

# Comparison Between Rigid Fixation and Semi Rigid Fixation of Mandibular Angle Fracture

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## ABSTRACT

**Objective:** to compare treatment outcomes between rigid fixation by using bone plating and semi rigid fixation by using transosseous wiring with maxillomandibular fixation for the treatment of isolated mandibular angle fractures.

**Study Design:** A prospective comparative clinical study

**Place and Duration of Study:** This study was conducted at the Department of Oral and Maxillofacial Surgery, Liaquat University of Medical & Health Sciences, Jamshoro from April 2013 and April 2015.

**Materials and Methods:** A prospective comparative clinical study was conducted on 30 patients who were treated for isolated mandibular angle fractures. The patients were selected and treated with semi rigid and rigid fixation techniques. The patients were evaluated for 4 weeks for the post-operative complications in terms of infection, malocclusion, malunion and sensory disturbances.

**Results:** Infection was seen to be more in semi rigid fixation when compared to rigid fixation. (20% vs 6.6%) whereas sensory disturbances (13.3%) were maximally found in rigid fixation technique. Never the less in this study the post-operative complications in either of the techniques were not significant.

**Conclusion:** In this study analysis of primary complications were done whereas the late complications can also occur. Such occurrences may not be recognized unless long term follow up is undertaken.

**Key Words:** Semi rigid fixation; rigid fixation; infection; malocclusion; malunion; sensory disturbances.

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## INTRODUCTION

A major cause of death and morbidity throughout the world is the Maxillofacial Accidents. Most common among the maxillofacial injuries are the mandibular fractures. Mandibular fractures occurs most commonly in Pakistan and are associated with high incidence rates along with various combinations.<sup>1</sup>

Mandibular angle is one of the most popular locations of mandibular fractures. Due to changes in calcification lines and pressure from the horizontal body to the vertical ascending ramus, the mandibular angle is the ideal area of fractures.<sup>2</sup>

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A change in the occlusion of the mandibular angle fracture may be evident during a physical examination. Premature post-traumatic posterior dental contact and retrognathic occlusion may result in a mandibular angle fracture. The ideal treatment of these fractures is controversial and the complication rates noted, though many involve inconsistent populations, are unacceptably great. Mandibular angle divide is prone to the highest complication rates for all fracture sites, from 0% to 32 percent.<sup>4</sup>

Unfortunately, mandible fractures are associated with number of complications. Most common amongst them includes infection, malocclusion, mal-union and neurosensory dysfunction.

Besides many controversies, treatment involved rigid fixation with maxilla-mandibular fixation (MMF) to produce absolute bony stability along with union.<sup>6</sup>

However, despite these complications the rigid internal fixation with miniplates and MMF for short duration is advantageous and showed lesser complications as compared to plating and MMF.<sup>7</sup>

Therefore, this prospective study has been carried out to assess the various complications that were encountered following the treatment of isolated mandibular angle fractures with rigid fixation and semi rigid fixation.

**Fracture healing:** Bony repair after reduction of fracture is based on optimum supply of blood and it is

affected by contamination and in delaying the days of reduction and immobilization.<sup>8</sup>

Bone healing occurs by a primary or secondary intention. In rigid fixation primary healing occurs. When the fragments are rigidly immobilized, osteoclasts fills the fracture gap. Tissue osteoblasts then begins to lay down newbone. With maturation these become new haversian canals. This process is called “contact healing”. When a small gap remain between the fragments, lamellar bone is laid down within this gap. New haversian canals crossing the gap will form. This process is called “gap healing”.

With either of these types of primary bone healing no external callus would be found along the walls of the fragments if they were rigidly immobilized.

In secondary bone healing, there is formation of hematoma, inflammation occurs, formation of callus (soft and hard) and bone remodeling to form lamellar bone. Secondary bone healing takes place when precise anatomic reduction cannot be achieved by primary way.<sup>9</sup>

Callus provides the stability so that the union of bone can be initiated.

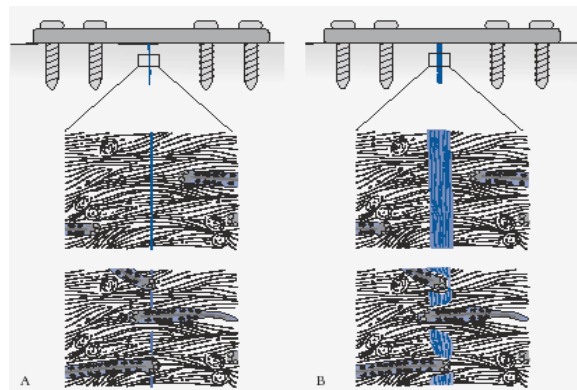


Figure No.1: Types of primary or direct bone healing (A) contact healing (B) gap healing.

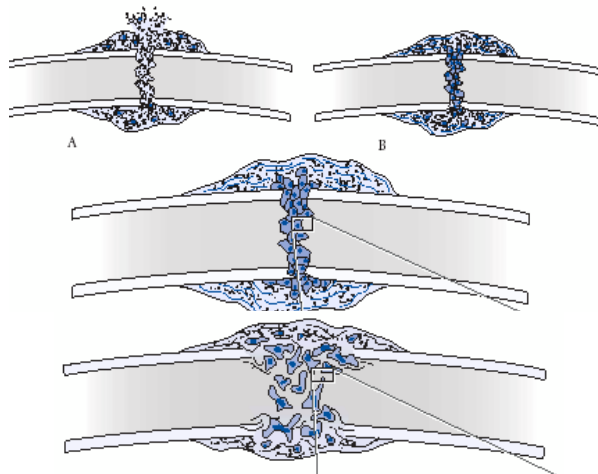


Figure No.2: secondary or indirect bone healing. (A) hematoma formation (B) soft callus formation (C) hard callus formation (D) remodeling and replacement of woven bone.

**REVIEW OF LITERATURE**

**Historical review:** Schede was the first person who introduced ORIF Oral Reduction and Internal Fixation. He used the plates and screws which were made up of steel.<sup>6</sup> The Pre-antibiotic area noticed many methods which were used to reduce mandibular fractures.

Izuka T, et al<sup>10</sup> In their study of rigid internal fixation they concluded that:

1. Recommended method in the treatment of comminuted fractures of the mandible.
2. Can be applied when IMF is undesirable.
3. Results in more complications than semi rigid methods but refined surgical technique and increased use of intraoral approach can reduce the rate of infection.
4. Should not be used in uncooperative patients.

Scheimmer MA, et al<sup>11</sup> Conducted a study on patients in whom rigid internal fixation was used for the treatment of fractures and continuity defects of the mandible. They concluded that the rigid internal fixation obviates the use of IMF, its applicability in non-compliant patients, ability to maintain good oral hygiene, minimizing periodontal trauma during fixation of arch bars and to maintain precise anatomic relationships of mandibular segments when continuity defects exists.

Johansson B, et al<sup>12</sup> In their study treated infected mandibular fractures with mini plate osteosynthesis. They recommended that all teeth should be carefully evaluated which present in the fracture line and in patients are suffering from alcohol and drug abuse or in those from whom lack of co-operation can be anticipated.

Brown JS, et al<sup>14</sup> conducted a comparative study of isolated mandibular fractures treated with IMF and with miniplate-osteosynthesis. They have concluded that the expenses for IMF were found to be higher and greater number of out-patients visits was registered. Patients preferred their fractures managed without IMF. Nursing staffs are often anxious at prospect of recovering patients wired together and chances of potential airway embarrassment post operatively on patients who are on IMF and thus mini plates was the material of choice.

Assael LA<sup>15</sup> States that rigid internal fixation of mandibular fractures permit healing under stable conditions with immediate function and precise lyre-establishes the pre-injury position of the bones.

**MATERIALS AND METHODS**

This study was carried out as a prospective randomized clinical trial evaluating the post-operative complications following the treatment of isolated mandibular angle fractures with open reduction and stable internal fixation.

The patients for this study were selected from those visiting the department of Oral and Maxillofacial Surgery, Liaquat University Hospital, Hyderabad,

between April 2013 and April 2015. The Ethical Review Committee approved the clinical evaluation and all subjects gave an informed consent.

A total of 30 patients who were treated for isolated mandibular angle fractures and were assessed for any complications after the treatment. The patients ranging in the age group between 20-40 years were included in the study. Preoperative information was obtained from the patients and radiographs. The cases with relevant medical history, medically compromised patients, associated bone pathology and also patients who presented with systemic orofacial infection were excluded from the study.

The patients were selected randomly and were grouped into two. One group comprising of 15 patients were treated with rigid fixation i.e. miniplates and the other group comprising of another 15 patients were treated with semi rigid fixation i.e. transosseous wire.

The area that was considered in the study was mandibular angle region which were non-infected, non-comminuted and in subjects where IMF was not medically contraindicated.

The treated patients were prospectively followed and examined for the post-operative complications such as:

- Infection
- Malocclusion
- Malunion
- Sensory disturbances.

**Infection:**

- Purulent discharge from the site.
- Swelling which has increased beyond seventh post-operative day.
- Fistula formation with drainage.
- Fever along with infection (swelling, erythema or tenderness)

**Malocclusion:**

- Slightly displaced but satisfactory occlusion can be achieved by occlusal grinding.
- Severely displaced and unacceptable occlusion which requires a second operation to correct the occlusion

**Malunion:** Treated fracture sites was assessed radiographically

- Slightly displaced fragments (< 5mm)
- Severely displaced fragments (> 5mm)

**Sensory Disturbances:**

- Patients were asked about the sensory disturbances especially on the region of mental nerve and this was compared with the non-injured side and with the skin of the cheek.
- Cotton wool was used for the sensation of light touch and for the sharp sensation, a dental probe on the skin of the chin and the lower lip.

Patients were followed up at the intervals of one week, two weeks and four weeks and were evaluated for any of the above complications. The data was analysed

using the statistical packages for social sciences (SPSS) versions 17.0.

**Surgical Techniques:** Preoperative Maxillomandibular fixation with arch bar and wires were used to reduce displaced fragments. The surgical procedure was done under aseptic condition under general anaesthesia and nasotracheal intubation.

Xylocaine with Adrenaline (2%) was used, Intra-oral incision was placed using cutting cautery over the oblique ridge from the distal aspect of the second molar and extending over the ascending ramus posteriorly about 1 cm superior to occlusal plane. Extra orally submandibular incision was ideally placed. Incision was made by No.15 Bard-Parker blade. Mucoperiosteal flap was elevated and the fractures it was exposed. Keeping the fracture ends in reduced position rigid fixation or semi rigid fixation was done.

In case of rigid fixation miniplates with 2 mm monocortical screws were inserted with archbar.

In case of semi-rigid fixation transosseous wire placed. Wound toileting was done and closed with 3-0 vicryl in layers. Reversal of anesthesia was done.

Postoperative IMF was applied as an addition to all patients to ensure maximum possible occlusion & stability. The use of post-surgical maxilla mandibular fixation (MMF) for 1 week (rigid-fixation cases) and 4 weeks (semi rigid-fixation cases). Prophylactic antibiotics along with mouth washes with povidone iodine was prescribed for at least seven days and as of diet was advised for a minimum of 2 weeks after IMF has been removed.

**Method of Statistical Analysis:** The collected data was entered in Microsoft Excel and Statistical analyses were done using the SPSS (version 17.0) software.

Univariate analysis of all the dichotomous variables encoded was performed by means of the Chi square test with Yates correction if required. A "p" value of less than 0.05 was accepted

## RESULTS

The study consists of 27 (90%) male and 3(10%) female in the age range from 20-40 years with mean age of 31.5±6.30 years. The total number of mandibular angle fracture observed in 20 to 29 years is 22(73%) 30 to 40 years 8(26.6%).

The age specific mandibular angle fracture in male was 83% (25 out of 30) in the age group of 20 to 29 years followed by 6.6% (2 out of 30) in the age group 30 to 40 years.

The age specific mandibular angle fracture in female was 6.6% (2 out of 30) in the age group of 20 to 29 years followed by 3.3% (1 out of 30) in the age group 30 to 40 years. The difference observed was not statistically significant ( $p > 0.05$ ). (Table-1).

Road traffic accident (66.6%) was found to be the most common cause of fracture over the other causes.

(Table-2)

Left side mandibular angle fractures were more common as compared to its contralateral side. Cross bite was present in all cases preoperatively.

Above tables show the different infection rates, malocclusion, malunion and sensory disturbances in rigid and semi rigid fixation. Maximum number of infections (20%) was seen in semi rigid fixation. 6.6 % of Malocclusion was seen in rigid fixation and 13.3 in semi rigid fixation, Malunion was seen in 6.6% semi rigid fixation. 6.6% rigid fixation cases, Sensory disturbances was observed in rigid fixation cases 13.3 and 6.6 % in semi rigid fixation cases. The results in both semi rigid and rigid fixation were not statistically significant. (Table-3)

**Table No.1: Age and gender distribution of the study population**

Age	Gender		Total
	Female	Male	
20-29	2(6.6)	25(83)	27
30-39	1 (3.3)	2(6.6)	3
Total	3(10)	27(90)	30

**Table No.2: Distribution of cause of fracture among the study population**

Cause	Number	Percent
Assault	5	16.6
RTA	20	66.6
Selffall	2	6.6
SI	3	10

**Table No.3: Distribution of type of complications observed according to type of fixation among the study population**

Type of fixation	N	Infection	Malocclusion	Malunion	Normal Union	Sensory disturbance
Rigid	15	1(6.6)	1(6.6)	1(6.6)	14(93)	2(13.3)
Semi Rigid	15	3(20)	2(13.3)	1(6.6)	14(93)	1(6.6)
P value		>0.05	>0.05	>0.05		>0.05

**DISCUSSION**

The history of the treatment and complications of facial bone fractures parallels the development of modern oral and maxillofacial surgery. We have moved from an era when our primary concern in bone healing was reduction and stabilization of fracture segments, while preserving maximal periosteal blood supply (closed reduction), to an era when precise reduction and stabilization can be achieved with semi rigid/ rigid fixation (open reduction) that overcomes functional loads and minimizes the postoperative complications.<sup>8</sup> The intra oral approach used in the present study is expected to expose the bone to a higher bacterial count than an extra oral approach and thereby

increasing the chances of infection.<sup>20,21</sup> Our study agrees with Sadiq, et al<sup>3</sup>, who said that extraoral approach has more chance to nerve damage. However, the selection of extraoral or intraoral approaches mainly depends upon the accessibility of the fracture location. In this study 80% of the cases intraoral approach was used and extra oral approach was favored only for when a traumatic laceration provided access to the fracture or when there was multiple fractures.

The longstanding concept that teeth in the line of fracture must be removed to prevent complications seems to be changing now, giving way to newer concept that such teeth can be preserved under the favourable conditions.<sup>19,22</sup>

Teeth in the fracture line may often be of great value in repositioning of fracture; moreover, the extraction of such teeth may cause further injury to the bone tissue and also often difficult to reduce anatomically when the fragments are highly mobile.<sup>23</sup>

The role of teeth in line of fracture in promoting post-surgical infections has been difficult to determine from previous studies. The present study also does not clear this critical issue because the results of patients treated with or without extractions were equal. Out of 30 cases, 5 cases had teeth in line of fracture of which 2 patients developed infection and in few cases teeth were removed secondarily when the infection was treated.

Cawood, et al<sup>29</sup> also recommended fixation from 12-24 hours after injury. However in this study 90% of the cases were treated within 5 days whereas the rest were treated later and the results showed no significant difference in the infection rates between the time groups.

This study revealed a significant difference in the incidence of infection between the two methods [6.6% (rigid) vs. 20% (semi rigid)]. Infection rates were seen to be higher with semi rigid fixation than in rigid fixation.

Our study agrees with the work done by Iizuka, et al<sup>13</sup> and AO/ASIF investigators according to them the post-operative infection is not only the result of contamination but can also be due to insufficient fractures ability as in the cases with semi rigid fixation<sup>18</sup>.

Iizuka and Lindquist<sup>10</sup> in their study also showed that post operative monitoring of C-reactive protein (CRP), a laboratory parameter of infection and tissue destruction was associated with larger increase in CRP level in the fixation of mandibular fractures with semi rigid fixation than rigid fixation.

According to Spiessl<sup>31</sup> to avoid asymmetric stress distribution over the fracture site, over bending of the plate and use of tension band is necessary which in turn reduces the rate of mal occlusion. The low rate of malocclusion in this study could be attributed to the ease which plates were adapted to the fracture sites.

In this study sensory disturbances were recorded according to patient's complaint. In this study there was no record of any involvement of the mandibular branch of the facial nerve as it has been reported<sup>25,26</sup>. The tests used in this study measures mainly mechanoreceptor. The present methods were chosen because they are simple and suitable for trauma patients. According to this study 13.3% of the patients had sensory disturbance persisting upto 6 weeks with rigid fixation. The results of present study indicate that preoperative sensory status corresponding to the presence of fractured is placement did not affect the degree of the post operative sensory disturbance, when adequate reduction and fixation is done. However, the sensory disturbance may also be affected by the surgical procedure.

The results of our study failed to agree with that of Nakamura et al<sup>17</sup>, who found in his study that miniplates used to treat fractures are plagued with a high complication rate.

Cawood<sup>49</sup> and Reton TF<sup>27</sup> have supported the rigid internal fixation as the treatment of choice. On the other hand Lamphier J<sup>32</sup>, Moulton BR<sup>28</sup> and Leach J<sup>29</sup> have found the traditional techniques superior to the newer techniques regarding post-operative complications. Balourian R<sup>30</sup> and Chritah A<sup>5</sup> used Mini plates + MMF for few days and found lesser complications. Our study found that rigid internal fixation is the treatment of choice of mandibular angle fracture.

Lastly, in this study only primary complications were analyzed where late complications can also occur. These may be associated with plate removal, osteomyelitis, nonunion, joint dysfunction, hypertrophic scar formation, prolonged sensory disturbances that in some cases might develop into posttraumatic neuralgia. Such developments may not be recognized unless long term follow up is undertaken.

## CONCLUSION

This study will help to develop a protocol for successfully managing these fractures in an indigent Population and patient will become active participant to the society.

### Author's Contribution:

Concept & Design of Study:	Muhammad Sibghatullah Khan
Drafting:	Saaduddin Siddiqui, Naveed Iqbal
Data Analysis:	Syed Kashif Abrar, Aqeel Aslam, Raheel Allana
Revisiting Critically:	Muhammad Sibghatullah Khan, Saaduddin Siddiqui
Final Approval of version:	Muhammad Sibghatullah Khan

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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