

# A COMPARATIVE STUDY OF TITANIUM VS STAINLESS STEEL MINIPLATE FIXATION IN THE MANAGEMENT OF MANDIBULAR ANTERIOR FRACTURE

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## Abstract

**Background:** The aim of study was to evaluate the biocompatibility of Titanium miniplates over stainless steel miniplates in mandibular anterior fracture.

**Materials and Method:** The present study was carried out in the Department of Oral & Maxillofacial Surgery Teerthanker Mahaveer Dental College and Research Centre, Moradabad. A total number of 20 patients with isolated mandibular fracture (single or multiple) without pre existing infection and comminution were selected. Patients were randomly divided into 2 equal groups of 10 patients each. Group A patients underwent osteosynthesis using Titanium miniplates while Group B patients underwent osteosynthesis using Stainless Steel miniplates. Fractures were treated under LA/GA. Pain (in Visual Analogue Scale score), swelling, infection, Wound dehiscence, hardware failure was measured postoperatively on 1<sup>st</sup> week, 1<sup>st</sup> month and 3 month 6 month.

**Results:** In this study we found that At 1 week interval, the mean pain score in Group A was  $5.7 \pm 0.674$  and in Group B it was  $6.30 \pm 0.674$ . At 6 months none of the patients in Group A and Group B had pain. At none of the time intervals, a statistically significant difference was observed between two groups ( $p > 0.05$ ). Infection was observed in only 2 (10%) patient in Group B. Statistically, there was no significant difference between two groups ( $p > 0.05$ ) at any time interval. Only 2 (10%) patient in Group B had hardware failure. Statistically, there was no significant difference between two groups at any time interval ( $p > 0.05$ ). At 1 week interval, the mean swelling score in Group A was  $15.02 \pm 1.36$  and in Group B it was  $17.4 \pm 1.05$  a statistically significant difference was observed between two groups ( $p < 0.05$ ). whereas on 1 month the mean swelling score in Group A was  $11.9 \pm 1.57$  as compared to  $13.8 \pm 1.38$  in Group B statistically significant difference was observed between two groups ( $p < 0.05$ ). From 3 month onwards the mean swelling score in Group A was  $10.1 \pm 0.87$  and in Group B it was  $11.29 \pm 1.75$ . No statistically significant difference was observed between two groups ( $p > 0.05$ ). At 6 months the mean swelling score in Group A was  $10.2 \pm 0.918$  and in Group B it was  $10.4 \pm 0.95$ . No statistically significant difference was observed between two groups ( $p > 0.05$ ).

**Conclusions:** In this study of short duration it is showed that the titanium miniplates were more biocompatible when compared to stainless steel miniplates as evident by rate of infection, pain, swelling, wound dehiscence and hardware failure. But there is no statistical significant difference found between titanium and stainless steel miniplates in treatment of mandibular anterior fracture.

**Key words:** Mandible fracture, Miniplate, Stainless steel, Titanium.

## Introduction

In the era of increasing auto mobilization, industrialization and technology, the treatment of maxillofacial injuries has attained a prominent position. Road traffic accidents, which are becoming more and more frequent, particularly have brought about an increase in maxillofacial injuries. The other causes of maxillofacial injuries are interpersonal violence, falls, sporting injury and industrial trauma.<sup>1</sup>

Mandibular fractures are more common than middle third fracture (anatomical factor).<sup>2</sup> The symphysis and parasymphysis are one of the most frequently fractured sites in the mandible after the angle and the condyle making up 18-20 % of the mandibular fractures in adults.<sup>2</sup> Forces applied to the mandible cause varying zones of tension and compression, depending on where the bite force is located. The superior portion of the mandible is designated as the tension zone and the inferior portion is designated as the compression zone.<sup>3</sup>

Surgical treatment of mandibular fractures has advanced significantly; semi rigid internal fixation and early return to function have replaced the use of wire osteosynthesis

and prolonged use of maxillomandibular fixation resist torsional forces<sup>4</sup> the technical advantages of (MMF). Champys described the ideal lines of the osteosynthesis on which plates have to be applied to miniplates are small size and easily adapted monocortically on bone. They provide functional stability since the system is biomechanically balanced. But one of the most significant drawbacks was the phenomenon of stress shielding atrophy of the bone under the rigid plate which makes the bone vulnerable to refracture once the plates were removed. Although gold, silver, copper and its alloys lead and aluminium and its alloys were tested. Stainless steel emerged through the era as the new corrosion resistant material. At about the same time or later on the other metals or alloy like titanium were introduced with claims of advantages over the classic stainless steel.<sup>5</sup>

Titanium was first used in 1940 was shown to be not only biocompatible but had a tendency for osteointegration and had excellent corrosion resistance. Titanium has proven its suitability as an implant material for the bone-

plates, because of its excellent biocompatibility and corrosion resistance. Titanium is a highly reactive metal, forms a dense, coherent passive oxide film TiO<sub>2</sub> which prevents the ingress of corrosion products into the surrounding tissues.<sup>6</sup> Biomechanically titanium has a high tensile strength and a low modulus of elasticity. The elastic moduli of titanium are approximately half that of stainless steels and therefore create less risk of stress protection of bone. It also had excellent ductility and totally nontoxic. These observations prompted a study, to compare the biocompatibility of titanium bone plates and screws with stainless steel bone plates and screws used in the treatment of mandibular anterior fracture.

**Inclusion criteria**

1. Patients were selected randomly irrespective of etiology, age, sex, and religion and socio economic status. (Table: 1,2,3)
2. Patient were selected on the basis of site and location of mandible fracture including, symphysis, parasymphysis region.
3. Patient who were willing participate in this study.

Etiology	Number of patients	Percentage
Road Traffic accident	11	55
Fall	3	15
Assault	3	15
Other	3	15
Total	20	100

Table 1: Showing the various etiological factors for maxillofacial trauma

Age	Frequency	(%)
18-25	8	40
26-35	10	50
36-45	0	0
46-55	1	5
56-65	1	5
Total	20	100

Table 2: Distribution of study subjects based on gender

Type of Fracture	No. of Patients	Percentage
Left Parasymphysis	6	30
Right Parasymphysis	12	60
Symphysis	02	10
Total	20	100

Table 3: Present table showing frequency distribution of fracture type

**Exclusion criteria**

1. Participants who did not meet the criteria were excluded.

2. Pregnant and lactating women were not included in the study.
3. Medical compromised patient.
4. Comminuted mandibular fracture.
5. Fractures others than specific sites.

**Materials and Method**

This prospective study was conducted on 20 trauma patients having mandibular anterior fracture without any systemic disease reported in the department of oral and maxillofacial surgery in Teerthanker Mahaveer Dental College Moradabad. Proper case history was taken. All clinical and radiological examinations were done to achieve the diagnosis of mandibular symphysis or Parasymphysis fracture (Figure 1).



Figure 1: Pre operative radiograph

Patient was advised for all haematological investigation. All patients were explained in detail about the surgical procedure and due consent was taken. 20 patients were randomly divided into two group of 10 patient's i.e Group A and Group B.

**Group A:** Group A patients were treated by titanium miniplates.

**Group B:** Group B patients were treated by stainless steel miniplates.

Regardless of the groups all the patients were operated either under local anaesthesia or general anaesthesia with nasotracheal intubation and stainless steel or Titanium Mini plates were placed in both respective groups. (Figure 2). And post operative radiograph were taken (Figure 3).



Figure 2: Stainless steel or Titanium miniplates



Figure 3: Post operative radiograph

## Observation and Results:

Comparison of study groups based on post-operative evaluation of malocclusion (Table 4), pain (Table 5), infection (Table 6), wound dehiscence and swelling (Table 7) was done using Independent T test;  $p \leq 0.05$  was considered to be statistically significant.

Occlusion arrangement	Preoperative		Postoperative	
	Group A	Group B	Group A	Group B
Deranged	20	20	0	0
Intact	0	0	20	20

Table 4: Comparison of preoperative and postoperative occlusion arrangement.

Follow up period	Group A (n=10)		Group B (n=10)		'p'
	Mean	SD	Mean	SD	
1 week	5.7	.674	6.3	1.52	0.062
1 month	0.20	0.421	0.40	0.51	0.355
3 month	0	0	0.1	0.31	0.343
6 month	0	0	0	0	0

Table 5: Comparison of pain (VAS scale) in group A & B

Time intervals	Group A (10=20)		Group B (n=10)		statistically significant difference	
	No. of patients with infection	%	No. of patients with infection	%	$\chi^2$	P
1 week	0	0	0	0	–	–
1 months	0	0	0	0	–	–
3 months	0	0	0	0	–	–
6 months	0	0	2	10	1.053	0.305

Table 6: Comparison of Infection in group A & B

Follow up period	Group A (n=10)		Group B (n=10)		'p'
	Mean	SD	Mean	SD	
1 week	15.2	1.36	17.4	1.05	0.000
1 month	11.9	1.57	13.87	1.38	0.008
3 month	10.1	.875	11.29	1.759	0.72
6 month	10.20	.918	10.4	.950	.607

Table 7: Comparison of swelling in group A & B

## Discussion

In the present study, it is seen titanium miniplates are effective in the treatment of mandibular fractures and overall complication rates are lesser as compared to Stainless steel miniplates although the difference is not statistically significant ( $p > 0.05$ ) Champy *et al.*<sup>7</sup> Cawood JI<sup>8</sup>, Ellis *et al.*<sup>9</sup> earlier used miniplates for the patient with mandibular fracture and found uneventful healing. The same finding was reported in our study. Intra-oral & extraoral approaches were used in all cases of monocortical plating (Champy *et al.*<sup>7</sup> A minimum of 2 screws, on each side of segment were used to prevent

rotational movement of fractured fragment which was in correlation with study of Champy.<sup>7</sup> None of the patients were placed into postsurgical maxilla mandibular fixation Edward Ellis<sup>9</sup> According to estimates of Association of Automobile Manufactures of India (AIAMI) the number of automobiles on road has grown more than tenfold during the last ten years (Source : AIAMI website). Apart from this our centre is also tertiary centre where patients come from as far as neighbouring states. In this study, road traffic accidents were found to be responsible for majority of the fractures i.e. 11 patients (55%), which also correlates with the study of Champy M *et al.*<sup>7</sup>, Ellis E<sup>9</sup>, Hussain S *et al.*<sup>10</sup>. In the present study the number of male patients was higher (80%) than the number of female patients (20%), which was in accordance with the study of Ellis *et al.*<sup>9</sup> Cawood JI<sup>8</sup> (1985). They demonstrated the high incidence of facial trauma in males. In our study mean age of patients was 30.4 years of group A & 26.4 years of group B and total mean age was 29 years. Similarly, mean age of the patients in other studies were in the same range like 28.6 years in the study of Ellis E III. In our study showed in symphysis/parasymphysis fracture (alone-40% or in combination with angle or condyle-60%) frequently fractured site, usually in conjunction with other site (30 patients). This is in accordance with various study like as Ellis E III, Hussain S *et al.* Boole JR *et al.*<sup>11</sup> stated, the symphysis is one of the most frequent sites of mandibular fractures in children, and comprises about 20% of adult mandibular fractures. Symphysis/parasymphysis fractures with displacement are often fixed with 1 or 2 miniplates. At 1 week interval, the mean pain score in Group A was  $5.7 \pm 0.674$  and in Group B it was  $6.30 \pm 0.674$  whereas on 1 month the mean pain score in Group A was  $0.20 \pm 0.42$  as compared to  $0.40 \pm 0.51$  in Group B. From 3 month onwards none of the patients in Group I had any pain whereas at 3 month the mean pain score in Group B was  $0.1 \pm 0.31$ . At 6 months none of the patients in both the groups had pain, however. At none of the time intervals, a statistically significant difference was observed between two groups ( $p > 0.05$ ). Infection was observed in only 2 (10%) patient in Group B at 3 months. Statistically, there was no significant difference between two groups ( $p > 0.05$ ) at any time interval.

Only 2 (10%) patient in Group B had hardware failure at 3 months interval. Statistically, there was no significant difference between two groups at any time interval ( $p > 0.05$ ) At 1 week interval, the mean swelling score in Group A was  $15.02 \pm 1.36$  and in Group B it was  $17.4 \pm 1.05$  a statistically significant difference was observed between two groups ( $p < 0.05$ ). whereas on 1 month the mean swelling score in Group A was  $11.9 \pm 1.57$  as compared to  $13.8 \pm 1.38$  in Group B statistically significant difference was observed between two groups ( $p < 0.05$ ). From 3 month onwards the mean swelling score in Group A was  $10.1 \pm 0.87$  and in Group B it was  $11.29 \pm 1.75$ . No statistically significant difference was observed between two groups ( $p > 0.05$ ). At 6 months the mean swelling score in Group A was  $10.2 \pm 0.918$  and in Group B

it was  $10.4 \pm 0.95$ . No statistically significant difference was observed between two groups ( $p > 0.05$ ). In Group A, no patient reported with infection at follow-up of 6 months. In Group B, two (10%) patient reported with infection follow up (3 months) who presented with extra oral sinus and pus discharge near the fracture site. Pus culture and sensitivity test was done and specific antibiotic therapy started. After antibiotic therapy improvement was seen and pus discharge stopped. Infection was because of loosening of screw. This may be attributed to the high speed drilling of bone leading to bone necrosis at the bone and screw interface and ultimately loosening of screw. It is stated that the friction between the screw head and plate is the main weak point of the entire fixation. (But there was no mobility at fracture site and fracture has been united, so plate was removed. This however did not affect our final result. Infection rate seen in our study (i.e. 10%) is in correlation with the infection rate reported in the studies of Champy - 3.8%, Cawood - 6%, Smith- 2.5%, TB, Bays RA - Our study does accordance with the study conducted by Ellis E<sup>9</sup>, Pilia D et al<sup>4</sup> and Hussain S.<sup>10</sup>. There were 2 patients in Group B with Hardware failure. Rehman AU et al study plate removal of 33.3% from the fracture osteosynthesis of mandible in the body region and 18.5% in parasymphiseal region. Over all complication rate in current study was low when compared with results of other cited studies. One has to keep in mind that results depends much more on the characteristics of the fracture, compliance of the patient, absence of systemic disease, postoperative care, and adherence to partial postoperative functional restrictions.

### Conclusion

The most common cause of mandibular fracture was found to be road traffic accident (55%). Patients in the 26-35 years of age were the predominant age group presenting with mandibular fracture (50%). Males were most commonly affected with mandibular fracture (60%). Parasymphysis (right and left) alone was the commonest site of fracture comprising of 30%+60% respectively followed by symphysis (10%). Swelling was seen in first week at 1<sup>st</sup> follow up in 6 (30%) patients of both Group A & Group B. Swelling subsided gradually in next follow-up in all patients. Infection was observed in only 2 (10%) patient in Group B at 3<sup>rd</sup> month follow-up because of loosening of screw. Pain decreases significantly at 1 week, 1 month and pain was absent after 6 month in both the groups. Hardware failure was observed in 2 (10%) patients in group B. Wound dehiscence was observed in 2 (10%) patients in group B. Titanium miniplate appears to be better than stainless steel miniplate for mandible fracture fixation.

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