Biomechanics of Unusual Isolated Mandibular Body Fracture -A Rare Case

*Deepashri H. Kambalimath [1] and Sridhar R.[2]
*Corresponding Author E-mail: dkambalimath@yahoo.co

Contributors:

[1]Associate Professor, [2]Reader Department of Oral and Maxillofacial Surgery, College of dental sciences, Davangere - 577004 Karnataka

Abstract

The mandible being the only movable bone in the maxillofacial skeleton is bond to get fractured due to various etiologies. The mandible has few mechanically weak regions. The fracture of mandible has been classified depending upon the region of involvement of the mandible, but we found that the fracture of body involving only the lower border in the sagittal plane without deranging the occlusion is comparatively rare. Here, a unique pattern of mandibular body fracture in sagittal plane without deranging an occlusion is presented with possible etiology and biomechanics for its unique presentation is reported.

Keywords: *Mandibular Body Fracture, Isolated, Occlusion Stability*

1. INTRODUCTION

Incidence of injuries to the facial skeleton are not uncommon, it mainly occurs due to road traffic accidents, assaults, accidental falls, sports injuries, gunshot injuries, etc.[1]. More than 3000 people are killed on the road, atleast 30,000 others are disabled or injured every day and over 1.2million people are killed and as many as 50 million injured each year as estimated by The World Health Organization[2,3]. India being the second most populated country in the world "epidemic" trauma claims lakhs of lives every year[4]. Of these road traffic accidents about 20-60% have some level of maxillofacial injuries with mandibular fracture ranging from 25-75%[5,6] mandible fractures are the most common of all maxillofacial fractures. Mandible is the only movable bone in the facial skeleton it is more vulnerable to fracture due to its mechanically weak regions mainly in the angle, condylar process[7] and both sides of mental region[8,9]. There are various factors which influence the location of mandibular fractures mainly the area of force applied, the direction, severity and velocity of the force which are broadly categorized as external factors[10,11] while dental status, mouth opening being the internal factors[9] condition of the bone is considered as intrinsic factors[12,13]. Depending on the region of fracture involved, the mandibular fractures are classified as symphysis fracture, parasymphysis fracture, body fracture, angle fracture, condylar process fracture, coronoid process fracture and ramus fracture[14]. Mandibular fractures usually follow the predictable pattern as determined by the direction and impact of force applied in contrast to gunshot and high velocity motor vehicle accidents which may not follow the predictable pattern[15, 16].

Here, a unique pattern of mandibular body fracture in sagittal plane without deranging an occlusion is presented with possible etiology and biomechanics for its unique presentation is reported. During our extensive search of literatures in various search engines(Pub med, Science direct, Google scholar etc), only one literature with unique pattern of a fracture of the mandible in a sagittal plane in angle region resembling a sagittal split osteotomy was found[15], and two case reports with sagittal fracture in symphysis region[8,13].

2. CASE REPORT

A 30 year old man reported to our emergency services with neck laceration resulting from assault (knife or matchet) during a fight involving between the groups. On stabilizing the patient with primary care and on examination he had a huge neck lacerataion of about 10 cms extending from left submandibular region to right submental region (fig1). Intraorally submucusal ecchymosis was present in right angle and mucobuccal fold region. Occlusion was perfectly alright with paraesthesia in the mental nerve distribution area. CT in axial view (Figure 2)

reveals break in the continuity in the body region in sagittal plane. CT in 3 D (Figure 3) (Figure 4) reveals a break in continuity (fracture line) along the inferior border of body region of mandible extending from mental foramen to angle region without involving the dento-alveolar segment of mandible. No other facial fractures were seen on radiographs. Under general anesthesia the soft tissue laceration was thoroughly debrided and after soft tissue dissection in the right mental region the fractured mandible in mental region was exposed (Figure 5), fractured angle region was exposed intraorally along the external oblique ridge. The fracture segments were reduced and fixed with miniplates and screws, 2 plates along the parasymphysis region and one along the external oblique ridge. Layered closure was done and pressure pack was given. Patient stood the surgery well. Eighteen months post-operative radiograph reveals proper reduction and stabilization of fracture(Figure 6, Figure 7). There was postoperative sialocele formation in the right submandibular region which got completely resolved in 3 weeks by pressure packing and anti-sialogouge medication. Complete recovery of right lower lip sensation was found after 4 months postoperatively.

3. DISCUSSION

The mandible being the only movable bone in the maxillofacial skeleton is bond to get fractured due to various etiologies[1,18]. The mandible has few mechanically weak regions mainly angle, condylar process and either side of mental region[7,13]. The fracture of mandible has been classified depending upon the region of involvement of the mandible, but we found that the fracture of body only involving the lower border in the sagittal plane of the mandible without deranging the occlusion was comparatively rare. The location, pattern and direction of mandibular fractures usually follow the lines of weak regions which is usually constant in a biomechanical pattern. External or internal force dictates the biomechanical pattern of fracture depending on the impact of force applied. The occurrence of mandibular fracture varies with soft tissue injuries, age, sex, dental trauma, pattern and position of mandibular fractures of particular patient[16].

The lower part of condylar process is likely to be fractured by horizontal external forces applied in the mental region[13], as the mandible is located at the lowest portion of the skull. This fracture likely serves as a protective mechanism allowing greater dissipation of forces which result in less residual energy to be transmitted to the midface and cranium[16]. The role of presence of impacted teeth attributes to the angle fracture[7]. In symphysis region due to curved nature of the mandible, stresses caused by axial compression and bending are combined resulting in reduced tensile stresses on the concave surface with increased compressive forces on convex side leading to vertical fracture[17].Furthermore body is the strongest part of the lower jaw, the stability and structural strength of the body is enhanced by the medial and lateral oblique lines[18,19].

An isolated sagittal fracture of the lower border of the mandible without involving the alveolar segment is rare[13]. The biomechanism for such unusual fracture can occur when the local stress exceed the ultimate strength of the bone in that region. The cortical or trabecular ratio of the bone along with its geometry will determine the strength and structural property of that particular bone. High speed moving objects only can produce an impact to fracture a bone in a non biomechanical pattern[18]. In our case a sharp matchet or knife might have been used lacerating the soft tissue of the neck from left submandibular region superficially to deep right mental region striking the mandible with horizontal orientation such an acute loading would have acted like a high powered osteotome leading to fracture mimicking an sagittal spit osteotomy of body. The matchet or knife would have to have a horizontal orientation with a sharp edge when stricking the mental region. In straight bone like body and ramus, a loading force causes compression on the outer cortex and tension on the inner cortex leading to splitting of the mandible in the sagittal plane[17]. Considering the dynamic mechanism of mandibular fractures, it is assumed that a sagittal fracture of the mandibular body region such as that experienced by our patient is extremely rare. In assault or any accidental fall, individuals basically develop an involuntary movement of the body and head that protect and minimize the impact of trauma. By this mechanism our patient might have escaped

from grave consequences of severing of major vessels of neck and saving his life limiting it to mandibular fracture.

Mitsukawa et al reported a similar non-conventional horizontal fracture of mandibular symphysis which was caused by a flying object resulting from an explosion, resembling a horizontal osteotomy for genioplasty[9]. Ladeinde et al reported a case of horizontal fracture of mandibular symphysis caused due by a sharp matchet cut[13]. Subramanian B reported an unusual pattern of mandibular fracture of angle region resembling sagittal split osteotomy. The possible cause could be an unique presentation of the mandible to the point of impact while falling down and probably the decreased height of the alveolar bone to the lower border of the mandible[15]. Shunmugavelu K et al reported a peculiar case of vertical mandibular symphysis fracture in a helmet wearer[20] without involvement of bilateral condylar fracture.

Fig. 1

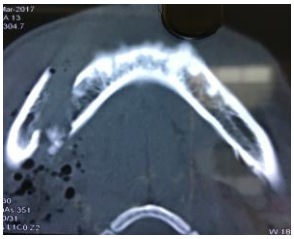

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

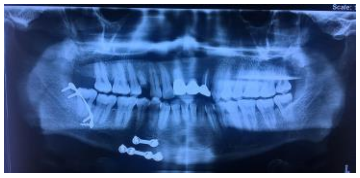

Fig. 7

4. CONCLUSION

Clinically and radiographically this type of mandibular fracture is a unique and rare case of presentation following an assault with a sharp instrument. Understanding the etiology and biomechanics behind the fracture helps us in gauging the severity of damage to the tissue and also psychological bearing on the patient. Overall the management may remain conventional. The damage to the neurovascular bundle should be kept in mind, as the shearing effect of the sagittal fracture may have a greater impact on the neurovascular bundle and the recovery may take a bit longer. Accordingly, this type of rare fracture presents a dilemma with regards to classification. It does not easily fit into any of the usual mandible fracture classification, leaving us with a difficulty in communicating about the type of fracture involved.

Conflict of interest: nil

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