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# Mandibular Fracture: An Analysis of Vulnerable Fracture Points, Types and Management Methods

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**Abstract:**

***Objective:*** To understand the vulnerable fracture points of mandible and also find their various management methods.

***Background***: The mandible is the second most common facial fracture bone. The weak points of mandible and sites more prone to fractures are neck of mandible and mental foramen. The fractures are classified as standard fractures, based on anatomical position, based on dentition status and based on stability of fracture. In the dentition status, the patients may be either edentulous or dentulous or pediatric and hence, the age changes of mandibular structures must be taken into consideration. The management of the fractures will also be elaborated in this article.

***Reason for Review***: Being the second most common fracture bone, understanding the weak points and their trauma management is crucial.

## INTRODUCTION:

Maxillofacial trauma is frequent and is a major cause of mortality and morbidity worldwide.[1]. The most common cause is automobile injuries. Other causes include interpersonal violence, gunshots, sports, home and industrial violence. [2] There normally is an extensive degree of violence associated with this injury, in which this mandible is splintered or crushed, broken into several pierces or pulverised to give rise to many small fragments.[3]. Treatment for this type of fracture has always been a challenge to surgeons, considering both the severity of Trauma and lack of consensus regarding the ideal type of treatment for this type of injury. The aim of treatment of fractures of mandible is to restore Anatomy, function and esthetical appearance. [4]

## ANATOMY:

To accurately treat fractures of mandible, the surgeon must first understand the anatomy and physiology of the structure and its surrounding. The mandible articulates with the base of the skull through the temparomandibular joint and is held together in position using muscles of mastication, which are masseter, buccinator, medial and lateral pterygoid. It can be divided into eight major regions. [5]

1. The symphysis is located in the midline and joins the left and right halves of the mandible. It becomes an osseous union by first year.
2. The parasymphyseal is located on either side of midline and extends to both canines.
3. Moving posteriorly, the body is the region that extends from symphysis to the angle.
4. The angle is the curved portion that bears no teeth and connects body and ramus.
5. The ramus is the vertical portion that terminates in coronoid, the triangular region and the condylar, the elliptical prominence.
6. The mandibular notch is located in between coronoid and condylar process.
7. The inferior alveolar nerve passes through the mandibular foramen and into ramus, angle and body, finally terminating as mental nerve which exists the mandible through mental foramen in the external surface. It provides sensation to lower lip and chin.
8. The arterial supply is from internal maxillary artery from external carotid with contributions to inferior alveolar artery and mandibular artery. [6]

Common fracture sites include the condylar process, angle, body and at the region of the third molar, if present, the mental foramen. [5]

## OCCLUSION:

Occlusion is the relation between maxillary and mandibular teeth when the jaw is closed. To appreciate this aspect of oral morphology is important as the first and primary objective is to re-establish the patient's premorbid occlusion. It is based on the relationship between mesiobuccal cusp of maxillary first molar to buccal groove of mandibular first molar and the relationship between maxillary and mandibular canine. It can be classified as class 1 which is normal, class 2 or overbite (retrognathism) and class 3 or underbite (prognathism). Two other malocclusions are also commonly observed. [5,6] The first is open bite wherein some teeth occlude while there is a gap between the others in closed jaw, commonly as a result of fracture or poorly healed fracture. The other is cross bite where there is abnormal medial/lateral relationship between maxillary and mandibular teeth [7]

## CATEGORISATION OF MANDIBULAR FRACTURES:

Mandibular fractures can be classified in several ways. Standard fracture nomenclature for long bone fractures is the first classification (simple, compound, comminuted, or

greenstick). The second method is by anatomic location. The third is by dentition status, and the fourth is by stability of the fracture, i.e. favourable versus unfavourable. In a simple fracture the oral mucosa and external skin are intact. [8] In a compound or open fracture there is a laceration of the mucosa or skin present, or the fracture passes through a tooth root. Comminuted fractures have multiple bone fragments. Greenstick fractures involve only one cortex of the bone and occur most commonly in children.[4]

In terms of dentition status, the patient is either dentulous or edentulous, or pediatric. Having a full set of adult teeth makes for the most straightforward fracture reductions. In the edentulous patient, there are several changes in the mandibular bone that must be considered. In the pediatric patient, unerrupted dentition much be carefully avoided when placing any screws; the deciduous teeth that are present also hold wire poorly.[5]

Fractures can be classified as favourable or unfavourable based on the stability (or lack thereof) afforded by the pull of muscles on the fractured segments of bone. The temporalis and masseter muscles provide the primary upward force while the downward force is provided by the suprahyoid musculature and gravity. If these forces serve to bring the fracture line together, the fracture is favourable; if they serve to pull the fracture line apart, the fracture is unfavourable.[7]

**PATIENT EVALUATION:**

When evaluating mandible fractures, it is important to obtain a good history and physical exam. The mechanism of injury can help the clinician anticipate the fracture type. Motor vehicle accidents are associated with multiple comminuted fractures. A fist often results in a single, non-displaced fracture. An anterior blow to the chin results in bilateral condylar fractures. An angled blow to the parasymphysis can lead to contralateral condylar or angle fractures. Clenched teeth can lead to alveolar process fractures. Any history of bone disease, neoplasia, arthritis, temporomandibular joint disease is important. Collagen vascular disease or endocrine disorders, nutritional and metabolic disorders including alcohol abuse can affect patient outcome. A patient with a history of seizure disorder should not be put into maxillomandibular fixation. The physical examination as with any trauma patient begins with evaluation of the patient's ABC's. [15]

The pre-injury occlusion is important to assess. Posterior premature dental contact or anterior open bite is suggestive of bilateral condylar or angle fractures. A posterior open bite is common with anterior alveolar process or parasymphyseal fractures. A unilateral open bite is suggestive of a ipsilateral angle and parasymphyseal fracture. Retrognathic occlusion is seen with condylar or angle fractures. Condylar neck fractures are associated with an open bite on the opposite side of the fracture and deviation of the chin towards the side of the fracture. Bilateral mandible fractures of the body can result in airway distress. The physician may need to pull the jaw forward or tongue forward or put the patient in a lateral decubitus position. A tracheotomy may be necessary. Anaesthesia of the lower lip is pathognomonic of a fracture distal to the mandibular foramen. [9] Any intraoral or skin lacerations associated with an open fracture can potentially be used to access the fracture for reduction and fixation. Ecchymosis of the floor of mouth is suspicious for a body or symphyseal fracture. The examination should also assess abnormal mandibular movement. Inability to open the mandible can be due to a coronoid fracture. Inability to close the mandible can be due to a fracture of the alveolus, angle or ramus. Trismus is usually the result of splinting by the patient due to pain. Multiple fractures of the teeth are associated with alveolar fractures. The mandible should also be palpated for point tenderness and crepitus. [10]

Another essential consideration in the mandible fracture patient is the possibility of a cervical spine injury. Considering all patients with facial fractures, if an isolated facial fracture is present, the rate of concomitant cervical spine injury is 5-8%; if 2 or more facial fractures are present, this rate increases to 7-11%. The patient's cervical spine should therefore be stabilized with a C-collar on presentation until a cervical spine injury has been excluded with imaging and clinical exam. [4]

**ASSOCIATED INJURIES:**

Forty to sixty percent of mandible fractures are associated with other injuries. Ten percent of these are lethal. The most common associated injury is to the chest. Cervical spine injury is associated in 2.59% of mandible fractures. Although the incidence of cervical spine injury associated with mandible fractures is low, missing this injury could result in severe neurological sequelae.[11] Motor vehicle accidents are the predominant cause of cervical spine injury in association with mandible fractures. C1 and C2 are most commonly involved. Condylar fractures can rarely be displaced with the fragment herniating through the roof of the glenoid fossa into the floor of the middle cranial fossa which can be associated with a dural tear. If this happens, consultation to neurosurgery should be obtained. [3]

**INITIAL MANAGEMENT:**

With rare exception, mandible fractures are not surgical emergencies; however, if surgical intervention is needed, it should be undertaken as soon as it is safe to do so. In the interim, the patient is maintained on a soft diet, adequate medication for good pain control, and antibiotics for all open fractures (including fractures involving tooth roots). Penicillins, cephalosporins, and clindamycin are appropriate antibiotic options. In 2011, Barker et al performed a chart review on 83 patients with mandible fractures over a 5 year period at a single institution; the mean time from injury to fixation was 6.7 days and no correlation was found between increased time to repair and the rate of complications (infection, nonunion, or malunion). Common pathogens involved in mandible fracture associated infection include strept, staph and bacteroides. Therefore, the patient is routinely placed on clindamycin or penicillin. Oral care should be instituted with half strength hydrogen peroxide rinses. Once hardware is placed, a bi-weekly exam is usually sufficient in the adult patient to assess the status of the hardware, and the patient's occlusion and nutritional status. [3]

**DEFINITIVE MANAGEMENT:**

The definitive management of mandible fractures ranges from soft diet only to closed reduction by maxillomandibular fixation (MMF) to open reduction and internal fixation (ORIF). Soft diet alone can be optimal treatment for some non-displaced ramus and subcondylar fractures; however, there must be no malocclusion for this to be viable option. [3]

**GENERAL PRINCIPLES OF MANDIBULAR FRACTURE TREATMENT:**

The general principles of mandible fracture treatment are:
1) restore the patient's pre-morbid occlusion,
2) repair both skeletal and soft tissue injuries
3) use lacerations when possible,
4) use mucosal incisions when possible,
5) reduce all fractures,
6) stabilize fractures, and
7) fixate all fractures adequately to allow bone healing [6]

**CLOSED REDUCTION THROUGH MMF:**

The indications for closed reduction include 1) nondisplaced favourable fractures, 2) pediatric fractures, where open reduction is best avoided due to the risk of injuring tooth buds, 3) grossly comminuted fractures, to avoid periosteal stripping of bone fragments, and 4) condyle fractures, except in cases of bilateral condyle fractures, where closed treatment alone can result in loss of mandibular height. [5]

MMF involves placement of arch bars onto the gingiva of the maxilla and mandible. These bars are fixed into place with 24 gauge wire to the interdental spaces of the premolar and molars. Care is taken not to put wires around the incisors as these can be avulsed or moved by placement of wires. Once the arch bars are secure, and the fracture reduced with the patient in normal occlusion, fish loops are placed to wire the mandible to the maxilla. Ivy loops made out of 26 gauge wire are used in selectively bringing occlusal pairs of teeth together. They have an application in children with mixed dentition, in partially edentulous patients who will have additional forms of fixation, and in patients who need temporary occlusion while other methods are being applied such as plates or external fixation. To make ivy loops, 26 gauge wire is cut to a 16 cm length and a small loop is formed in the center of the wire around a hemostat. The ends are inserted between two suitable teeth and the mesial end is passed through the loop and then tightened. 28 gauge wire goes through the eyelets for fixation. [5]

**OPEN REDUCTION AND INTERNAL FIXATION:**

The indications for ORIF include 1) displaced unfavourable angle fractures, 2) complex facial fractures requiring a stable mandibular base, 3) atrophic edentulous mandibles, which often have minimal cancellous bone and poor osteogenesis/healing potential, and 4) some condylar fractures. [12]

For ORIF, an intraoral approach is preferred; it is more direct, leaving no external scars, and has low risk of facial nerve injury; the disadvantage is exposure is more difficult. External approaches provide improved exposure of the posterior body, angle, and ramus, and is often required for severely comminuted fractures; disadvantages include leaving a cervical scar and risk of injury to branches of the facial nerve. Ultimately, the approach chosen should allow adequate exposure to reduce and immobilize the fracture(s). There are two overall competing principles, or schools of thought, concerning ORIF of the mandible. The first is Arbeitsgemenschaft fur Osteosynthesefragen (AO) technique, which emphasizes the use of large, load-bearing plates and bicortical screws, and the second is Champy technique, which emphasizes the use of small, load-sharing plates and monocortical screws. [12]

**POST OPERATIVE CARE :**

Wire cutters are kept at bedside upon leaving the operating room and sent home with the patent. Antibiotics do not need to be routinely continued beyond 24 hours post-op. Oral hygiene is stressed, including daily brushing of the teeth and arch bars; a water pick is also very effective. Dental wax is used to protect the buccal mucosa from the sharp edges of the wires and arch bars, if applicable. The patient is followed every week until the arch bars are removed.[16]

**POST-OPERATIVE COMPLICATIONS:**

Infection is one of the most common post-operative complication. Causes include:
1.Occurs in 10-15% of patients
2.No significant decrease in the infection rate with extended post-op antibiotics
3.No significant decrease in the infection rate with extended post-op antibiotics
4.Thought to result from fracture instability and movement instead of contamination with oral flora
5.Predisposing factors
6.Local
7. Poor reduction/immobilisation
8.Poorly closed oral wounds [14]

Non-Union occurs in 3-5% of fractures. The most common cause is inadequate reduction and immobilisation. The placement of a heavy reconstruction plate may be required.
Malunion can be caused by improper reduction, inadequate occlusal alignment, and inadequate stability of the fracture. It can be treated with orthodonticsor open surgical repair
Trigeminal nerve and facial nerve injury is also possible along the course. [14]

**CONCLUSION :**

Mandibular fracture is present with many different fracture pattern which need to be treated on a case by case basis. With multiple techniques available, there is still controversy over the best treatment for each type of mandibular fracture. The decision is a clinical one based on patient factors, type of mandibular fractures, type of hardware available and the skill of the surgeon. There are several potential post-operative complications which need to be kept in mind so as to avoid further problems.[13]

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