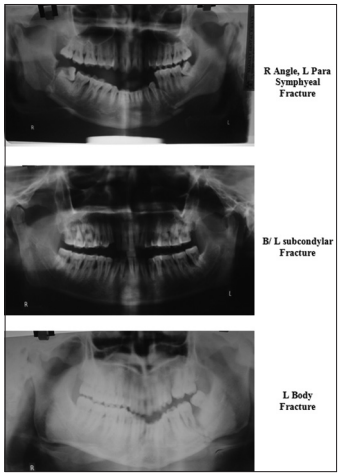

Figure 6: Orthopantomogram

Sex-wise distribution of mandibular fractures is shown in Table 2.

We found the majority of injuries occurring in young male population.

Table 3 shows the etiology of mandibular fractures.

Road traffic accidents and accidental fall constitute majority of cause of mandibular fractures. With increasing urban violence, the incidence of assaults is also on the rise.

We found that on an average the patients reached the department about 10 h after the injury.

Site-wise distribution of mandibular fractures is shown in Table 4.

Majority of fractures are seen in the angle and parasymphyseal region.

Nature of fracture is shown in Table 5.

Table 1: Age-wise distribution of mandibular fractures

Age group	Number of patients
5-14	3
15-24	12
25-34	24
35-44	8
45-54	4
55-64	3
65-74	0
75-84	1
Total	55

Table 2: Sex-wise distribution of mandibular fractures

Sex	Number of patients
Male	51
Female	4
Total	55

Table 3: etiology of mandibular fractures

Nature of injury	Number of patients
Road traffic accidents	21
Assault	15
Fall	18
Sports injury	1
Total	55

Single unilateral fractures are the most common type of fractures in this study. Among bilateral fractures, the combination of parasymphyseal fracture on one side and angle fracture on another side is most common.

The types of alveolar canal in the injured patients as per their orthopantomogram study are shown in Table 6.

Majority of patients had their alveolar canal lowdown in the body. One patient had bifid alveoloar canal with left-side angle fracture.

About 39 of the 55 patients were treated for mandibular fractures in this department. A patient with unicortical right-side body fracture was observed without any intervention with dietary management and followed for a period of 2 months and was found to heal successfully. Table 7 shows the details of management that was given to the patients.

Majority of patients have been managed with ORIF with miniplate and screws, 27 of 38 patients (71%). Patients who had MMF were immobilized for 3-4 weeks and were advised liquid and fluid diets for the period of immobilization.

Table 4: Site-wise distribution of mandibular fractures

Site of fracture	Number of fractures
Dentoalveolar	2
Symphyseal	3
Parasymphyseal	34
Body	7
Angle	31
Ramus	0
Condyle	5

Table 5: Nature of mandibular fractures

Nature of fracture	Number of fractures
Single unilateral	29
Double unilateral	2
Bilateral	21
Subcondylar	3
Total	55

Table 6: Type of alveolar canal in patients with mandibular fractures

Type of alveolar canal	Number of patients
Type 1	4
Type 2	48
Type 3	2
Type 4	1
Total	55

Intraoral approach was the preferred route for the management of all symphyseal, parasymphyseal (Figure 7), and angle fractures, as it avoids external scar, provides better opportunity to achieve proper reduction, and fixation and can be performed with experience in an easy manner.[24-27]

Endoscopic-guided fracture management of two cases of angle fracture was done using a 4 mm 30° endoscope and using a sleeve technique for fixation of fractures with a 0.5 mm external stab incision at the cheek. Accurate reduction and fixation were possible in these fractures, which are difficult to access through only an intraoral incision.

Risdon and retromandibular incisions were carried out in 3 cases which had high-angle fractures in the initial stages of the study. With progressing experience, majority of the cases subsequently were managed with only intraoral incision or endoscopic guidance.

About 20 patients of the total number had associated injuries, 12 of which were major injuries and 6 minor injuries. 2 patients were on ventilatory treatment at the time of assessment and had not recovered. Patients who had panfacial fractures (Figure 8) were managed for the other fractures as well and hence some of them required MMF (Figure 7 and Table 8).

All the patients who were managed were followed up for a period of 2 months to 2.5 years. The duration of hospital stay in these patients ranged from 2 to 25 days, averaging 15 days.

Table 7: Management of mandibular fractures

Management option adopted	Number of patients
MMF	11
ORIF with MMF	
Stainless steel wire	2
Miniplate and screws	10
Lag screw	0
ORIF without MMF	
Stainless steel wire	3
Miniplate and screws	10
Lag screw	1
Endoscopic-guided fixation	2

MMF: Maxillomandibular fixation, ORIF: Open reduction and internal fixation

Table 8: Patient with associated injuries

Nature of injury	Number of patients
Panfacial fractures	7
Upper limb injury	1
Lower limb injury	3
Head injuries	2
Chest wall injuries	2
Soft-tissue injuries face	5

Figure 7: Panfacial fractures

There were 4 complications noted among the patients treated with mandibular fractures during the study period. These include:

1. A patient with impacted molar in the line of fixation which produced persistent pain which was managed with dental extraction.
2. Marginal mandibular nerve paresis was noted in a patient with right-side angle fracture approached through submandibular incision, in whom an ORIF was done with miniplate and screw. The patient had not come for follow-up after 2 months of improving paresis.
3. A 23-year-old female patient who had right parasymphyseal fracture who was managed with MMF alone was found to have inter-incisor distance of 1.5 cm after removal of MMF and was managed with dynamic mouth opening splint and had recovered full mouth opening in 2 months' time.
4. One patient with left-side angle and right-side parasymphyseal fracture who was managed with MMF initially was found to have an inadequate reduction of fracture and hence was managed with ORIF with miniplate and screws and subsequently was found to have adequate reduction and fixation.

All the patients who were managed in this department during the study period for mandibular fractures were found to have good post-operative occlusion, adequate mouth opening, and good reduction of fractures.

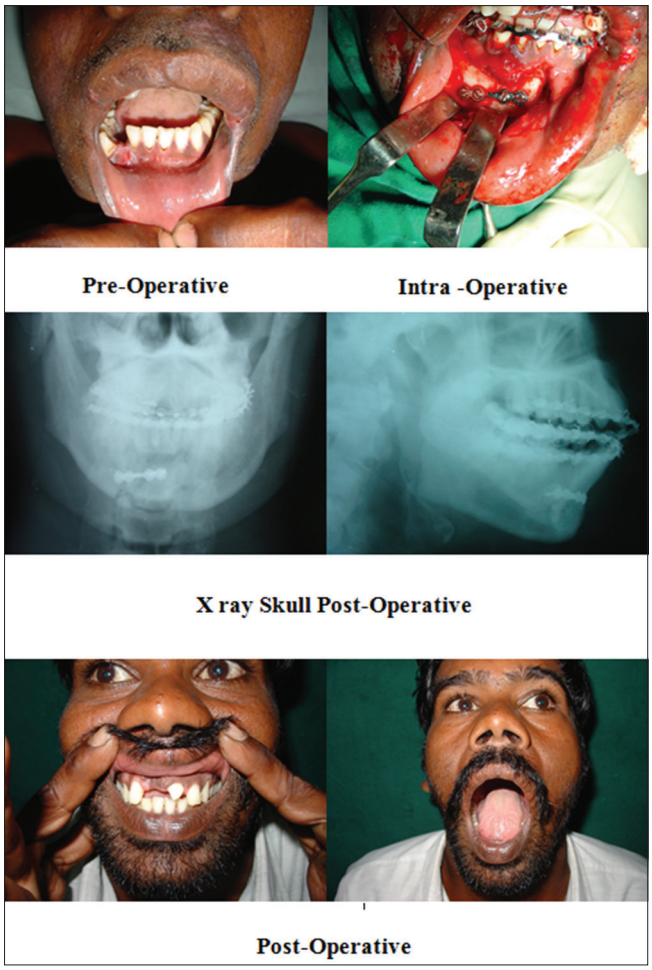

Figure 8: Parasymphyseal fracture

DISCUSSION

The treatment of mandible fractures can be divided into open and closed techniques.[16] Closed treatment refers to external fixation devices and MMF which is based on the principle that when the teeth of a fractured segment are incorrect occlusion, then the bone fragments to which they are attached will, in most cases, also be satisfactorily reduced.[17-29] Healing of the bone occurs by the secondary intention with callus formation in the same way as a long bone in a cast heals. Wire osteosynthesis is a form of semirigid fixation.[30-36] Open techniques of mandible repair are divided into rigid and semirigid fixation.[37,38] Adequate exposure is a key component of proper open reduction of mandible fractures.

A recent review describes the three basic types of rigid fixation: Stabilization by compression, stabilization by splinting, and semirigid fixation. The indications for the use of compression plates remain controversial, as the plates are technically difficult to use and may cause malocclusion and there are no studies showing their superiority versus other fixation methods.[30] Lag screws may be used for

compression if the fracture line is favorable and if the fracture is non-comminuted.[34-36]

A tension band plate is sometimes placed on the superior border of the fracture line to closely approximate this area because it tends to separate. This is referred to as the Champy technique. A locking reconstructing plate can be used when the fragments are small and comminuted and compression is not needed. This method has become more popular over the past few years. The treatment of comminuted fractures using AO/ASIF reconstruction plates was reported to have a low-complication rate of 3% in at least one study.[39-46]

Semirigid fixation can be performed using a small plate with 1.5-2.0 mm unicortical screws. The advantages are the limited periosteal stripping of the fracture site needed. This technique relies on the forces of the strong jaw muscles to "hold" the fracture in place. The minor complication rate is higher and includes plate/screw extrusion and fracture, but the major complication rate is low.

Endoscope-assisted treatment combines the best of open and closed treatment of mandible fractures. It is primarily used for condylar fractures and can be used for symphyseal fractures.[36-40,41-43] It has the potential to reduce the morbidity by limiting scar, reduces risk to facial nerve, eliminates MMF, all the while embracing the advantages of anatomic reduction, and rigid fixation. Subcondylar fractures without comminution, lateral displacement of proximal fragment, and non-dislocated condylar head without other major medical illness are ideal candidates for endoscopic management.[24-57]

CONCLUSIONS

Mandibular fractures are gaining greater time and attention of the plastic surgeons. Investigations into the mechanism of trauma, along with careful physical examination will often identify the location of fracture, which can then be verified radiographically. With increasing vehicular traffic and urban violence, accidents and assaults are forming the majority of causes of mandibular fractures. Self-disciplining of the individual and better policing might help to bring down the incidence. CT scan with 3D reconstruction and good orthopantomogram have given us an accurate way of detecting even small fractures and their effects on the mandible and hence their management. The type of inferior alveolar canal identification helps in placing the miniplates along Champy's lines and avoids damage to the nerve. With newer developments in the allied specialities of medicine, patients with concomitant injuries can be managed efficiently, simultaneously treating the mandibular fractures. Intraoral incisions, which avoid an external scar, have become the order of the day for almost all fractures of the mandible for it provides the necessary access and caters to the esthetic expectations of the patient. Using miniplates and screws have significantly reduced the post-operative morbidity of the patient to a great extent, allowing for an early mobilization. With endoscopy pushing the frontiers of management of mandibular fractures, accurate reduction and stable fixation are definitely possible even in difficult fractures with minimal external scars.

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