Fractures of angle of mandible — A retrospective study

Sourav Singh^{a,*}, Ramesh R. Fry^b, Ajit Joshi^c, Geeta Sharma^c, Smita Singh^d

ABSTRACT

Aims: This retrospective study was done to evaluate the efficacy of single miniplate osteosynthesis at superior border of angle of mandible.

Material and methods: In this study 50 patients were treated by single miniplate osteosynthesis according to Champy's principle. Bite force generated was used as a parameter for judging the efficacy of internal fixation. In this article we present our experience over the years in the management of the fractures of angle of mandible based on this model.

Results: Most patients were of 21–30 yrs of age with unilateral angle fracture of mandible except one patient who had isolated bilateral angle fracture. The patients were treated successfully according to Champy's principle of osteosynthesis. There was a progressive improvement in the bite force generated after osteosynthesis.

Conclusions: The angle of the mandible is an anatomically weak and an area susceptible to fracture. The presence of an impacted or partially erupted third molar tooth further weakens it. Angle of mandible is the most common site for fracture however, bilateral angle fracture is very rare and uncommon.

Osteosynthesis according to Champy's model led to an early functional improvement as demonstrated by the bite force generated.

Copyright © 2012, Craniofacial Research Foundation. All rights reserved.

Keywords: Fracture mandible, Champy's principle, Osteosynthesis, Bite force

INTRODUCTION

The mandibular angle is fractured in approximately 25%–33% of all mandibular fractures¹ as is the transition area between dentate and edentate regions of the mandible. In fact, according to Moore,² a change in the direction of the bone tends to weaken the angle region of the mandible and increases its susceptibility to fracture. This is observed in the area where the horizontal body and vertical ascending ramus meet. Presence of incompletely erupted third molars is associated with an increased risk of angle fracture. However, multiple factors influence fracture patterns in the mandible, such as presence of soft tissue bulk, direction and

severity of the forces, impact, and biomechanical intrinsic characteristics of the mandible (e.g., bone density and mass).³

Road traffic accidents⁴ and assaults⁵ are the primary cause of mandibular fractures. Signs and symptoms include pain and edema, change in occlusion, lower lip paresthesia, hematoma, ecchymosis, loose teeth, and crepitation on palpation.⁶

According to Paza et al.,⁷ displaced angle fractures can rarely be adequately reduced by maxillomandibular fixation alone. Therefore, an open reduction and internal fixation of these fractures should be performed. However, several studies have documented high complication rates after rigid internal fixation of the mandibular angle.⁸ The purpose of

^aProfessor and Head, ^bProfessor, ^cSenior Lecturer, Department of Oral and Maxillofacial Surgery, ^dProfessor and Head, Department of Conservative and Endodontics, Darshan Dental College and Hospital, Ranakpur Road, Udaipur 313001, Rajasthan, India.

*Corresponding author. Tel.: +91 2942425727, email: udaipurdentalclinic@rediffmail.com

Received: 6.6.2012; Accepted: 5.10.2012

Copyright © 2012, Craniofacial Research Foundation. All rights reserved.

<http://dx.doi.org/10.1016/j.jobcr.2012.10.001>

this study was to review cases of fractures of the mandibular angle and their associated complications.

PATIENTS AND METHODS

Information was obtained retrospectively from clinical case sheets, surgical records, and radiographs of 50 patients treated for fractures of the mandibular angle from 2007 until 2011, in the Department of Oral and Maxillofacial Surgery at Darshan Dental College And Hospital, Udaipur. The data recorded included patient age, gender, etiology, method of surgical treatment, medication, and complications. The radiographs were evaluated with respect to the condition of the reduction, dislocation, failure of the fixation, and fracture union. Success was considered if the fracture fixation provided stability, i.e., there was no inter fragmentary mobility, infection, or nonunion of the bone fragments. Follow-up of patients was done up to 6-month post-operatively. Bite force readings were recorded in kilograms, using a locally manufactured bite force recorder. Bite force recording was done pre-operatively before fixing Erich's arch bar and post-operatively at each follow-up (7th, 15th, 21st and 90th day). The mean bite force generated in normal young healthy individuals was used for comparison.

Intermaxillary fixation was maintained for 7–14 days for all patients. Antimicrobial and anti-inflammatory drugs were administered for a week after the surgery. An anti-septic mouthwash, 2.5% povidone iodine, was recommended. Patient was advised functional exercises after removal of intermaxillary fixation for 3 months.

RESULTS

The higher prevalence of trauma was observed in patients of younger age group. 36% of cases belonged to 11–20 years age and 48% cases between 21 and 30 years. The majority of fractures in this study were sustained in motor vehicle accidents (74%), followed by altercation/assault (14%). Patient demographic data is shown in Table 1.

Table 1 Demographic data (N = 50).

	Category	N (%)
Gender	Males	40 (80%)
	Females	10 (20%)
Etiology	Road traffic accident	37 (74%)
	Interpersonal violence	7 (14%)
	Fall	4 (8%)
	Accidents at work	2 (4%)

Fig. 1 Pre-operative intra-oral photograph fracture bilateral angle of mandible.

Higher prevalence of fracture was on left side, 29 (58%); right side, 20 (40%); and only 1 bilateral angle fracture (2%) (Figs. 1 and 2). No relevant medical history affecting bone healing, notably diabetes, prolonged steroid therapy, compromised immunity, and associated bony pathology were noted in any of the patients.

Of the total 50 patients, 46 underwent surgery under general anesthesia and 4 under local anesthesia. All patients were treated via intraoral approach, open reduction and fixation (Figs. 3–6), using a 4-hole 2.0-mm stainless steel miniplate fixed on the external oblique ridge (Figs. 7 and 8) as per Champy et al⁹ Isolated fracture of mandibular angle accounted for 20 patients, and when associated fractures were detected, the mandibular parasymphysal fracture was the most prevalent (10 contralateral, 3 ipsilateral) followed by body fracture (8 contralateral, 2 ipsilateral).

The mandibular third molar was present in 45 cases (90%). It was extracted in 42 cases where it was involved in the fracture line. The remaining 3 cases, third molar was not involved in the fracture line, hence not extracted.

Fig. 2 Pre-operative OPG fracture bilateral angle of mandible.

Fig. 3 Exposure of the fracture site (right).

The bite force measured and calculated was finally found to be statically highly significant (Table 2) in both the regions (incisor and premolar-molar) with the P value = <0.001 respectively.

DISCUSSION

Fractures of the mandibular angle account for the highest percentage of mandibular fractures in most of the studies. Several factors are associated with an increased risk of angle fracture incidence: site, direction and severity of force, musculature of the face, architecture of the mandible, soft tissue bulk, biomechanical intrinsic characteristics of the mandible, and presence or absence of third molars. Studies in animals and humans have confirmed that the presence of third molars is associated with an increased risk of mandibular angle fractures.^{1,4,10}

Many authors have concluded that the severity of the force necessary to produce an angle fracture is substantially less when a third molar is present compared with when

Fig. 5 Bone plating at the superior border (right).

absent.¹ According to a theory, the third molars would weaken the angle by reducing the total available bone mass in the region. Therefore, the mandibular angle would become more susceptible to fracture. In other words, the more deeply impacted are the third molars, the greater would be the risk for angle fractures. However, this hypothesis was not confirmed by several clinical studies. Instead, recent studies suggest that the risk of angle fractures is greater for partially erupted third molars and is decreased for deeper impactions.^{1,11}

According to Duan and Zhang,¹⁰ the impacted mandibular third molars increase the risk of mandibular angle fractures and decrease the risk of mandibular condylar fractures by moderate trauma force. The partially erupted third molars disrupt the cortical integrity of the external oblique ridge which weakens the mandibular angle, thus decreasing the resistance to angle fractures. Mandibular strength would be derived from the maintenance of cortical bone integrity.¹¹ Superficially impacted third molars are associated with an increased risk, whereas deeply impacted molars are not. In our study, 30 patients had impacted third molars

Fig. 4 Exposure of the fracture site (left).

Fig. 6 Bone plating at the superior border (left).

Fig. 7 Post-operative occlusion.

and 6 patients had them in erupting stage. Thus partially erupting third molars disrupt the cortical integrity of the external oblique ridge and increasing the risk of mandibular angle fracture. Tams et al¹² observed negative bending movements at bite points closer to the fracture angle thereby leading to tension at the occlusal level. In a retrospective study of 385 patients, Choi et al¹³ concluded that the incidence of mandibular angle fracture is greater on sides with a third molar, whereas the condylar fracture rate significantly increased in mandibles lacking a third molar or without a fully erupted third molar. Thangavelu et al¹⁴ also suggested that removal of mandibular third molars predisposes to increased incidence of condylar fractures.

The stability of single miniplate fixation of angle fractures was challenged by several biomechanical studies based on 3D models. Kroon et al¹⁵ and Choi et al¹⁶ observed bony gaps along the inferior fracture border,

Fig. 8 Post-operative OPG.

Table 2 Bite force (in kg).

	Pre-operative	90th day post-operative	Control
Incisor region			
Mean	1.3162	17.369	19.27
SD	0.447	0.618	0.511
T value		148.90	16.77
P value		<0.001 ^a	<0.001 ^a
Premolar-molar region			
Mean	3.2334	38.722	41.47
SD	0.394	0.757	0.57
T value		294.19	20.51
P value		<0.001 ^a	<0.001 ^a

^a Difference is highly significant.

and this fracture movement was thought to contribute to subsequent complications, including infection. A second plate was suggested to reduce anterior posterior separation of the fracture line as well as lateral displacement, which is frequently observed on post-operative radiographs.¹⁷ The resulting clinical studies were inconsistent because an additional miniplate does not cause any change in complications rates. More recent 3D models have shown that the rotational or torsional forces at the angle are relatively weak.¹²

All cases in our study were treated via intraoral approach with a miniplate placed on the external oblique ridge.⁹ We preferred intraoral approach to avoid facial scars and facial nerve injury. Plates were contoured and fixed, thus allowing a stable healing of the fracture. Many surgeons still feel that miniplate fixation does not provide adequate stability and required intermaxillary fixation for additional security. In a retrospective study of 287 patients with 499 mandible fractures, Valentino and Marentette¹⁸ compared 130 patients who underwent intraoral monocortical plating of matched fractures and found that the addition of intermaxillary fixation did not significantly alter complication rates. Seemann et al¹⁹ reported a low complication rate with open reduction and miniplate fixation. Prein et al²⁰ noted similar findings in a small prospective study of 32 patients, combining the old AO technique with intermaxillary fixation. As miniplates provide semi-rigid fixation, intermaxillary fixation was done in our study for 7–14 days in all patients as an additional precaution and to prevent complications.²¹

Gerlach and Schwartz²² used bite force measurements to evaluate the efficacy of Champy's tension band principle in 22 patients. They concluded that up to 31% bite force was registered at the end of first week post-operatively which gradually increased to 58% at the end of 6th week.²² Our findings too were consistent with their results (Table 2).

CONCLUSIONS

Angle of mandible is the most common site for fracture however, bilateral angle fracture is very rare and uncommon. Third molars can be definitively considered a dominant factor for mandibular angle fractures.

The use of a single miniplate on the superior border of mandible is simple, reliable, and is the preferred method of treatment. Osteosynthesis according to Champy's model led to an early functional improvement as demonstrated by the bite force generated.

CONFLICTS OF INTEREST

All authors have none to declare.

REFERENCES

- Meisami T, Sojat A, Sándor GK, Lawrence HP, Clokie CM. Impacted third molars and risk of angle fracture. *Int J Oral Maxillofac Surg.* 2002;31:140–144.
- Moore JR. *Principles of Oral Surgery*. 2nd ed. Manchester, UK: Manchester University Press; 1976.
- Lee JT, Dodson TB. The effect of mandibular third molar presence and position on the risk of an angle fracture. *J Oral Maxillofac Surg.* 2000;58:394–398.
- Olson RA, Fonseca RJ, Zeitter PL. Fractures of the mandible: a review of 580 cases. *J Oral Maxillofac.* 1982;40:23.
- Greene D, Raven R, Carvalho G, Maas CS. Epidemiology of facial injury in blunt assault. Determinants of incidence and outcome in 802 patients. *Arch Otolaryngol Head Neck Surg.* 1997;123:923–927.
- Fonseca RJ, Walker RV, Betts NJ. *Oral and Maxillofacial Trauma*. 2nd ed., vol. II. Philadelphia: WB Saunders; 1997.
- Paza AO, Abuabara A, Passeri LA. Analysis of 115 mandibular angle fractures. *J Oral Maxillofac Surg.* 2008;66:73–76.
- Peled M, Laufer D, Helman J, Gutman D. Treatment of mandibular fractures by means of compression osteosynthesis. *J Oral Maxillofac Surg.* 1989;47:566–569.
- Champy M, Wilk A, Schnebelen JM. Treatment of mandibular fractures by means of osteosynthesis without intermaxillary immobilisation according to F.X. Michelet's technique. *Zahn Mund Kieferheilkd Zentralbl.* 1975;63:339–341.
- Duan DH, Zhang Y. Does the presence of mandibular third molars increase the risk of angle fracture and simultaneously decrease the risk of condylar fracture? *Int J Oral Maxillofac Surg.* 2008;37:25–28.
- Halmos DR, Ellis E, Dodson TB. Mandibular third molars and angle fractures. *J Oral Maxillofac Surg.* 2004;62:1076–1081.
- 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;34:400–405.
- Choi BJ, Park S, Lee DW, Ohe JY, Kwon YD. Effect of lower third molars on the incidence of mandibular angle and condylar fractures. *J Craniofac Surg.* 2011;22(4):1521–1525.
- Thangavelu A, Yoganandha R, Vaidhyanathan A. Impact of impacted mandibular third molars in mandibular angle and condylar fractures. *Int J Oral Maxillofac Surg.* 2010;39(2):136–139.
- Kroon FH, Mathisson M, Cordey JR, Rahn BA. The use of miniplates in mandibular fractures. An in vitro study. *J Craniomaxillofac Surg.* 1991;19:199–204. osteosynthesis. *Otolaryngol Head Neck Surg* 1995;112:215.
- Choi BH, Yoo JH, Kim KN, Kang HS. Stability testing of two miniplate fixation technique for mandibular angle fractures. An in vitro study. *J Craniomaxillofac Surg.* 1995;23:123–127.
- Rudderman RH, Mullen RL. Biomechanics of the facial skeleton. *Clin Plast Surg.* 1992;19:11.
- Valentino J, Marentette LJ. Supplemental maxillomandibular fixation with miniplate osteosynthesis. *Otolaryngol Head Neck Surg.* 1995;112:215–220.
- Seemann R, Schicho K, Wutzl A, et al. Complication rates in the operative treatment of mandibular angle fractures: a 10-year retrospective. *J Oral Maxillofac Surg.* 2010;68(3):647–650.
- Prein J, Schilli W, Hammer B. Rigid fixation of facial fractures. In: Fonseca RJ, Walker RV, eds. *Oral and Maxillofacial Trauma*. Philadelphia: WB Saunders; 1991:1206–1240.
- Longwe EA, Zola MB, Bonnick A, Rosenberg D. Treatment of mandibular fractures via transoral 2.0-mm miniplate fixation with 2 weeks of maxillomandibular fixation: a retrospective study. *J Oral Maxillofac Surg.* 2010;68(12):2943–2946.
- Gerlach KL, Schwarz A. Bite forces in patients after treatment of mandibular angle fractures with miniplate osteosynthesis according to Champy. *Int J Oral Maxillofac Surg.* 2002;31:345–348.