ORIGINAL ARTICLE

THIRD MOLARS AND ANGLE FRACTURES

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ABSTRACT

Fractures of the mandibular angle are common and mandibular third molars are frequently implicated in their pathogenesis. The study was done to investigate this cause and effect relationship. The objectives were to measure the relationship between presence and status of mandibular third molar (M3) and mandibular angle fracture. Study design was descriptive. It was carried out in the Department of Oral & Maxillofacial Surgery, Punjab Dental Hospital, attached with de,Montmorency College of Dentistry, Lahore. 87 patients with clinical and radiographic diagnosis of mandibular fracture formed the study group. The predictor variable was the presence or absence of mandibular third molar. The outcome variable was the presence or absence of angle fracture. Hemi mandibles containing a third molar were seen to have a 2.3 times increased risk of having an angle fracture (p = 0.49) than a hemi mandible without a third molar. A significant association between third molar depth and risk of angle fractures was seen (p = 0.001). The presence and depth of mandibular third molar is associated with an increased risk for mandibular angle fracture.

Key Words: *Mandibular third molar, impacted teeth, mandibular angle fracture, mandibular fracture, maxillofacial trauma.*

INTRODUCTION

Mandibular fractures are one of the commonest maxillofacial bony injuries.[1] Multiple factors such as the size, direction, nature, and surface area of the impacting force are known to influence the pattern of mandibular fractures. Other factors that are thought to be responsible include the presence of soft tissue bulk and biomechanical characteristics of the mandible, such as bone density, mass, and normal or pathologic anatomic structures creating weak areas within the bone.[2]

Fractures of the mandibular angle are common and comprise 18-44% of all mandibular fractures.[3,4] The presence of mandibular third molar (M3) has been hypothesized to be a risk factor for fracture at the mandibular angle. Multiple studies report a 2 to 3-fold increased risk for mandibular angle fractures when M3s are present.[5,6] Finite element analysis using micro-CT in cadaver mandibles has also shown that in a mandible with third molar (M3), stress is concentrated around the root apex of the third molar, which alters the concentration and propagation of stress in the mandible, which increases risk of an angle fracture.[7]

It has been hypothesized that M3 weakens the angle by decreasing the bone mass in the region making the mandibular angle more susceptible to fracture. If this model is deemed right, the most deeply placed M3 would be the greatest risk for angle fractures.[6] This, however has not been proven correct through clinical studies. It was demonstrated that the most deeply placed third molars were associated with the lowest risk for an angle fracture, as those M3s which were erupted and were seen to be disrupting the external oblique ridge were most often seen to be involved in angle fractures.[6] So it can be argued that there may be advantages in removing third molars that are not deeply impacted (the superior border at angle region is already disturbed by their presence).[8]

A couple of studies locally have elucidated on the relationship between third molar presence and risk of angle fractures in Abbottabad and Peshawar.[9,10] However, these studies do not fully take into account the

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various statuses of mandibular third molars and their role in causing mandibular angle fractures. Our study assesses the risk posed by mandibular third molars in causing an area of weakness in the mandibular angle region, making it more susceptible to fracture in the region of Lahore. We made an additional query into the fact if there the risk of angle fracture varies with angulation, ramus relationship and depth of the M3.

The presence of mandibular third molar (M3) is associated with an altered risk for mandibular angle fracture. The objectives of this study were to measure the relationship between presence of mandibular third molar (M3) and mandibular angle fracture at a tertiary care teaching dental hospital in Lahore, and to measure the relationship between mandibular third molar (M3) position status and risk of angle fracture.

METHODOLOGY

The study was a descriptive case series, which was carried out at the Department of Oral & Maxillofacial Surgery, Punjab Dental Hospital, attached with de,Montmorency College of Dentistry, Lahore, from 7th December 2006 to 19th June 2007. 87 patients with clinical and radiographic diagnosis of mandibular fracture were included through convenience non-probability sampling technique. Cases of mandibular fractures (both genders and older than or 16 years of age) presenting at the Department of Oral & Maxillofacial Surgery and clinically and radiographically diagnosed as mandibular fractures were included. Mandibular fractures classified as iatrogenic or pathologic were excluded.

OPG was considered as the standard radiograph for assessment of mandibular fracture and status of third molar, with each patient contributing two hemi-mandibles to the study data. A supplementary PA view of the face was consulted to ascertain the radiographic diagnosis of angle fracture. After an informed consent from the patients, specially designed proforma was filled in accordance with the acquired information containing demographics, cause of accident and clinical findings, and an electronic copy was made using Microsoft Excel (Microsoft, Inc. Redmond, WA). Confounding variables were controlled through matching.

The predictor variable was the presence or absence of mandibular third molar (M3). If an M3 was present, its anatomic position in the mandible was classified using the Pell and Gregory system and the modified Winter's classification. According to these systems, the mandibular third molars were assigned Class 1, 2 and 3 according to their ramus relationship, positions A, B and C according to their depth and mesioangular, vertical, horizontal and distoangular according to their angulation. The outcome variable was the presence or absence of angle fracture. The confounding variables were the age, gender and cause of accident.

All the data collected was entered in SPSS version 10 (SPSS, Inc. Chicago, IL) and results analyzed accordingly. The qualitative variables in the demographic data (e.g. gender, predictor and outcome variable) are presented as percentages and proportions and quantitative data (e.g. age) is presented as means and standard deviations. The relationship between predictor and outcome variables is analyzed by using chi-square test. A p-value of less than 0.05 is considered as significant.

RESULTS

A total number of 87 patients with mandibular fractures were included. The mean age of these patients was 26.97 years (SD ± 9.88 years) with an age range of 16 to 60 years (Table 1). Males formed the predominant gender with 94.3%. The total number of mandibular fractures in these 87 patients was 134 with a minimum number of 1 fracture to maximum 3

TABLE 1: AGE, GENDER AND CAUSE OF ACCIDENT WISE DISTRIBUTION OF ALL MANDIBULAR FRACTURES AND SOLELY PATIENTS WITH ANGLE FRACTURES

	All mandibular fractures	Angle fractures	P-value
Total number of patients	87	38	
Total number of fractures	134	39	
Mean age	26.97 years (SD ± 9.88 years)	26.82 years (SD ± 9.47 years)	NS
Gender distribution	94.3% (males), 5.7% (females)	94.7 % (males), 5.3% (females)	0.9 (NS)
Cause of accident			0.1 (NS)
RTA	67 (77%)	33 (86.8%)	
Violence	7 (8%)	3 (7.9%)	
Falls	9 (10.3%)	1 (2.6%)	
Sports	1 (1.1%)	1 (2.6%)	
Gunshot wounds	1 (1.1%)	0	
Industrial	2 (2.3%)	0	

TABLE 2: DISTRIBUTION OF THE PRESENT MANDIBULAR THIRD MOLARS ACCORDING TO THE RAMUS RELATIONSHIP, OCCLUSAL DEPTH AND ANGULATION

Ramus relationship	Class 1	96 (69.6%)
	Class 2	37 (26.8%)
	Class 3	5 (3.6%)
Occlusal depth	Position A	84 (60.9%)
	Position B	20 (14.5%)
	Position C	34 (24.6%)
Angulation	Vertical	93 (67.4%)
	Mesioangular	30 (21.7%)
	Distoangular	5 (3.6%)
	Horizontal	10 (7.2%)

n = 138 (mandibular third molar was present in 138 out of the total 174 hemi mandibles)

fractures per patient. The mean number of fractures was 1.54 (± 0.55).

Road Traffic Accidents formed the major cause of accident with 77%, followed by falls (10.3%) and violence (8%). Only 2.3% of patients gave a history of helmet wearing at the time of injury).

The largest number of fractures was seen to be in the symphysis and parasymphysis region (38.81%), followed by 29.10% fractures in angle region and those in the body and condylar region formed 15.67% and 14.92% of the fractures, respectively.

A total number of 39 angle fractures were seen in 38 patients. The angle fracture was seen to occur predominantly on the left side (57.9%). 39.5% of the angle fractures were seen to be on the right side, while in one case, the angle fractures were observed to be bilateral. A similar male to female ratio was seen in angle fracture patients with 94.7% of the patients being male. The

TABLE 3: RELATIONSHIP BETWEEN THE PRESENCE AND ABSENCE OF MANDIBULAR THIRD MOLARS AND PRESENCE OR ABSENCE OF ANGLE FRACTURES

		Angle fracture		**Total**	**Relative risk**
		Present	**Absent**		
Mandibular third molar	Present	35 (25.4%)	103 (74.6%)	138	2.283
	Absent	4 (11.1%)	32 (88.9%)	36	1
Total		39 (22.4%)	135 (77.6%)		

Relative risk = 2.3, 95 % confidence interval = 0.87 to 6.005, $p < 0.05$

TABLE 4: RELATIONSHIP BETWEEN THE M3 STATUS (RAMUS RELATIONSHIP, OCCLUSAL DEPTH AND ANGULATION) AND PRESENCE OR ABSENCE OF ANGLE FRACTURES

		Angle fracture		**Total**	
		Present	**Absent**		Not significant
Ramus relationship	Class 1	24 (25 %)	72 (75 %)	96	
	Class 2	10 (27 %)	27 (73 %)	37	
	Class 3	1 (20 %)	4 (80 %)	5	
		35	103		
Occlusal depth	Position A	16 (19 %)	68 (81 %)	84	P < 0.005
	Position B	12 (60 %)	8 (40 %)	20	
	Position C	7 (20.6 %)	27 (79.4 %)	34	
		35	103		
Angulation	Vertical	20 (21.5 %)	73 (78.5 %)	93	Not significant
	Mesioangular	10 (33.3 %)	20 (66.6 %)	30	
	Distoangular	1 (20 %)	4 (80 %)	5	
	Horizontal	4 (40 %)	6 (60 %)	10	
		35	103		

age distribution in patients with angle fractures was also similar to that of the overall mandibular fractures, being 26.82 years (SD ± 9.47 years) with an age range of 16 to 55 years. The cause of accident behind those patients who had an angle fracture was RTA (86.8%), followed by violence (7.9%), falls and sports (2.6%) (Table 1).

Each patient contributed two hemi mandibles to the study data for the purpose of measuring the relationship between angle fractures and mandibular third molars. The total number of hemi mandibles was 174 (87 x 2). 138 mandibular third molars (79.31%) were seen to be present while in 36 hemi mandibles (20.69%), they were absent. Present M3s were assessed for their ramus relationship, occlusal depth and angulation. The largest number of M3s was seen to be in a Class I relationship, Position A depth, and displayed a vertical angulation with 69.6%, 60.9% and 67.4% respectively (Table 2).

A cross tabulation between the presence or absence of M3s and the presence or absence of angle fractures was done and Chi Square tests were applied. In 25.4% of the hemi mandibles containing an M3, an angle fracture was seen to be present, while 11.1% of the hemi mandibles without an M3 were observed to have an angle fracture, with a p-value of less than 0.05. Thus, the hemi mandibles containing an M3 were seen to have a 2.3 times increased risk of having an angle fracture (95% confidence interval = 0.87 to 6.005). On the whole, 89.74% of the angle fractures (35/39) were seen to be in hemi mandibles containing an M3, while 10.26% of the angle fractures (4/39) were seen to be in hemi mandibles without an M3 (Table 3).

A significant association between M3 status and presence or absence of angle fractures was only seen in case of occlusal depth. Of the 20 teeth with Class B depth, 60% were associated with an angle fracture. Overall, the association between the M3 depth and presence or absence of angle fractures was seen to be highly significant with a p-value of 0.001. (Table 4)

DISCUSSION

Mandibular angle region is vulnerable to fracture after a blow to the mandible because of various anatomical reasons, including the curvature of bone, thickness of bone and presence of third molars. Most of the times mandibular angle region gets a fracture because of an indirect blow delivering energy which tends to dissipate at the angle region by fracturing at this point. Iida[11] reported assault as the most common cause of mandibular angle injury, followed by falls and bicycle accidents. Fractures of the mandibular angle were observed most commonly due to assault (52%), followed by motor vehicle accidents (32%), sports (29%) and falls (29%). Iida et al[12] in another study found that the analyses of the causes of injury also consistently showed the higher frequency in the group with the incompletely erupted M3s, except among the motor vehicle crash cases, although there were no significant differences in any categories.

A significant association between M3 status and presence or absence of angle fractures was only seen in case of occlusal depth. The hypothesis that M3 level of impaction further increases the risk of angle fractures originated with the experimental work of Reitzik et al. on monkeys.[13] An overwhelming clinical evidence exists in the literature supporting the fact that patients with impacted lower third molars are more likely to have an angle fracture than those patients without impacted mandibular third molars.[14] One mechanism by which third molars have been hypothesized to increase the risk of angle fractures is by occupying osseous space and thereby weakening the angle region by decreasing the cross sectional area of the bone.[15] Safdar and Meechan[16] reported an association between the position of M3 and the risk of angle fractures. However, a secondary analysis of their data failed to show a statistically significant association between M3 position and the risk of angle fractures. Similarly, Tevepaugh and Dodson's study[17] also failed to confirm a relationship between M3 position and the risk of angle fractures.

Some authors believe that on examination of the cross-sectional anatomy of the mandible, it becomes obvious that the superior border is thicker or larger and the inferior border is thinner or smaller; perhaps the purpose of the thick alveolar component of the mandible is merely to accommodate teeth in the dentulous state. It is the basilar bone that remains the thickest and most stress-bearing component of the mandible.[18] This was stated as the biologic basis of a study on the association of M3s with angle fractures by Ma'aita and Alwrikat.[5] They found that most of their patients were young, which probably accounts for the relatively high incidence of unerupted M3s in this group. Their association between Class 3 and Position C depth was found to be highly significant with a p value of 0; which is perhaps one of the most conclusive results between presence of unerupted M3s and the risk for angle fractures.

Metin et al[19] reported in their study that patients having mandibular fractures and impacted or unerupted teeth had nearly a 1.73-fold increased risk of a mandibular fracture comparing with patients not having unerupted or impacted teeth. In a study by Iida et al.,[11] they found no statistically significant association between ramus relationship and number of dental roots of incompletely erupted M3s on the incidence of angle fractures. However, the position of M3 in relation to the inferior border (another way of measuring M3 depth) revealed that Position β showed higher incidence of angle fractures (51%) than Position α (20%), with this being statistically significant ($p < 0.0001$). Overall, their analysis of the mandibular halves showed a great incidence of fractures in the group with incompletely erupted M3s (30.8%), this being 2.2 times greater than in the normally erupted M3 group, and 3.0 times great-

er than in the group without M3s ($p < 0.0001$). They, therefore suggested that the presence of an incompletely erupted M3 is a definite risk factor for angle fractures.

Halmos et al[20] did a large multi centre study from three major hospitals and found out a 2.8 fold increased risk for an angle fracture to occur in hemi mandibles with a present M3. Their study was in continuity of the earlier studies of Lee et al[6] and Fuselier[21] with a larger data every time. They also found relatively superficial placed M3s (Class I with Position B and Class 2 with Position A) to pose more danger for an angle fracture to occur than their deeper placed counterparts.

Yamada et al[22] carried out a study on the association of mandibular fractures with presence and position of M3s. They divided their study population into two groups: fractures sustained in sports and the other containing fractures sustained due to other causes. The incidence of angle fracture was significantly higher in the sports group than in the other group ($p<0.05$). Schwimmer et al[23] had suggested that dental screening and early removal of impacted third molars can reduce the risk of mandibular fractures in young adults participating in contact sports. Similarly, Tevepaugh and Dodson[17] also hypothesized that persons involved in contact sports may benefit from removal of mandibular third molars to decrease the risk of angle fractures. We think that this would be of value in preventing angle fractures that occur as a result of indirect trauma. While trauma is sustained to the parasymphysis/symphysis region, the force is propagated in the direction of the force and in case of a present third molar, makes the angle region more susceptible to fracture. However, we hypothesize that in cases of direct impact to the angle region such as those sustained as result of fist impact on the lateral mandible, the angle will have more chances to fracture even when the mandibular third molar is absent. Fuselier et al[21] suggested in their study on mandibular angle fracture and M3s that when sufficient forces is applied to result in a mandibular fracture and when an M3 is present, the fracture is more likely to occur in the angle region of the mandible.

Most of our patients with an angle fracture had a road traffic accident as the cause, and many of them were motorcyclists without wearing any helmet. In quite a few of these cases, there was an associated parasymphyseal fracture with a possible indirect transmission of force to the angle region. With a high percentage of our study population having an M3 present, the chances of angle fracture increased as can be evidenced by the number of angle fractures sustained through a mechanism of RTA; not otherwise believed to cause a great number of angle fractures.

Hanson et al[15] did a meta-analysis of six selected studies with certain criteria on the association of third molars with mandibular angle fractures. These studies were published between 1995 and 2002. The total number of patients was 3002; 835 with an angle fracture (cases) and 2167 with some other fracture of the mandible (controls). The crude relative risk estimates in the 6 studies ranged from 1.2 to 12.7. The summary relative risk ratio across all 6 studies was 2.8 (95% CI being 2.3-3.5). The random-effects estimates was slightly higher (relative risk ratio 3.1), and the 95% CI was greater (2.0 to 5.0). The authors concluded that the available published data allowed them to calculate only crude risk estimates. Adjusted relative risk estimates might differ from the crude estimates. When this possibility was examined in one study, adjusting for age and sex revealed no confounding by these variables, whereas adjusting for mechanism of injury resulted in an estimate of 2.9. If the confounding influence of age, sex and mechanism of injury is similar in the other 5 studies, then the true summary relative risk estimate may be slightly greater than their estimate of 2.8 for all studies.

Ugboko et al[24] in their investigation concluded that the presence of an M3 does not necessarily predispose to fractures of the angle of the mandible. They contended, however that angle fractures are more likely to occur in people with unerupted lower third molars than in those in whom they have erupted.

Our result of a significant association between Position B depth and angle fracture is of interest as we think that M3s in a Class B depth stand in a unique position of weakening the angle region in two ways. Their depth accounts for the osseous space occupied by their roots whereas on the other hand, being not completely buried in bone means that they are also seen to disrupt the external oblique ridge.

Takada et al[7] in their biomechanical study on three-dimensional bone microstructures of the mandibular angle using micro-CT and finite elemental analysis, found that for mandibles with or without third molars, in the area above the mandibular canal, trabecular bone was mainly aligned vertically from the alveolar crest to the mandibular canal. In the area below the mandibular canal, trabecular bone was aligned horizontally connecting the buccal and lingual cortical bone. In the Volume of Interest (the space occupied normally occupied by the M3 in the angle region), the trabecular bone consisted of plate and rod-like trabeculae and there was no marked intergroup difference in bone structure. In terms of the distribution of von Mises equivalent stress on sagittal sections, in the mandible without a third molar, stress was transmitted along the mandibular canal towards the body, and was distributed diffusely. However, for the mandible with a third molar, stress was concentrated around the root apex of the third molar. When the sagittal section was superimposed with the partially impacted M3, stress was clearly seen to be concentrated at the root apex. Also, stress was seen to be transmitted towards the base of the mandible and the angle, thus matching the clinical findings associated with angle fractures.

It is thus reasonable to suggest that disruption in bony anatomy at the tension line in mandibular angle fractures created by the presence of third molars might weaken the bone and increase the susceptibility to fracture.

While the premise that mandibular third molars predispose the mandibular angle region to fracture, it cannot be used to justify the prophylactic removal of mandibular third molars in people susceptible to facial trauma, such as those involving in contact sports. It has also been shown that in the absence of mandibular third molars, mandibular condyle becomes more likely to get fracture, since the energy does not get dissipated at the angle and continues to travel to the condyle, ultimately culminating in fracture of the mandibular condyle.[12]

One of the limitations of this study was the smaller number of patients with mandibular fractures. Studies done over a 2-3 year period with around 500 patients would have allowed us to have a more conclusive result with achievement of better confidence intervals at 95%. Another limitation was the dependence on patient's history to ascertain the cause of accident. Violence (especially fists directed from the side of the jaw) is a known confounding factor for angle fractures and cases of violence / altercations may have been under reported for the fear of resultant medico legal enquiries.

CONCLUSION

Angle fractures are a common finding in mandibular fractures (29.1% of all mandibular fractures) and mandibular third molars are one of the factors associated with a higher incidence (2.3-fold) of angle fractures. Similarly, Class B depth of mandibular third molar is also associated with a higher incidence of angle fractures. We are unable to show a significant association between the ramus relationship and angulation of mandibular third molar and incidence of angle fractures. If the association between the presence of mandibular third molar and the risk for angle fractures is causal, then this might be taken into account, along with other factors, in any decision regarding the removal of third molars.

RECOMMENDATION

People at risk of getting a mandibular fracture (such as those playing contact sports) should have their mandibular third molars evaluated by a maxillofacial surgeon but their injudicious removal is also not warranted.

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