

# Immediate Post-Operative Complications in the Treatment of Mandibular Fractures at Angle Region by Rigid Fixation Using Mini Bone Plates With or Without Intermaxillary Fixation

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## Abstract

**Objective:** The purpose of this study was to determine the impact of intermaxillary fixation in immediate post operative inflammatory phase in treatment of mandibular fractures at angle region by rigid fixation using mini bone plates.

**Place and Duration:** The study was conducted in the department of Oral and Maxillofacial Surgery, Pakistan Institute Medical Sciences, Islamabad, Pakistan from July 2005 to June 2009.

**Materials and Methods:** This study comprised 60 patients within the age group of 12-60 years divided into two treatment groups. Group (A) was treated by titanium bone plating with IMF for 10 days and group (B) by bone plating without IMF. All the fracture was treated by Open Reduction and Internal Fixation (ORIF) via intra-oral approach.

**Results:** Majority of the patients were males (93.3%) with a male to female ratio of ratio of 14:1. Mean age of the patients was 28.13 years (12-60 years). The commonest etiology was road traffic accidents. The immediate post operative complications in 6, 12 and 72 hours gave the impact of acute inflammatory phase. The results demonstrated significantly higher incidence of post operative pain in patients who underwent rigid fixation without IMF ( $p=0.0043$ ). However post operative transient airway obstruction was evaluated at a higher frequency in patients treated with IMF ( $p = 0.024$ ).

**Conclusion:** Titanium mini plates offer sufficient stabilization of mandibular angle fractures with a significant reduction in immediate post operative complications if IMF period is extended up to 10 days.

**Key Words:** Isolated mandibular angle fracture, Open reduction & internal fixation, Intermaxillary fixation (IMF).

## Introduction

Mandible is one of the most prominent bones of the facial skeleton. It has been compared to an archery bow, which is strongest at its centre and weakest at its ends, often where it breaks.<sup>1,2</sup> A broken bone is a serious injury for any patient, but fractured jaws can be a major catastrophe. The way in which mandibular fractures are treated and repaired has undergone a

gradual evolution. Over the years, many techniques for the repair of mandibular fractures have been introduced. The methods have ranged from maxillomandibular fixation (MMF) to combination of MMF and wire osteosynthesis, lag screw, and plate fixation.<sup>3,4</sup> The latest trend of treating the fractured jaw is by osteosynthesis. It was initially performed by rigid internal fixation by compression plates, but later, noncompression monocortical miniplate fixation for

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osteosynthesis of mandibular fractures was introduced by Michelet et al (1973) and further advanced by Champy et al (1976), Edward and Lee (1996).<sup>5, 6, 7</sup> With the introduction of rigid internal fixation (RIF) i.e. bone plating, inter maxillary fixation (IMF) has become a second choice. The benefits of avoidance of IMF are reported as early functioning of the mandible, increased patient satisfaction, shorter periods of hospitalization and earlier return to the workplace.<sup>8,9</sup>

Many surgeons consider that osteosynthesis does not provide adequate stability required IMF for additional support.<sup>10</sup> Some complications have been reported with rigid fixation like occlusal disturbances, infection, and dehiscence of wound and osteomyelitis due to surgical manipulation, especially in mandibular angle fractures where the operation was done without IMF.<sup>7,11,12,13</sup> Conor and Gerard (2006), Siddique A. et al (2007) reported that osteosynthesis with IMF overcomes these difficulties.<sup>14,15</sup> Considering these facts, already many studies have been performed on osteosynthesis with IMF for a certain postoperative period.<sup>16</sup> The purpose of this study was to assess the influence of immediate post operative inflammatory phase in treatment of mandibular fractures at angle region by rigid fixation using mini bone plates with or without intermaxillary fixation (IMF).

## Materials and Methods

The study was conducted in the department of Oral and Maxillofacial Surgery, Pakistan Institute Medical Sciences, Islamabad, Pakistan from July 2005 to June 2009. This study consisted of 60 patients with clinically and radiographically diagnosed isolated mandibular angle fractures.

A pre-structured history and clinical examination proforma was completed for each patient. To reach at the conclusive diagnosis, Orthopantomogram (OPG) was the standard radiograph which was supplemented by posteroanterior view of face. The patients were divided into two groups by using random number table. Group (A) was treated by titanium bone plating (rigid fixation) with IMF for ten days and other group by titanium bone plating without IMF. Post-surgery radiographs were taken and each patient was followed regularly for immediate complications.

For the osteosynthesis, an incision was made intra-orally at the fracture site over the external oblique ridge of mandible. Fracture segments were exposed and reduced in normal anatomical position, immobilized by IMF to maintain occlusion and hold the fractures

segments. Finally a single bone plate was applied and fixed with the help of screws. The soft tissue incision was sutured and IMF released in both groups. IMF was again done after removing throat pack in group A and maintained for ten days.

## Results

60 cases of isolated mandibular fracture were recruited for this study. Out of these, 56 were male and 4 females (male to female ratio 14:1; Figure-1).

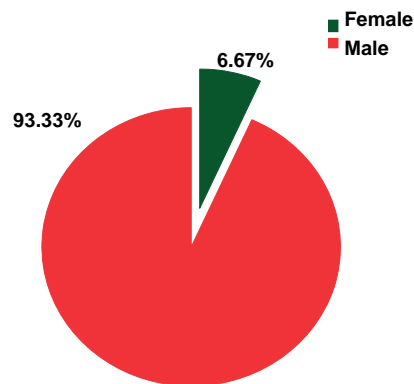


Figure 1: Gender Distribution

Patients ranged within the age range of 12-60 years with mean age of 28.13 years. Maximum number of patients fell into age group between 21-30 years (45%) and least number were of age group of 51-60(5%) however, most of the cases (78.33%) fell in the young age bracket between 15-35 years.

Road traffic accidents were the cause of fracture in 30 (50 %), falls in 15 (25 %), assault in 9 (15 %) and sports injuries in 6 (10%) patients.

Angle of the mandible is frequently associated with fractures for several proposed reasons, including the presence of the third molar. These were erupted fully in 46.7%, impacted partially in 11.7%, impacted fully in 36.7% and missing in 5.0% of our patients.

Post-operative swelling was observed by criteria of Peterson et al (1993), who measured the swelling as mild, moderate and severe.<sup>17</sup> We observed mild swelling in 23 patients in group A and 7 in group B. Moderate swelling was present in 7 patients in group A and 18 in group B. Five patients presented with severe swelling in group B only (Table I).

Post operative pain was assessed on basis of Visual Analogue Pain Intensity Scale by Mc Keen et al (2005) in different categories e.g. mild, moderate & severe.<sup>18</sup> Within the first six hours, mild pain was present in 20

patients in group A and 11 in group B. Moderate pain affected 8 in group A and 14 in group B. Severe pain was reported in 2 patients in group A and 5 in group B. (Table: I) These findings were analyzed statistically and Chi-Square test was applied which projected that moderate and severe pain were significantly higher in group without IMF ( $p=0.0034$ ).

**Table I: Immediate Post Operative Complications within 6 Hours with & Without IMF**

Complications within 6 Hours	Score	Rigid Fixation With IMF (n=30)	Rigid Fixation Without IMF (n=30)
Swelling	Mild	23	7
	Moderate	7	18
	Severe	0	5
Pain	Mild	20	11
	Moderate	8	14
	Severe	2	5
Bleeding	Mild	3	7
	Moderate	1	5
	Severe	0	1
	None	26	17
Transient airway Obstruction	Mild	11	6
	Moderate	7	5
	Severe	1	0
	None	11	19

Post surgery bleeding was categorized as mild, moderate, and severe according to Peterson (1993)<sup>17</sup>. Within the first 6 hours, mild bleeding was observed in 3 patients in group A and 7 in group B, moderate bleeding was reported in 1 patient in group A and 5 in group B, severe bleeding was reported in one patient in group B only. Mild post operative bleeding within 6 hours was statistically higher ( $p=0.045$ ) in group B.

Airway obstruction was assessed according to Steen et al (1992) as mild, moderate and severe.<sup>9</sup> In our study, we observed mild post-operative transient air way obstruction within the first 6 hours in 11 patients in group A and 6 in group B, 7 patients had moderate airway obstruction in group A only, severe airway obstruction was seen in one patient in group A only. Chi-square test was applied and it was statistically evident that incidence of post operative airway obstruction was higher in patients who underwent surgery of Rigid Fixation with IMF ( $p=0.037$ ). All patients recovered without any further complication and without removal of IMF.

Postoperative complications after 24 hours were assessed and it was revealed that mild swelling was

present in 25 patients in group A and 7 in group B ( $p=0.021$ ). Moderate swelling was observed in 5 patients in group A and 19 in B group. Mild pain was observed in 19 patients in A group and 13 in group B but moderate pain in 6 in A group and 12 in group B. Severe pain in 2 patients in group A and 5 in group B. Mild bleeding was seen in 2 patients in group A and 9 in group B. Moderate bleeding in 2 patients in group A and 6 in group B. Mild bleeding was significantly higher ( $p=0.041$ ) in group B. Mild postoperative transient airway obstruction was seen in 12 in group A and 9 in group B. Statistically, there was no significant difference between the two groups ( $p=0.065$ ). Moderate obstruction occurred in 5 patients in group A and 4 in group B and one patient in group A only had severe obstruction. (Table II)

Postoperative complications within 72 hours were also

**Table II : Immediate Post Operative Complications within 24 Hours With & Without IMF**

Complications within 24 Hours	Score	Rigid Fixation With IMF (n=30)	Rigid Fixation Without IMF (n=30)
Swelling	Mild	25	7
	Moderate	5	19
	Severe	0	4
Pain	Mild	19	13
	Moderate	6	12
	Severe	2	5
	None	3	0
Bleeding	Mild	2	9
	Moderate	2	6
	None	26	15
Transient airway Obstruction	Mild	12	9
	Moderate	5	4
	Severe	1	0
	None	12	17

assessed which showed that mild swelling was seen in 12 patients in group A and 17 in group B. Moderate swelling was seen in 2 patients in group A and 11 in group B. Severe swelling was seen in 2 patients in group B only. Statistically a higher incidence of swelling was seen in group B ( $p=0.042$ ). Mild pain was observed in 22 patients in group A and 7 in group B. Moderate pain was experienced by 8 patients in group A and 21 in B. Only two patients in group B experienced severe pain. Severity of pain was higher in group B ( $p=0.029$ ). Mild bleeding was seen in 7 patients and moderate bleeding in 1 patient in group B. Incidence of mild bleeding was higher in group B ( $p=0.031$ ). Mild postoperative airway obstruction was seen in 5 in group A and 3 in group B, moderate in 2 patients in group A

and one in group B.(Table III). There was no statistically significant difference of airway obstruction in both groups (p=0.071).

**Table III: Immediate Post Operative Complications within 72 Hours With & Without IMF**

Complication within 72 Hours	Score	Rigid Fixation With IMF (n=30)	Rigid Fixation Without IMF (n=30)
Swelling	Mild	12	17
	Moderate	2	11
	Severe	0	2
	None	16	0
Pain	Mild	22	7
	Moderate	8	21
	Severe	0	2
	None	0	0
Bleeding	Mild	0	7
	Moderate	0	1
	None	30	22
Transient airway Obstruction	Mild	5	3
	Moderate	2	1
	Severe	0	0
	None	23	26

## Discussion

The results of the present study have demonstrated comparable results in treatment of isolated fracture of mandible at angle region by rigid fixation using mini bone plates with or without intermaxillary fixation (IMF) to similar loco-regional studies. However, the morbidity associated with using IMF could be significantly reduced using ORIF, thus the period of post-operative IMF could be almost eliminated in patients with unilateral angle fractures whereas about half the patients with bilateral angle fractures needed IMF for relatively short period of time. In all patients, IMF was not considered until swelling had abated.

The initial inflammatory phase appears soon after the surgery, many factors are involved, including growth factors, inflammatory cytokines, and antioxidants.<sup>18,19</sup>

These factors result in clinical signs of inflammation like pain, swelling, loss of function including trismus (In fracture mandible may cause phonetic problem, malocclusion and airway obstruction). The post operative bleeding is another important factor for the assessment of wound healing.<sup>20</sup> Ihan and Miljavec (2008) suggested that the healing response after six hours can be assessed on the basis of acute inflammatory signs.<sup>21</sup> These inflammatory signs were

observed in both groups in our study to compare acute inflammatory response in both modalities.

We observed mild swelling in about 23 patients in group A after six hours. Five patients presented with severe swelling in group B. The study of Schneider et al (2008) reflects this domination of IMF. He suggested that less movement in the injured area results in less soft tissue oedema.<sup>9</sup> This correlates with our study. Patients of both groups were administrated intravenous corticosteroid injection as per operative protocol to minimize swelling.

Post operative pain was assessed in both groups of patients. Mild pain was high in patients without IMF (p=0.034). These findings coincide with the study of Adeyemi et al (2012) it may be true as IMF restricts post operative movements of injured part, which favors less release of inflammatory mediators.<sup>22</sup>

Seemann R et al (1986) and Ward et al (2005) mentioned many reasons for post operative bleeding in jaw surgery.<sup>23,24</sup> Post surgical bleeding in our study was categorized as mild, moderate, and severe according to Peterson (1993).<sup>17</sup> Mild bleeding was significantly high in patients without IMF. Only 3 patients reported with post operative mild bleeding in group A and 7 patients in group B. Only one patient had severe bleeding due to hypertention and excessive jaw movements that also belong to group B. This tendency of bleeding in group B clearly demonstrates the benefits of post operative IMF in osteosynthesis.

Schneider et al suggested acute airway obstruction in the immediate postoperative period reported as a complication to IMF in osteosyntheses.<sup>9</sup> We also observed a statistically higher incidence of post-operative transient air way obstruction in group A (p=0.037).

Six hours post surgical period is considered to be important to evaluate the initial inflammatory response. Pain, swelling and post operative bleeding were more obvious in group B. Our findings correlate with the study conducted by Shahid et al (2003) on fracture of mandibular angle. He suggested that the short term IMF with osteosynthesis is associated with fewer post operative complications.<sup>25</sup>

Post operative pain after 24 hours was assessed in both groups of patients. Mild pain was higher in A group (19 patients) and 13 in group B, moderate pain in 6 in A group and 12 in group B and severe pain in 2 in A and 5 in group B. Mild bleeding in 2 in group A and 9 in group B, moderate bleeding in 2 in group A and 6 in group B.

Mild postoperative airway obstruction was seen in 12 in group A and 9 in group B, moderate obstruction in 5 in group A and 4 in group B and one patient in group B had severe obstruction in group B. These findings coincide with the study of Renton and Wiesenfeld (1996), it may be true as IMF restricts post operative movement of injured part, which favors less release of inflammatory mediators.<sup>22</sup>

Only 19 patients reported with post operative mild bleeding in both groups of patients, six patients (20%) with moderate bleeding were seen in group B. None were observed with severe bleeding after 24 hours post-operatively. Our results are supported by Peterson (1993), Edward et al (1996).<sup>7,17</sup> Overall group B yet remains dominant in complications as observed after 24 hours.

Three days after surgery, dominant inflammatory cells (Macrophages) have the capability to release a wide variety of mediators, growth factors and enzymes causing important consequences in the surrounding tissues. They also enhance both the proliferation and secretion of collagen by fibroblasts.<sup>26,27</sup> As this time, inflammatory phase reaches at the end stage, fibroblasts begin to enter the wound site and lymphocytes also migrate into wound, produce lymphokines and favor fibroblasts replication and collagenous protein synthesis.<sup>28</sup> Post operative movement of the wound provokes the release of the inflammatory factors causing lingering of inflammatory phase. These microscopic findings were assumed to be taken place as normal healing process.

Postoperative complications within 72 hours were assessed which showed that mild swelling was seen in 12 patients in group A and 17 in group B, moderate swelling was seen in 2 patients in group A and 11 in group B while severe swelling was seen in 2 patients in group B only. Statistically a higher incidence of swelling was seen in group B ( $p=0.042$ ). A higher incidence of postoperative swelling after 72 hours in group B showed the beneficial effect of surgical intervention by rigid fixation with IMF in mandibular fractures.

Mild pain was observed in 22 patients in group A and 7 in group B, moderate pain in 8 in group A and 21 in B and mild bleeding was seen in 7 patients in group B and moderate bleeding in 1 patient in group B. Mild postoperative airway obstruction was seen in 5 in group A and 3 in group B, moderate in 2 in group A and one in group B.

These findings correlate favorably with the Vineeth K et al (2013), Weber et al (1990) and Nakamura et al (1994) they reported that post operative IMF keep the mandible immobilized until the soft tissue incision has healed, is often cited as reason.<sup>28,29,10</sup> This also gives advantage of less release of inflammatory mediators to cause patient discomfort. Our findings regarding post operative mild bleeding correlate with Seemann R et al. (2010) 5.3% and Bormann KH et al (2009) 7.2%.<sup>30,23</sup>

## Conclusion

This study demonstrates the importance of post osteosynthesis IMF period in reducing the consequences of acute inflammatory phase, like bleeding, swelling, pain and post-operative airway obstruction. IMF also proved to be an excellent tool to provide good inter-digitation hence, good occlusion, function and rehabilitation as compared to osteosynthesis without IMF.

## References

1. Peter L. Williams, Roger Warwick, Mary Dyson, and Lawrence H. Bannister: Gray's Text Book of Anatomy; 37<sup>th</sup> Ed: 367-370, 1995
2. Michelet FX, Dessus B, Benoit JP, Moll A: Mandibular osteosynthesis without blocking by screwed miniature stellite plates. Rev Stomatol Chir Maxillofac; 74:239-45, 1973
3. Cawood JI, Small plate osteosynthesis of mandibular fractures. Br J Oral Maxillofac Surg; 23: 77-91, 1985
4. Theriot BA, Van Sickels JE, Triplett RG, Nishioka GJ. Intraosseous wire fixation versus rigid osseous fixation of mandibular fractures: a preliminary report. J Oral maxillofac Surg; 45: 577-82, 1987
5. Michelet FX, Dessus B, Benoit JP, Moll A. Mandibular osteosynthesis without blocking by screwed miniature stellite plates. Rev Stomatol Chir Maxillofac; 74:239-45, 1973.
6. Champy M, Lodde JP, Jaeger JH, Wilk A : Osteosynthesis mandibulaires selon la technique de Michelet. I bases biomecaniques. Revue de stomatologie et de chirurgie maxillo faciale; 77: 569-76, 1976
7. Edward Ellis, Lee R. Walker: Treatment of Mandibular Angle Fractures using one Non- compression Miniplate; J Oral Maxillofac Surg; 54:864-871, 1996
8. Albert J. Fox, Robert M. Kellman: Mandibular angle fractures; Two mini plates fixation and complications; Arch Facial Plast Surg. 5: 464-469, 2003.
9. Schneider M, Erasmus F, Gerlach KL, Kuhlisch E, Loukola RA, Rasse M: Open reduction and internal fixation versus closed treatment and mandibulomaxillary fixation of fractures of the mandibular condylar process: a randomized, prospective, multicenter study with special evaluation of fracture level; J Oral Maxillofac Surg, 2537-44. Dec 2008
10. Nakamura S, Takenoshita Y, Oka M: Complication of miniplate Osteosynthesis for mandibular fractures. J Oral Maxillofac Surg; 52:233, 1994
11. Meisami T, Sojat A, Sandor GKB, Lawrence HP, Clokie CML. Impacted third molars and risk of angle fractures 31: 140-4, 2002;
12. Abbas I, Ali K, Mirza YB. Spectrum of mandibular fractures at a tertiary care dental hospital in Lahore. J Ayub Med Coll Abbottabad; 15: 12-4, 2003

13. Ma'aïta J, Alwrikat A. Is the mandibular third molar a risk factor for mandibular angle fracture? *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*; 89: 143-6, 2000
14. Conor P. Barry, Gerard J. Kearns: Superior Border Plating Technique in the Management of Isolated Mandibular Angle Fractures: A Retrospective Study of 50 Consecutive Patients. *J Oral Maxillofac Surg*; 65:1544-1549, 2006
15. Siddiqui A. George Markose, Khursheed F. Moos, Jeremy Mc Mahon, Ashraf F, Ayub: One miniplate versus two in the management of mandibular angle fractures: A prospective randomized study. *BJ of Oral and Maxillofacial Surg*; 45: 223-225, 2007
16. Bennet Neil T and Schultz Gregory S. Factors and Wound Healing: Biochemical Properties of Growth Factors and their Receptors. *American Journal of Surgery*; 165: 728-737 .1993
17. Peterson LJ: Contemporary Management of Deep Infection of the Neck, *J Oral Maxillofac Surg*; 51: 226, 1993
18. Mckean, S, Kochilas, X, Kellher, R and Dockery: use of intravenous steroids at induction of anesthesia for adult tonsillectomy to reduce post operative nausea and vomiting and pain :a double –blind randomized controlled trial .*Clin. Otolaryngol.*31,36-40, 2005
19. Cohen J. John. Apoptosis: the physiologic pathway of cell death. *Hospital Practice*: 35-43 .1993
20. M. OAPOSNEILL .Ultrasound Evaluation of Bone Healing in Distraction Osteogenesis of the Mandible; *Atlas of the Oral and Maxillofacial Surgery*, Volume 13, Pages 63-67, 2007
21. IHAN HREN N.; MILJAVEC M. Spontaneous bone healing of the large bone defects in the mandible *International journal of oral and maxillofacial surgery* vol. 37.1111-1116; 2008
22. Adeyemi MF, Adeyemo WL, Ogunlewe MO, Ladeinde AL: Is healing outcome of 2 weeks intermaxillary fixation different from that of 4 to 6 weeks intermaxillary fixation in the treatment of mandibular fractures? *J Oral Maxillofac Surg*;70(8), 1896-902, 2012
23. Seemann R, Schicho K, Wutzl A, Koinig G, Poeschl WP, Krennmair G, Ewers R, Klug C: Complication rates in the operative treatment of mandibular angle fractures: a 10- year retrospective; *J Oral Maxillofac Surg*; 68(3), 647-50. 2010
24. Ward, B. E. Weideman. Long-Term Postoperative Bleeding After Dentoalveolar Surgery in the Pretransplant Liver Failure Patient *Journal of Oral and Maxillofacial Surgery*, Volume 64, Issue 10, Pages 1469-1474, 2005
25. Shahid Hussain, Muhammad Ahmed, M. Ibrahim Khan Maxillofacial Trauma: Current Practice in Management At Pakistan Institute of Medical Science, Islamabad, J Ayub Med Coll Abbottabad:15:8-11, 2003
26. Susan E. Brown, PhD. How to speed the fracture healing, [http://www.betterbones.com/bone\\_fracture\\_speedhealing.aspx](http://www.betterbones.com/bone_fracture_speedhealing.aspx) copyright 2002-2009
27. Newsham-West R, HNicholson, MWalton, and Pmilburn .Long term morphology of a healing bone –tendon interface: a histological observation in the sheep model .*J Anat.* 210(3):318-327 .2007
28. Vineeth K , R.M. Lalitha, Kavitha Prasad, K. Ranganath, V. Shwetha, Jasmeet Singh: A comparative evaluation between single noncompression titanium miniplate and three dimensional titanium miniplate in treatment of mandibular angle fracture – A randomized prospective study; *Journal of Cranio-Maxillofacial Surgery* ; Volume 41, Issue 2, Pages 103–109, 2013
29. Weber N, Reuther J , Michel C et al : Erfahrungen bei der Versorgung von Gesichtsschadelfrakturen mit dem wurzburger Titan-mini-plattensystem. *Dtsch Z Mund-Kiefer-Gesichts Chir* 14:46 . 1990
30. Bormann KH, Wild S, Gellrich NC, Kokemuller H, Stuhmer C, Schmelzeisen R, et al: Five-year retrospective study of mandibular fractures in Freiburg, Germany: incidence, etiology, treatment, and complications; *J Oral Maxillofac Surg* :67(6), 1251-5. 2009.