

## Mandibular Third Molar and Angle of Mandible Fractures: An Unsolved Clinical Dilemma

(Gigi Geraham Bongsu dan Kepatahan Sudut Rahang Mandibel:  
Dilema Klinikal yang Belum Terjawab)

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### ABSTRACT

*The purpose of this study was to investigate the relationship between partially erupted impacted mandibular third and the risk for angle of mandible fracture. We designed a retrospective cohort study composed of patients who presented with mandible fractures. The predictor variables were the presence and angulation of the partially erupted impacted mandibular third molar and the distance between the apices of the mandibular third molar and the inferior border of the mandible. The outcome variable was the presence or absence of an angle fracture. Patients with a partially erupted impacted mandibular third molars had a 3.3 times greater chance of an angle fracture than patients without mandibular third molars ( $p < 0.001$ ). No significant association was found between the distance of the apices and angulation of the mandibular third molars to the inferior border of the mandible with angle of mandible fractures. Our findings highlight the need for enforcement of proper protective gear in young individuals who are at high risk for facial trauma.*

*Keywords: Angle of mandible; fracture; mandible; third molar; trauma*

### ABSTRAK

*Kajian ini bertujuan untuk menyelidik kaitan antara gigi geraham bongsu separuh tumbuh mandibel dengan risiko untuk mengalami kepatahan tulang mandibel. Satu kajian kohort retrospektif dalam kalangan pesakit yang mengalami kepatahan tulang mandibel telah dilakukan. Pemboleh ubah yang dikaji adalah kehadiran serta angulasi gigi geraham bongsu separuh tumbuh mandibel dan jarak antara apeks gigi geraham bongsu mandibel ke sempadan bawah tulang mandibel. Pesakit dengan gigi geraham bongsu separuh tumbuh mandibel mempunyai risiko 3.3 kali risiko lebih tinggi untuk mengalami kepatahan mandibel berbanding pesakit yang tiada gigi geraham bongsu bawah ( $p < 0.001$ ). Tiada perkaitan dapat dilihat antara jarak apeks gigi geraham bongsu mandibel ke sempadan bawah tulang mandibel dengan risiko untuk mengalami kepatahan mandibel. Penemuan ini menekankan kepentingan pemakaian alat pelindung muka terutamanya dalam kalangan individu yang terlibat dalam aktiviti yang mempunyai risiko yang tinggi untuk mengalami trauma muka.*

*Kata kunci: Fraktur; geraham bongsu; mandibel; rahang bawah; trauma muka*

### INTRODUCTION

The angle of the mandible is a unique anatomical region as it acts as the transition zone between the dentate and edentate region (Fuselier et al. 2002). This anatomical region is associated with the presence of the mandibular third molar (M3) which may be either erupted or unerupted with different types and depth of impaction (Paza et al. 2008). Fractures of the angle of mandible contributes to 40% of all fractures involving the mandible and often seen in the younger age group (Haug et al. 1990). Prophylactic pre-emptive removal of mandibular third molars (M3) to prevent angle of mandible fractures especially in athletes and individual at high risk to have facial trauma has until today been an ongoing controversy among clinicians (Tevepaugh & Dodson 1995; Yamada et al. 1998).

To date, studies have shown that mandibular fracture patterns are multi-factorial (Lee & Dodson 2000). The

contributing factors include direction and amount of force, presence of soft tissue bulk and biomechanical characteristics of the mandible such as bone density and mass (Lee & Dodson 2000; Weiss 1965). Interestingly, teeth have been shown to be the most relevant factor in determining the location of a fracture (Huelke 1964). This has led researchers to focus on possible factors related to M3 that could contribute to an increased risk of an angle of mandible fracture. Biomechanical and epidemiologic studies done on animals as well as human clinical studies have all shown that the presence of M3 significantly increases the likelihood of an angle of mandible fracture (Fuselier et al. 2002). Internationally, two strong theories have emerged and become the basis for research. One is based on a biomechanical studies which states that mandibular resistance is maintained by the integrity of the cortical bone and not the medulary bone highlighting

the importance of the external oblique line (Meisami et al. 2002; Reitzik et al. 1978). The other theory which is at odds with this, reports that the deeper the localization of the M3, the more bone space occupied therefore making the mandible much weaker (Reitzik et al. 1978). Clinically, the first theory would be related to the presence of partially erupted impacted M3's in which the superficial crown portion of the M3 would create a line of weakness whereas the second theory would focus on deeply impacted M3's. Due to this continued controversy surrounding these two theories, we performed a retrospective study with the aim of assessing the relationship of partially erupted M3's to further contribute to the evidence related to the role of the integrity of the external oblique ridge. We aimed to understand the association between the presence and angulation of partially erupted impacted M3's presence and angle fracture and the association between the distance of the apex of the M3 and the inferior border of mandible.

We hypothesize that the presence of a partially erupted M3 and a smaller distance between the apices to the inferior border of mandible would weaken the integrity of the angle and be more likely to fracture.

## MATERIALS AND METHODS

### STUDY DESIGN AND SAMPLE

This study undertook a retrospective review of all mandibular fractures seen at the Oral and Maxillofacial Department of two teaching hospitals in Malaysia from 2000 until 2009. Hospital case records and orthopantomogram radiographs (OPG) were used to assess the presence of partially erupted M3's, position and angulation of the impacted M3s. The inclusion criterion was all patients with mandible fracture whose radiographs showed the status of a mandible fracture (presence and location) and of the third molar (presence and absence). The patients were all medically fit and healthy. Exclusion criteria were edentulous patients as well as patients with any bony pathology.

### STUDY VARIABLES

*Primary Outcome Variable* The primary outcome variable the presence or absence of an angle of mandible fracture. An angle fracture is defined as a fracture located posterior to the second molar, extending 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 the mandible (Fuselier et al. 2002). A fracture line passing elsewhere was classified as a non-angle fracture.

*Predictor Variables* The predictor variables were the presence or absence of partially erupted impacted M3, the distance between the apices of the partially erupted M3 and the inferior border of the mandible and the angulation of the partially impacted M3.

If a partially erupted M3 was present the relative depth of the M3 was determined by measuring the distance between the apices of the M3 and the inferior border of the angle region in all mandibular fracture cases presenting with the presence of the impacted M3 was measured. This measurement was done on the preoperative OPG by the use of the film digitizer (VIDAR model: Diagnostic Pro Advantage Version 2.0 adds USB 2.0 Functionality, Software version: PAX TS5 AGFA) with the PACS system (Brand: AGFA model: IMPAX6, software version: 6.3.1.2813 2008) and Dicom Viewer system (CD Viewer 4.5.1 Copyright 2001, Agfa-Gevaert, N.V). The distance on the soft-copy image of the OPG was then divided by the magnification rate of the X-ray machine to obtain the actual distance.

The angulation of M3 was measured using Shiller's method (Weiss 1965). Using the panoramic radiographs, the inclination of the occlusal surface of the M3 was measured in relation to the occlusal surface of the second molar. The partially impacted M3 were classified as vertical if they were between 0 and 10°, mesioangular and distoangular if they were between 11 and 70° and horizontal if they were more than 71°.

*Data Management and Analysis* All measurements were done three times by two different examiners using the same film digitizers at different times with an interval of three weeks from each measurement to avoid examiner bias and the results were compared later. If there was disparity, a third examiner who was blinded to the results of the previous examination was used to clear the disparity. The reliability test was conducted with (0.95) intra-class correlation coefficient. All statistical data analyses were carried out with the SPSS software program, version 12.0.1 for windows. The influence of the presence and angulation of an impacted mandibular third molar in mandibular angle fractures was calculated by using Chi Square test. If  $p < 0.05$ , then statistical significance was inferred.

## RESULTS

During the study period of 9 years, a total of 274 patients were identified with mandibular fractures total. The demographic data for the study sample is summarized in Table 1.

### DESCRIPTIVE STATISTICS

The mean age for patients with mandible fracture was 27.4 years. The majority of patients were males (86.9%) and the most frequent cause of mandibular fractures was road traffic accidents (69.3%), followed by assaults (16.8%) and falls (8.8%).

### ANALYTICAL STATISTICS

*Relationship between the presence of a Partially Impacted M3 and Angle of Mandible Fractures* The relationship between the partially erupted impacted M3's and angle

TABLE 1. Demographic characteristics of 214 participants

Sample size ( <i>n</i> )	214
Age	
Mean (SD)	27.36 (7.97)
Gender ( <i>n</i> ) (%)	
Male	186 (86.9)
Female	28 (13.1)
Race ( <i>n</i> ) (%)	
Malay	109 (51.0)
Chinese	45 (21.0)
Indian	51 (23.8)
Others	9 (4.2)

fractures is shown in Table 2. Our results indicated that there was statistically significant association between the partially erupted impacted M3 and angle of mandible fracture (Pearson chi-square with one degree of freedom = 53.40,  $p < 0.05$ ). The odds ratio was 3.34 (95% confidence interval for this estimate was 2.39-4.66) There was a significant relationship between the presence of the impacted mandibular third molar and the incidence of the mandibular angle fracture ( $p < 0.001$ ) when compared with the absence of the impacted mandibular third molar indicating that the impacted mandibular third molar statistically has a significant influence in mandibular angle fracture.

*Relationship between the Angulation of the M3 and Angle of Mandible Fracture (Table 3)* In mandibular

angle fractures, the results showed that the most frequent angular position of the impacted mandibular third molar was the mesioangular position (27, 71.1%), followed by the horizontal impactions in 16 patients (48.5%). Contrary to nonangular fractures, the horizontal mandibular third molars impactions were the most common (17, 51.5%), followed by mesioangular position (11, 28.9%) and vertical mandibular third molar impactions (3, 21.4%). This relationship however was not significant ( $p > 0.05$ ).

*Relationship between the Distance of the M3 Apices and the Inferior Border of the Mandible (Table 4)* The median distance of the M3 molar apices to the inferior border of mandible according to presence and absence in angle mandible fracture were 13.38 and 13.04, respectively. These results indicate that there is no statistically

TABLE 2. Relationship between the presence of a partially impacted M3 and angle of mandible fractures

Impacted mandibular third molar within mandibular fractures	Mandibular fractures		Total <i>n</i>	<i>p</i> value*
	Mandibular angle fractures	Other mandibular fractures		
	<i>n</i> (%)	<i>n</i> (%)		
Presence	55 (60.4)	31 (16.9)	86	<0.001
Absence	36 (39.6)	152 (83.1)	188	
Total	91 (33.2)	183 (66.8)	274 (100%)	

\*Chi square test was used at level of significance 0.05

TABLE 3. Relationship between the angulation of the M3 and angle of mandible fracture

Types of impaction	Mandibular angle fractures	Other mandibular fractures	Total	<i>*p</i> value
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
	Mesioangular	27 (71.1)	11 (28.9)	
Horizontal	16 (48.5)	17 (51.5)	33 (100)	
Vertical	11 (78.6)	3 (21.4)	14 (100)	
Total	54 (63.5)	31 (36.5)	85 (100)	

\*Chi square test was used at level of significance 0.05

TABLE 4. Relationship between the distances of the M3 apices to the inferior border of the mandible

Distance from the impacted mandibular third molar apex to the inferior border of mandibular	Mandibular angle fracture		Mandibular angle fracture		* <i>p</i> value
	(Median	(IQR))	(Median	(IQR))	
	13.38 mm	(2.49)	13.04 mm	(5.03)	0.729

\* Mann-Whitney test was used at level of significance 0.05

significant difference in median distance of the M3 apices to the inferior border of mandible to the presence of angle mandible fractures. This is supported with the  $U=734.0$ ,  $p=0.749$  (95% confidence interval). The distance between the impacted mandibular third molar apex and the inferior border of the mandibular angle region showed no significant difference ( $p=0.729$ ) in relation to the angle of mandible fractures.

#### DISCUSSION

The main etiological factor of the angle of mandible fractures seen in our study was road traffic accident and seen mainly in males below 30 years of age. These findings are in agreement with larger cohort studies as individuals in this age group are the ones whom are most likely to present with an unerupted or partially erupted M3 (Safdar & Meechan 1995). The common finding of road traffic accidents within these groups of patients is also well observed among other trauma related to mandibular fractures globally (Fuselier et al. 2002; Meisami et al. 2002; Paza et al. 2008).

The first specific aim of this study was to contribute to the understanding of the role of the integrity of external oblique line in relation to the resistance of the angle of mandible to fracture. We did this by identifying the relationship between the presence of partially erupted impacted M3s and mandible of angle fracture in comparison with the presence of angle of mandible fracture without the presence of M3. We confirmed our first hypothesis in which we found a statistically significant association between the presence of a partially erupted impacted M3 and the angle of mandible fracture which is in agreement with studies done in other trauma centers (Lee & Dodson 2000; Ugboko et al. 2000). We found that individuals with partially erupted impacted M3 are three and more likely to have an angle of mandible fracture as oppose to those who did not have an M3. This finding supports biomechanical studies that suggest that the ability of the mandible to resist traumatic insults is dependant of the integrity of the cortical bone of the mandible and not the medulary bone (Iida et al. 2005; Meisami et al. 2002).

The second and third aims of this study were to assess the relationship between the distance of the apices of M3 and the inferior border of the mandible as well as the relationship between different angulations of the M3 and

angle of mandible fractures. In our study, a shorter distance from the apices of the M3 as well as being partially erupted would theoretically mean that the angle region should be much weaker and have an increased relative risk to fracture as the superior and inferior border is presumed to be weakened. However, we found no significant association between these two indices. This finding goes to further strengthen researchers views on the significant role of the cortical integrity. The findings also seem to suggest that the zone of tension on the superior external oblique plays a more important role than strength of the zone of compression on the inferior border in maintaining the integrity of the mandible.

This study contributes to epidemiologic studies that investigate if prophylactic removal of unerupted and asymptomatic M3s is warranted for the prevention of angle of mandible fractures. This has been advocated by certain clinicians when treating susceptible individuals especially athletes involved in contact sports (Tevepaugh et al. 1995; Yamada et al. 1998). Based on our findings as well as other studies, the previous concept of prophylactic removal of deeply impacted M3s is no longer acceptable compared with a partially erupted impacted M3.

Our finding was strong, however it falls short of enabling us to make a fundamental statement to advocate prophylactic removal of asymptomatic partially erupted M3's. This is primarily due to the limitation of this study in its sample size as well the unavailability of a control group to compare. Ideally, in order for us to make a statement we would need to identify all cases of mandibular fractures with full bony impaction as well as to be used as a comparison group. Our sample population is small and the exposure to other predictor variables cannot be excluded. However, it must be stated that the findings are still in support of those done in larger cohorts suggesting that our findings are relevant. Future research could be strengthened by taking into consideration other possible predictor variables like the angulation of the impaction, type of impaction (i.e. bony or soft tissue impaction, fully erupted, partially erupted, as well as depth of impaction with relation to the coronal portion and the external oblique ridge). Findings in our study should be used as a platform to conduct larger cohort studies to include full bony impaction third molars in order to fully support the biomechanical theory of the role of the cortical bone in maintaining the integrity of the mandible.

## CONCLUSION

The important finding of our study is that we found that young individual with partially erupted M3 have an increased risk for sustaining an angle of mandible fracture. This brings forward the need to stress the importance of protective facial gear and mouth guards in younger individuals who are active in contact sports or those whom are exposed to high risk of facial trauma.

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