

Association between Mandibular Angle Fracture with Third Molar Positioning and Residual Bone Height

Ishfa Banu Haque¹, Sandhya Joshi,² Kishor Bhandari,¹ Gaurav Karna,² Bandana Khanal¹

ABSTRACT

Background: Mandibular angle fracture are frequently associated with presence of third molar. This study aimed at assessing the role of third molar with angle fracture in relation to its positioning and the remaining bone between the apex of third molar and inferior border of mandible.

Methods: A retrospective study of all patients who reported for treatment of mandibular fracture between January 2019 to January 2021 were undertaken. Patient's data and orthopantomogram radiographs were obtained from their medical records. The collected data included presence/absence of mandibular angle fracture, presence/absence of mandibular third molar, angulation and positioning of third molar along with residual bone height. Statistical analysis was done in SPSS version 20 with p-value set at $p < 0.05$

Results: Total of 86 mandibular fracture reported in the study period, of which 34 (39.53%) had angle fracture. Third molar was present in 31 (45.6%) cases and was associated with angle fracture with statistical significance of $p < 0.026$. Mesioangular impaction (86.4%) with class II (57%) ramus relation and position B (72.7%) in occlusal relation were associated with angle fracture in comparison to non-angle fracture group where angulation and occlusal position were statistically significant $p < 0.001$ and $p = 0.002$, respectively. Residual bone height was also found to be less in angle fracture group in comparison to other mandibular fracture group showing statistical significance ($p < 0.023$).

Conclusions: 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.

Keywords: Mandibular angle fracture; residual bone height; third molar impaction.

INTRODUCTION

Mandible is one of the most frequently involved facial bone in traumatic injuries resulting in fracture due to its vulnerable position and anatomical configuration.¹ Of these, angle fracture is the second commonest fracture after condyle.²

The presence of mandibular third molar, which occupies a significant space in the angle region leads to weakening of area and increases the risk of angle fracture by two to four-fold.^{1,3-5}

The third molar could be partially erupted disrupting the continuity of the superior border of mandible,^{4,7} or deeply located, occupying significant space making the mandible weaker and susceptible to fracture on slight

trauma.^{1,8,9} Many research has been done regarding its role but without a constant result.^{10,11} This study was aimed at finding the role of third molar in cases of angle fracture with regard to positioning and residual bone height.

METHODS

A retrospective study was designed and approved by the institutional review board (IRB) of National Academy of Medical Sciences (NAMS) Bir hospital, Nepal (Ref no. 483/2078/79). Data were collected from cases of mandibular fracture who reported to Department of Oral and Maxillofacial Surgery, Bir hospital, NAMS from January 2019 to January 2021. Hospital case records and orthopantomogram (OPG) radiographs were used to assess the mandibular fracture and the presence of

Correspondence: Dr Ishfa Banu Haque, Department of oral and maxillofacial surgery Bir hospital, NAMS, Mahabouddha, Nepal. Email: ishfabanu@gmail.com, Phone: +9779851147788.

Author Affiliations

¹Department of oral and maxillofacial surgery Bir hospital, NAMS, Mahabouddha, Nepal, ²National Trauma Centre, Kathmandu, Nepal.

third molar. The inclusion criteria were all mandibular fracture (presence and location of fracture) and third molar (presence and absence). The exclusion criteria were edentulous patient, comminuted fractures of mandible where calculation is not possible and third molar pathology.

The primary outcome variable was presence or absence of angle fracture, where in angle fracture is defined as radiolucent line passing distal to second molar from any point on the curve formed by the junction of the body and ramus in the retromolar region to any point on the curve formed by the inferior border of the body and posterior border of the ramus of mandible.⁴

Presence or absence of third molar were the predictor variables. Including the angulation, the position in the ramus and the distance between the third molar apices and the inferior border of mandible.

The third molar angulation was measured with Shiller's classification.¹² The angulation were classified as vertical $\pm 10^\circ$, mesio-angular and distoangular $\pm (1^\circ$ to $70^\circ)$ and horizontal more than $\pm 71^\circ$.

If third molar was present, the Pell and Gregory classification was used to determine its anatomic position.¹³ The level of vertical impaction was determined by the highest position of the mandibular third molar crown and its relationship to the second molar, as follows:

Position A- The occlusal level of the third molar was at the same level of the second molar.

Position B- The occlusal level of the third molar was between the occlusal surface and the cemento-enamel junction of the second molar.

Position C- The occlusal level of the third molar was below the cemento-enamel junction of the second molar.

The antero-posterior or horizontal level of the mandibular third molar was determined by the space available between the second molar and the ascending ramus of the mandible, as follows:

Class 1- There was sufficient space between the ramus and the distal part of the second molar to accommodate the mesio-distal diameter of the third molar.

Class 2- The space available between the distal part of second molar and the ascending ramus was less than the mesio-distal diameter of the third molar.

Class 3- The third molar was almost in the ramus of the mandible.

Residual bone height was measured manually from their OPG's in accordance to the method of measuring the mandibular height given by Iizuka,¹⁴ which is the distance between the apices of the third molar and the inferior border of the mandible as shown in figure-1. The space which the third molar occupied in the bone was analyzed in relation to mandibular height. The mandibular height was determined by drawing a line tangent to the inferior border of the mandible (L). From that line a perpendicular line was drawn through the most mesial point (A) of the third molar. The height of the mandible was measured as the distance between the superior border of the mandible and the mandibular line (a). The distance between the most inferior part of the third molar (B) and the lower border of the mandible was determined (b). The difference between "a" and "b" was calculated (c) allowing calculation of a ratio $b/a \times 100$, representing the height of the tooth as a percentage of mandibular height.

Other variable included the demographic details like age, gender and mode of injury obtained from the medical records. Data were entered in Microsoft excel sheet and analyzed in IBM SPSS Statistics for Windows, version 20 (IBM Corp., Armonk, N.Y, USA). Mean, standard deviation, frequency and percentage were calculated depending upon the nature of data. The association between presence of third molar with fracture site was calculated using chi-square test. The association of position and angulation of a third molar in mandibular angle fracture were calculated using Fisher's exact test. For calculating the relationship between the fracture site and distance of the third molar apices to the inferior border of the mandible (residual bone height) independent t-test was used. Level of significance was set at $p < 0.05$.

RESULTS

During the data collection period, total of 86 individuals presented with mandibular fracture that fulfilled the criteria for the study. The demographic data for the study sample is summarized in Table 1. Among them, 34 (39.53%) had mandibular angle fracture and 52 (60.47%) had other mandibular fractures. The mean age of the study participants was 28.31 ± 7.71 years and among them 77 (89.5%) were males and 9 (10.5%) were females. Most of the study participants 62 (72.1%) had mandibular fractures due to road traffic accident followed by fall 15 (17.4%) and assault 9 (10.5%).

The presence of third molar showed significant

association with site of mandibular fracture ($p=0.026$, Table 2). Most of the individuals who had third molar presented with mandibular angle fractures 31(45.6%) than those who did not have third molar 3 (16.7%).

The angulation and position of third molar were also significantly associated with fracture site ($p<0.001$ and $p=0.002$, respectively). Majority of individuals with mesioangular impaction 19 (86.4%) and position B 16 (72.7%) had mandibular angle fracture (Table 3). However, class or horizontal relation to ramus with third molar did not show any association with fracture

site. For non-angle fracture group vertical angulation 29 (74.4%), level I 18 (66.7%) and class A 29 (70.7%) was more frequent.

Table 4 shows the relationship between the fracture site and distance of the third molar apices to the inferior border of the mandible. Those individuals with mandibular angle fracture had mean distance of 10.13 ± 2.58 mm from the third molar apex to the inferior border of mandible whereas those with other mandibular fractures had 11.70 ± 2.94 mm and their mean difference was statistically significant ($p=0.023$).

Table 1. Demographic characteristics of study participants.

Characteristics	Category	Individuals with mandibular angle fractures	Individuals with other mandibular fractures	Total
Age in years (mean \pm SD)	-	27.62 \pm 8.65	28.77 \pm 7.08	28.31 \pm 7.71
Sex n (%)	Male	28 (32.6)	49 (57.0)	77 (89.5)
	Female	6 (7.0)	3 (3.5)	9 (10.5)
Mode of injury n (%)	Assault	4 (4.7)	5 (5.8)	9 (10.5)
	Fall	7 (8.1)	8 (9.3)	15 (17.4)
	Road traffic accident	23 (26.7)	39 (45.3)	62 (72.1)

Table 2. Association of presence of third molar with fracture site.

Third molar within fracture	Mandibular angle fracture n (%)	Other mandibular fracture n (%)	Total n	p-value*
Absence	3 (16.7)	15 (83.3)	18	0.026
Presence	31 (45.6)	37 (54.4)	68	
Total	34 (39.5)	52 (60.5)	86 (100%)	

*Chi square test at level of significance < 0.05

Table 3. Association of third molar pattern with fracture site.

Type of impaction	Mandibular angle fracture n (%)	Other mandibular fracture n (%)	Total n	p-value*
Angulation				
Horizontal	2 (28.6)	5 (71.4)	7	<0.001
Mesioangular	19 (86.4)	3 (13.6)	22	
Vertical	10 (25.6)	29 (74.4)	39	
Horizontal position				
Class I	9 (33.3)	18 (66.7)	27	0.156

Class II	20 (57.1)	15 (42.9)	35	
Class III	2 (33.3)	4 (66.7)	6	
Vertical position				
Position A	12 (29.3)	29 (70.7)	41	0.002
Position B	16 (72.7)	6 (27.3)	22	
Position C	3 (60.0)	2 (40.0)	5	
Total	31 (45.6)	37 (54.4)	68 (100%)	

*Fisher’s exact test at level of significance < 0.05

Table 4. Association between the fracture site and distance of the third molar apices to the inferior border of the mandible.

Category	No. of study participants	Distance from the third molar apex to the inferior border of mandible in mm (mean ± SD)	Standard error of mean	p-value*
Mandibular angle fracture	31	10.13 ± 2.58	0.46	0.023
Other mandibular fractures	37	11.70 ± 2.94	0.48	

*Independent t-test at significance level of significance < 0.05.

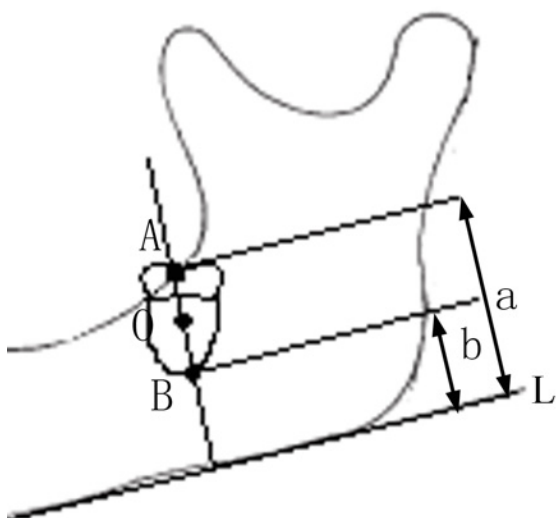


Figure 1. Measuring distance between apex of third molar and inferior border of mandible.¹⁴

DISCUSSION

Mandibular angle region due to its complexity has been a strong research area where several investigations are done to ascertain the role of third molar with angle fracture. However, the controversies are murky regarding the role of third molar. The purpose of this study was to ascertain the role of third molar and the residual bone height of the mandible in cases of angle fracture.

The site of fracture is dependent on several factors, such as point of application, direction and severity of force including biomechanical intrinsic characteristics of the mandible, the forces exerted by muscle of mastication and the osseous anatomy.⁵ One such characteristic is the presence of mandibular third molar, which occupies a significant space in the angle region, reducing the bone mass and bone density which leads to weakening of area. Our findings are similar to other studies showing a strong association between presence of third molar and angle fracture.^{8,10,11,15}

The impaction status of third molar is also responsible for mandibular angle fracture as shown by the study of Fuselier et al and Antic et al.^{3,4} Some authors suggest that deeper the localization of third molar in the mandible greater is the risk for angle fracture, suggestive of unerupted third molar.^{1,8,9} The study done by Reitzik et al¹⁶ on monkeys has shown that mandibles with unerupted third molar fractured more frequently than with erupted third molar. Contrary to these findings the result of our study has shown that class II and position B third molar were associated with fractures, this is in agreement to the recent studies which suggest that the risk of angle fracture is greater for partially erupted third molar.^{6,7,11,17,18} This supports the biomechanical study which suggest that, the ability of the mandible to resist traumatic insult is dependent upon the integrity of the cortical bone of the mandible which in turns disrupts the integrity of external oblique ridge and not

the medullary bone.^{6,8,16,19,20} This finding also supports other studies which suggests that, the zone of tension on the superior oblique ridge plays a more important role than the strength of the zone of compression on the inferior border in maintaining the integrity of the mandible.^{3,7,19}

Ma'aita and Alwrikat¹ study showed the relevance of various angulation of the third molar to the risk of angle fracture, the frequent finding in their study was vertical and distoangular position. In contrary, this study had third molar angulation in angle fracture group to be in mesioangular and vertical position according to Shiller's classification. As the root of mandibular third molar in these two angulations is directed towards the angle of the mandible, by which the injury force is redirected toward the mandibular ramus and angle.^{6,8,11,17,19}

The residual bone height also plays an important role in predicting the angle fracture.^{6,14,19} Iida et al⁸ suggested a new classification of mandibular third molar position related to the inferior border of the mandible which enables a better analysis for the risk for angle fracture. If the mandibular third molar is positioned low which is close to the inferior border of mandible the risk for fracture is high. This is also supported by the findings of Yadav et al⁶ and Iizuka et al¹⁴ who suggested that residual bone height could be a good predictor for an angle fracture in an otherwise healthy mandible consisting of third molar. This study agrees that when the bone height is less the chances for fracture in the angle region is high. Also in the angle fracture group there was significantly less bone remaining below apex of third molar compare to other mandibular fracture. But so far no clinical study have been successful in clearing this doubt^{16,19}

Most of the cases of angle fracture were in male which is in agreement with other studies.^{7,9,17,19} As this population is more involved in outdoor activities. Road traffic accidents was most common mode of injury for mandibular fracture followed by fall similar to findings of others.^{1,9,17} Road traffic accidents are most commonly observed in eastern part of world when compared to western countries where interpersonal violence is frequent finding.^{5,20} This could be due to poor road condition, driving under influence, crowded public transports, unsafe constructions and harsh geographical terrain of our country. Present study has less sample in angle fracture group in comparison to other mandibular fracture which limits us in giving a more precise role of third molar in angle fracture so similar study with larger sample size is recommended for obtaining data.

CONCLUSIONS

This study showed that there is a strong association between presence of third molar and angle fracture. Here third molar with class II and position B according to Pell and Gregory's classification are associated with angle fracture. Mesioangular angulation according to Shiller's was frequent. Also, residual bone height showed a significant relation with fracture suggesting that this could be a good predictor for angle fracture. However, till date only few studies were conducted similar to our study with different findings, we suggest further research in this area.

ACKNOWLEDGEMENTS

We would like to thank Dr. Srijana Dahal for her contribution in data management and statistical advice.

CONFLICT OF INTEREST

None

REFERENCES

1. Ma'aita J, Alwrikat A. Is the mandibular third molar a risk factor for mandibular angle fracture? *Oral Surg Oral Med Oral Pathol Oral Radiol Endodontology*. 2000 Feb;89(2):143–146. [\[PubMed\]](#)
2. Tams J, van Loon JP, Rozema FR, Otten E, Bos RR. A three-dimensional study of loads across the fracture for different fracture sites of the mandible. *Br J Oral Maxillofac Surg*. 1996 Oct;34(5):400–405. PMID: 8909730. [\[PubMed\]](#)
3. Antic S, Saveljic I, Nikolic D, Jovicic G, Filipovic N, Rakocevic Z, Djuric M. Does the presence of an unerupted lower third molar influence the risk of mandibular angle and condylar fractures? *Int J Oral Maxillofac Surg*. 2016 May;45(5):588–592. [\[PubMed\]](#)
4. Fuselier JC, Ellis EE, Dodson TB. Do mandibular third molars alter the risk of angle fracture? *J Oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg*. 2002 May;60(5):514–518. [\[PubMed\]](#)
5. Lee JT, Dodson TB. The effect of mandibular third molar presence and position on the risk of an angle fracture. *J Oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg*. 2000 Apr;58(4):394–398; discussion 399. [\[PubMed\]](#)
6. Yadav S, Tyagi S, Puri N, Kumar P, Kumar P. Qualitative and quantitative assessment of relationship between

- mandibular third molar and angle fracture on North Indian population: A clinico-radiographic study. *Eur J Dent.* 2013 Apr;07(02):212–217. [[PubMed](#)] [[Download PDF](#)]
7. Asim MA, Maqsood A, Aslam F, Mujtaba A. Effect of lower third molar status on fracture of mandibular angle and condyle. *Journal of Rawalpindi Medical College.* 2018 Jun 30;22:152-5. [[Article](#)][[Download PDF](#)]
 8. Iida S, Hassfeld S, Reuther T, Nomura K, Mühling J. Relationship between the risk of mandibular angle fractures and the status of incompletely erupted mandibular third molars. *J Cranio-Maxillofac Surg.* 2005 Jun;33(3):158–163. [[PubMed](#)]
 9. Kandel L, Mishra R, Yadav D, Tripathi S, Shubham S, Chhetri P. Impact of mandibular third molars on angle fractures: A retrospective study. *Dent Traumatol Off Publ Int Assoc Dent Traumatol.* 2021 Feb;37(1):103–107. [[PubMed](#)]
 10. Giovacchini F, Paradiso D, Bensi C, Belli S, Lomurno G, Tullio A. Association between third molar and mandibular angle fracture: A systematic review and meta-analysis. *J Cranio-Maxillofac Surg.* 2018 Apr;46(4):558–565. [[PubMed](#)]
 11. Sohal K, Moshy J, Owibingire S, M. Simon E. Association between impacted mandibular third molar and occurrence of mandibular angle fracture: A radiological study. *J Oral Maxillofac Radiol.* 2019;7(2):25. [[Google Scholar](#)] [[Download PDF](#)]
 12. Shiller WR. Positional changes in mesio-angular impacted mandibular third molars during a year. *J Am Dent Assoc.* 1979 Sep;99(3):460–464. [[PubMed](#)]
 13. Pell GJ. Impacted mandibular third molars: classification and modified techniques for removal. *Dent Dig.* 1933;39:330–338. [[Google Scholar](#)] [[Download PDF](#)]
 14. Iizuka T, Tanner S, Berthold H. Mandibular fractures following third molar extraction. A retrospective clinical and radiological study. *Int J Oral Maxillofac Surg.* 1997 Oct;26(5):338–343. [[PubMed](#)]
 15. Revanth Kumar S, Sinha R, Uppada UK, Ramakrishna Reddy BV, Paul D. Mandibular Third Molar Position Influencing the Condylar and Angular Fracture Patterns. *J Maxillofac Oral Surg.* 2015 Dec 1;14(4):956–961. [[PubMed](#)] [[Download PDF](#)]
 16. Reitzik M, Lownie JF, Cleaton-Jones P, Austin J. Experimental fractures of monkey mandibles. *Int J Oral Surg.* 1978 Apr;7(2):100–103. [[PubMed](#)]
 17. Ahmed Hamad S. Effect of Lower Third Molar -Presence and Position on the Occurrence Mandibular Angle and Condyle Fractures: A Prospective Clinical Study. *Int J Dent Oral Sci.* 2021 Nov 22;5091–5095. [[Download PDF](#)]
 18. Subbaiah MK, Ponnuswamy I, David M. Relationship between mandibular angle fracture and state of eruption of mandibular third molar: A digital radiographic study. *J Indian Acad Oral Med Radiol.* 2015;27(1):35. [[Google Scholar](#)] [[Download PDF](#)]
 19. Abd Jabar N, Rajandram R, Nabil S, Shareif MS, Ishak I, Jamaludin M, et al. Mandibular Third Molar and Angle of Mandible Fractures: An Unsolved Clinical Dilemma. *Sains Malays.* 2013 Jan 1;42:39–43. [[Google Scholar](#)] [[Download PDF](#)]
 20. Meisami T, Sojat A, Sándor GKB, Lawrence HP, Clokie CML. Impacted third molars and risk of angle fracture. *Int J Oral Maxillofac Surg.* 2002 Apr;31(2):140–144. [[PubMed](#)]