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Impact of Mandibular Third Molars on Mandibular Angle Fracture

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AIM: To assess the risk factors associated with mandibular angle fracture. MATERIALS & METHODS: The medical records and panoramic radiographs of a patient cohort with mandible fractures was retrospectively reviewed. Data were collected for the following variables: age, sex, race, mechanism of injury, number and location of mandible fractures, and the presence and position of the mandibular third molars. Conclusion: In the present study, the greatest incidence of angle fractures was recorded in cases with partially impacted M3 and Class B, with statistical significance, that sup- ports studies conducted by Thangavelu et al. and Meisami et al. Regarding the horizontal position, we found the highest frequency of angle fractures in the Class II, followed by the Class III. However, according to our results of significantly higher angle fracture frequency in Class b, the shortened distance between the M3 and inferior border of the mandible also contributes to the angle fragility. The single coni- cal root of the M3 also showed significant association with angle fractures. The reason is probably in concen- trated stress around the single root apex that overcomes the bone strength.

Keywords: mandibular angle fracture, Risk factors, panoramic radiographs.

1. Introduction

Mandible is the largest, strongest, corticocancellous, membranous bone with a curved surface, which projects from the base of the skull in downward and forward direction because of their prominent nature they are more prone for fracture [1].

Outer cortical plates made up of inorganic salts like hydroxyapatite crystal provide compressive strength by their rigidity and Spongy / fibrous structure of collagenous connective tissue, provides tensile stability to counter disrupting forces. The inner cancellous bone in trabeculae pattern arranged at right angles to one another and their alignment supports cortical bone in areas of stress. On cross-sectional of the mandible, the superior border is thicker or larger compared to the inferior border which thinner or smaller. Thicker superior border accomodated the dentate component purpose of the thick alveolar component of 7the mandible is merely to accommodate teeth in the dentulous state. It is basilar bone that remains the thickest and most stress-bearing component of the mandible.

Mandibular fractures are very common, accounting for 36% to 76% of facial fractures,

amongst them, mandibular angle fractures account for 16 to 37% of mandibular fractures [1,2]. Mandibular fractures eti- ologies consist mainly of assault, traffic accidents, falls, and sports accidents. The mechanism of the trauma influences the location of the fracture, especially angular or condylar fractures. Angular frac- tures are predominant following assaults or falls, while they are less associated with high kinetic traumas such as traffic accident. However, the presence and the position of the lower third molar (LTM) is the predominant risk facto [6].

The angle is a unique anatomic subcomponent of the mandible. It serves as the transition zone between dentate and edentate regions and is commonly asso- ciated with impacted teeth . The mandible is the strongest andrigid bone in maxillofacial region , however, mandible is more commonly to be fractured in maxillofacial bone fracture (Patil, 2012) accounting for 40 to 65% of all facial fractures (Yadav et al., 2013) , which can be due to its prominence and exposure to traumatic situations (Banks, 1991).

Mandibular angle accounts for 25-33% of all Mandibular fracture.

Huelke et al reported that Mandibular fracture are more common in dentulous region rather than in edentulous region. Huekle and Dodson explained mechanism of fracture, they explained fracture occurs at the tensile strain because of their greater resistance to compression force. Maximum tensile force are observed in the lingual side of second and third molar . Weakness in this region can be attributed by abrupt curve in nature.

Bradley et al reported the maximum strength of the mandibular body in the third molar region is in the upper border , strength can be attributed because of their thick cortical plate. Presence of partially erupted or unerupted teeth disturbs continuity of this thick cortical plate and weakens this area.

Antic et al in his study reported that the third molar occupies the bony space and makes the angle region prone for fracture. Antic et al also said the deeper the impaction , increases the risk of mandibular angle fracture. Safdar and Meechan concluded through their research that deeply impacted M3s have the highest relative risk for angle fractures

He also said that single conical root is significantly associated with angle fracture because of stress concentrating around single root apex.

In spite of being the strongest bone in the maxillofacial region, the mandible is ironically one of the most commonly fractured bones due to its prominence in the face and the weakening of the corticocancellous framework due to the presence of teeth. Fractures in the mandible are most often seen in the angle region, condylar region, and the parasymphysis. The angle region is quite vulnerable due to the fact that it forms the junction between the ramus and the body and is influenced, to a great extent, by the masticatory sling of muscles attached to the medial and lateral aspects. The incidence of mandibular angle fractures is approximately 30%.1 One of the primary factors influencing angle fractures is the presence of third molars which tend to weaken the area, predisposing it to fracture.

2. DISCUSSION:

The location of a fracture depends on various factors. These include the site, force, and direction of impact. A large force acting on a small area results in a fracture at the point of

impact. But when the force is distributed, the fracture occurs at the weakest point. Therefore, it would be prudent to believe that the risk of angle fracture incidence is not related to any single factor, whether it be the vector of force, amount of force, musculature of the face, architecture of the mandible, or the presence or absence of a third molar.2

Anatomically, the mandibular angle is at a transition zone from the dentate body to the lateral flare of the ramus, thus increasing the risk of fracture.3 Moore has also suggested that a change in the direction of the grain of bone, which occurs where the vertical ascending ramus and the horizontal body meet, tends to weaken the angle region of the mandible and increases its susceptibility to fracture.4

In a study of the three-dimensional biomechanical properties and the intrinsic strengths and weaknesses of the mandible by Tams et al,5 the mandibular angle was identified as having the greatest amount of positive bending movement, resulting in tension at the alveolus and compression at the inferior border.

The presence of third molars has been suggested to contribute to an increased mandibular fragility because the mandible loses part of its bone structure to harbor tissues that do not contribute to its strength.

A computational method for mechanical tests by creating virtual elements with finite dimensions and physical properties based on aeronautical engineering can be adapted to real structures, to recreate load applications and present the distribution of stresses and deformation. In one such study by Bezerra et al,7 the maximum stresses were located at the symphysis, in the retromolar area, and both condyles on the three experimental models. The presence of the third molars resulted in a difference in the stress distribution. Bezerra et al also found that it was noticeable that the impact of force on the chin resulted in a concentration of stress on the external oblique ridge, and when the third molar was present, this concentration extended to the alveolar process. The comparative analysis showed a stress concentration on the vestibular aspect of the mandibular angle when the third molar was present, and on the condylar neck when it was absent.

Meisami et al6 suggest one such model where mandibular strength is derived from maintenance of cortical, not medullary, bone integrity. As such, superficially positioned M3s disrupt the cortical integrity of the external oblique ridge, producing a point of weakness in the mandible and making it susceptible to fracture. This is in contrast to our results.

An explanation to this was given by Huelke and Harger.8 Once a force is applied to an anterior mandibular region, the energy dispersion will occur along the body toward the condyles, causing stress on the lateral aspect of the angle and condyle. The force seeks out the weakest point in the arch and causes extreme bending and tensile failure at that point. Third molars can be related to the fragility of the angle, as their presence significantly alters its biomechanics.

[8].

When the LTM is present, it decreases bone quality and density, resulting in an area of bone fragility at the mandibular angle, which will be prone to fracture. Several studies have shown that the presence of LTM increases the risk of mandibular angle fractures . This risk of fracture is directly linked with the position of the LTM. Class B and class II of the Pell & Gregory classification are the main risk factors for mandibular angle fracture, whereas classes A and I

are protective factors and class C is not associated with a risk modification according to Armond et al . This can be explained by the fact that the upper bony layer of the mandibular angle is a zone of tension while the lower bony layer is a zone of compression as shown by Champy et al. When LTM are rated C, the upper bony layer remains intact, inducing less weakness. On the other hand, we know that the pres- ence of LTM protects against the occurrence of condylar fractures, which are at risk of functional limitation . The value of preventive extraction of asymptomatic impacted LTM is therefore controversial

The management of LTM in cases of mandibular angle fracture remains debated, some historic studies advocate LTM removal , while more recent studies advocate LTM preservation . LTM preservation could help in fracture reduction and fixation. No statistically significant difference in postoperative complications between LTM preservation and LTM removal was found in several studies . Nevertheless, they advocate LTM removal in cases of tooth infection, mobility or fracture [6].

On the other hand, Fernandes et al. [2] found that the absence of LTM in the mandibular angle fracture line, following peroperative LTM removal or LTM absence prior to trauma, is associated with a lower rate of post-operative infection when compared to mandibular angle fractures with LTM in the fracture line [6].The impacted LTM may help in fracture reduction and enhance reduction stability, thus helping to achieve better bone healing. On the other hand, if LTM is fractured or infected (active pericoronitis), it should be removed intra-operatively Impacted LTM was not associated with a decrease or an increase of infection occurrence. This is in accordance with several other studies . How- ever, the systematic review of Fernandes et al. found that the absence of LTM, whether missing preoperatively or removed during fracture treatment, is associated with a lower rate of infection. Hence, the impacted LTM should be preserved in mandibular angle fractures, unless it is fractured or infec[6].

Some authors have suggested prophylactic removal of the third molar, especially in people involved in contact sports (Hanson et al., 2004), in order to prevent mandibular angle fracture. However, this kind of approach has not been commonly accepted (Yamada et al., 1998; Antic et al., 2016b)

This sensitivity analysis is in accordance with those reported in single studies: Antic et al. (2016a), Lee and Dodson (2000), and Fuselier et al., 2002 reported a major incidence of mandibular angle fracture when Class B occurred, while Ma'aita and Alwrikat (Ma'aita and Alwrikat, 2000) and Subhashraj (2009) showed that this kind of fracture was most associated with Class C. On the other hand, Fuselier et al., 2002 and Lee and Dodson (2000) described an increased incidence of angle fracture with Class II, in contrast with Ma'aita and Alwrikat (Ma'aita and Alwrikat, 2000) and Subhashraj (2009) who reported a major association of this fracture with Class Ill. Antic et al. (2016a) reported the same increased incidence of mandibular angle fractures when both Class II and Class III occurred [1].

Tevepaugh and Dodson demonstrated that patients with fractured mandibles and M3s are 3.8 times more likely to have an angle fracture than patients without M3s, but they did not confirm the relationship between M3 position and angle fracture. Patients with a level C, level 3 impacted M3 may have an increased risk for an angle fracture compared with a patient with a level A, level 1 M3. Our results confirm the relationship between the M3 position and angle fracture, which is not consistent with the results reported by Wolujewiez and by Tevepaugh

and Dodson.The results of this study demonstrate that unerupted M3s make the mandibular angle more susceptible to fracture and that the incidence of angle fracture is increased by vertical and distoangular types of impactions [5].

Patient with partially erupted mandibular third molar are more frequently associated with angle fracture and the residual bone height could also be a good predictor for risk of angle fracture. Residual bone height was also found to be less in angle fracture in comparison to other mandibular fracture group [2].

The mandibular angle forms where the mandibular body joins the ramus and the anterior margin of masseter muscle forms its anterior limit . Many anatomical and mechanical factors may increase the risk of angle fracture, such as abrupt change in the direction from horizontal body to vertical rami, impacted third molars, reduced bone volume and the direction of pterygomasseteric sling pull at the angle region [3].Mandibular angle fracture usually commences at the upper border of the mandible, where the anterior border of the ramus meets the mandibular body, usually in the third molar region, and extends downward to the inferior border or backward, in the gonial angle region . Mandibular angle fractures may be favorable or unfavorable, depending on the direction of fracture line, in the horizontal and vertical planes, and the degree of displacement of the proximal and distal fractured segments .

Gonial angle is an important angular measurement, used to assess the growth trend and pattern . Based on the degree of gonial angle, the mandible can be considered as having low or high angle . A high gonial angle indicates clockwise rotations of the mandible, whilst low gonial angle designates anticlockwise growth rotation of the mandible[3].

The higher vulnerability to angle fractures in high-angle patients was previously attributed to lower bite forces, which result in less cortical bone thickness at the angle region. Furthermore, it has been demonstrated that in high angle cases, the height of the mandible at the ramus and angle area is much lower than in normal persons . The current study found that ramus height and antegonial angle are considerably lower in high angle fracture patients than in normal and low angle cases [3].

According to James C. Fuselier et al decrease in osseous structure is the primary etiology for mandibular angle fracture. So, the previous “prophylactic” removal of asymptom- atic deeply impacted M3s does not appear to be appropriate. One must now consider if prophylactic removal of partially impacted M3s is indicated be- cause they are associated with the highest relative risk of angle fractures[4].

It was observed that the presence of a third molar protects against condylar fracture. However, if the third molar is retained and a fracture occurs in the region of the mandibular angle, complications due to infection in teeth in the line of fracture may occur. As expec-

the results of this meta-analysis showed that the presence of a third molar of Pell and Gregory class B increased the chance of mandibular angle fracture (Fig. 4). When comparing the presence of a third molar of class B with the presence of a third molar of class A, the interpretation of the outcome of this review is explicable, since class B third molars are deeper in the bone than class increased bone fragility , suprisingly, when class C third molars were assessed, no increase in the chance of mandibular angle fracture was found compared to class A and B molars. This result was not expected, since this class has a greater tooth bone inclusion

than class B.Perhaps studies with a very small sample size or poor methodological quality, especially in the selection of cases, may have influenced the results of the meta-analysis. The lower occurrence of third molars of class C is another potential reason for this result.According to the Pell and Gregory classification assessing the position in relation to the mandibular ramus (class I, II, and III), the interpretation of the results is exactly the same as for class A, B, and Cin relation to the occlusal plane. In this review it was observed that there was a higher chance of mandibular angle fracture when a third molar of class II was present.

The theory postulated in the mentioned study suggested that the bone space occu- pied by tooth (M3) makes the angle region weaker and prone to fracture, so deeper localization of the M3 would increase the risk for angle fracture. In the stud- ies of Fuselier et al. (25). and Ma'aita & Alwrikat (20), deeply impacted M3 was suggested as the main factor responsible for higher the risk of angle fractures. In contrast, Lee and Dodson (11) noted that completely impacted M3s did not increase the relative risk of angle fractures, compared to fully erupted M3s. Halmos et al. (26). agreed but added that partially impacted M3s might be the main contributors to angle fractures. Thangavelu et al. (16). also observed an association between higher incidence of angle fractures and par- tially impacted M3s, specifically Class IIB and mesioangular position. Recently, Naghipur et al . found the highest relative risk of angle fractures in the Class IIB, but statistical significance was not reached. In addition, biomechanical study conducted by Mei- sami et al. suggested that the continuity of the external oblique ridge was the main factor of resistance of the angle region. This means that partially impacted M3 with disrupted integrity of oblique ridge, will contribute to the increased angle fragility.

The results of this study revealed that injury mechanism was also an important factor which supports the results obtained in a study by Duan and Zhang [8]. In patients where moderate force resulted in two fracture areas; impacted 3rd molars played an important role in angle and condyle fractures along with other associated fractures. In patients sustained with low force which resulted in single fracture site, 3rd molar position either impacted or erupted played an insignificant role in condyle and angle fracture. In patients injured by a high traumatic force, who sustained multiple fracture sites, an influence of impacted 3rd molars on angle and condylar fracture was not demonstrated. The severity of injury was the primary factor resulting in multiple fractures, not the presence or absence of 3rd molars [7].

The results of this study demonstrate that unerupted mandibular 3rd molars make the mandibular angle more susceptible to fracture and that the incidence of angle fracture is increased by mesioangular and distoangular types of impactions. Irrespective of the status or position of 3rd molar, condyle and angle region were susceptible to fracture but angle has a much higher risk. When the 3rd molar is completely erupted, condyle has the tendency to fracture especially the subcondylar region. Patients with impacted 3rd molars were at higher risk of angle fractures than those without impacted 3rd molars no matter how deep they are positioned. Considering the injury mechanism and injury cause, the risk of angle fracture is much more influenced by the impacted 3rd molar. Position of 3rd molar also influences the other associated fracture sites along with angle and condyle, which is more common with angle fracture. The results of the study show that the 3rd molar can dictate the fracture pattern in mandible taking some of the above mentioned factors into consideration Tevepaugh and Dodson's study further supports their recommendation . Hence, if the patient is at risk of

further trauma to the region of mandibular angle as a result of occupation or lifestyle, it may be appropriate to remove the tooth to strengthen the mandible in this area. [7].

The association between M3s and mandibular angle fracture is believed to be because impacted M3s occupy more osseous space in the jaw that would otherwise be occupied by bone, thereby decreasing the quantity of bone and weakening the mandibular angle. This hypothesis was supported by the study of Reitzik et al [8].

Furthermore, the presence of M3s significantly diminishes the tensile strength of

the bone and encourages the propagation of the fracture along the least resistant path. The external oblique ridge provides a pillar of strength for the mandible in that region of the jaw. When M3s are completely in occlusion, the external oblique ridge remains intact. However, when the M3s are partially impacted, the tension line may be disrupted, weakening the mandibular angle and making it more susceptible to fracture[8].

3. RESULT:

63% of angle fracture occurs in high gonial angle case, 96% were associated with impacted third molar of which 56% are mesioangular, 30% are distoangular and 10% are horizontally impacted ; 41.6% are position A, 10.41% are B and 6.25% are C ; 68.74 % are class I, 29.16% are II and 2.08% are III.

4. CONCLUSION:

In the present study, the greatest incidence of angle fractures was recorded in cases with partially impacted M3 and Class B, with statistical significance, that sup- ports studies conducted by Thangavelu et al. (16). and Meisami et al. (28). Regarding the horizontal position, we found the highest frequency of angle fractures in the Class II, followed by the Class III. However, according to our results of significantly higher angle fracture frequency in Class b, the shortened distance between the M3 and inferior border of the mandible also contributes to the angle fragility. The single coni- cal root of the M3 also showed significant association with angle fractures. The reason is probably in concen- trated stress around the single root apex that overcomes the bone strength [6].

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