

# Comparison of 3D Titanium Miniplate versus Conventional 2D Miniplate Fixation in the Management of Isolated Mandibular Angle Fractures

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## ABSTRACT

**Objective:** To compare 3D titanium miniplate versus conventional 2D miniplate fixation in the management of isolated mandibular angle fractures in the context of occlusion.

**Methodology:** It was a cross-sectional comparative study conducted in the Department of Oral & Maxillofacial Surgery, Sharif Medical City Hospital, Lahore from April to October 2020. After meeting the inclusion criteria, 90 patients were enrolled by convenient sampling technique. Patients were divided into two groups and each group included 45 patients. Patients in group A were treated with 3D miniplate placement on the lateral cortex following the principle of 3D fixation of Farmand and Dupoirieux whereas group B patients were treated with 2D conventional miniplate placed along Champy's line of ideal osteosynthesis. After the procedure, patients were admitted to the ward for three days. All patients were examined at 2<sup>nd</sup> postoperative month to assess posttreatment occlusion.

**Results:** Mean age of the patients was 34.04±12.19 years. Seventy seven (85.56%) patients were males, and 13(14.44%) patients were females. In the 3D plate group, occlusion was achieved in 38(84.4%) patients, and in the 2D plate group, the outcome was achieved in 29(64.4%) patients. A statistically significant difference (p-value=0.030) was found when posttreatment occlusion was compared in both groups at the 2<sup>nd</sup> postoperative month.

**Conclusion:** This study concluded that 3D titanium miniplate showed significantly better occlusion as compared to conventional 2D miniplate fixation in the management of isolated mandibular angle fractures.

**Keywords:** Mandible. Titanium miniplate. Conventional miniplate.

## INTRODUCTION

Mandibular fractures are ranked as second (23.3%) most common facial bone fractures after nasal bone fractures (58.7%).<sup>1</sup> Road traffic accidents, gunshots, sports, and falls are responsible for most of the mandibular fractures.<sup>2</sup> The goal of treatment is to restore the anatomical form and function, as well as to maintain stable fixation and pay specific attention to the reestablishment of occlusion.<sup>3</sup> Angle fracture is the most common kind of mandibular fracture (27-30%), followed by parasymphysis fracture (26.9%).<sup>1,4</sup> Mandibular angle fractures are prevalent and can be caused by several reasons, including thinner cross-sectional area, presence of 3<sup>rd</sup> molar, muscle forces, or the architecture of the rami abruptly shifting from horizontal to vertical.<sup>5</sup>

Mandibular angle fractures may be characterized as a fracture line beginning at the connection of the posterior boundary of the mandibular ramus and inferior border of the body of the mandible, generally in

the region of the 3<sup>rd</sup> molar.<sup>6</sup> The management of mandibular angle fractures needs diligent knowledge of the surgical framework, insertion of the muscle, related biomechanics of the forces at the angle, significance of occlusion, and presence of mandibular third molar in the line of fracture.<sup>7</sup>

In the past, many techniques, such as closed reduction with intermaxillary fixation, transosseous wires for open reduction, plate osteosynthesis with lag screws, and a straight line miniplate on the superior and inferior edge have been documented for the treatment of mandibular angle fractures.<sup>3,6</sup>

The most widely used method for angle fractures is a single miniplate (2D miniplate) applied on the superior border of the external oblique ridge according to Champy's principles.<sup>1</sup> Recently, concerns about the lack of three-dimensional stability with traditional single miniplate fixation of mandibular angle fractures have sparked controversy among surgeons, as mandibular angle fractures have a greater rate of occlusion disorders than other mandibular fractures, ranging from 0% to 32%.<sup>6</sup>

The three-dimensional titanium miniplates (3D miniplates) are a relatively new plating technique. It is imagined that such a single matrix miniplate may give the needed functional degree of fixing stability with little surgical time and a low complication rate. The shape of the 3D miniplate theoretically allows for a

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higher number of screws, while maintaining three-dimensional stability and resistance to torque shearing and bending forces while maintaining a low profile or malleability.<sup>8</sup>

No major work on 3D miniplates has been done in Pakistan. The goal of this study was to compare 3D miniplate fixation on the superior border of the external oblique ridge with normal 2D miniplate fixation in isolated mandibular angle fractures. However, there isn't as much definitive research on 3D miniplate fixation in the literature as there is on traditional 2D miniplate fixation.

## METHODOLOGY

A cross-sectional comparative study was conducted in the Oral & Maxillofacial Surgery Department, Sharif Medical City Hospital, Lahore from April to October 2020. It was carried out with approval from the ethical committee of the Institution (Letter No: SMDC/SMRC/80-18, 10-11-2018). Patients provided written informed consent. A total of 90 patients were included in this study by convenient sampling technique. Patients were further divided into two groups, each group included 45 patients. Adult males and females, aged 16 to 60 years with fracture line beginning at the area where the anterior border of the ramus meets the body of the mandible in the region of the third molar, were included in this study. These patients were diagnosed by using orthopantomogram (OPG) and posteroanterior (PA) views of the face. Patients with previously treated mandibular angle fractures, infected mandibular angle fractures, comminuted fractures, completely edentulous, and medically compromised patients were excluded from the study. Patients in group A were treated with 3D miniplates put on the lateral cortex using the Faramnd and Dupoiroeux approach of the 3D plating system. In group B, patients were treated with one 2D conventional miniplates placed along Champy's line of optimal osteosynthesis.

The treatment was carried out by a single surgical team. All patients were treated with the same surgical procedure using an intraoral incision. A temporary intraoperative maxillomandibular fixation was provided using eyelet wiring. The intermaxillary fixation was released once the fracture had been reduced and repaired. Patients were given Amoxicillin 1.2 g I/V BD & analgesics Diclofenac Sodium 75 mg I/M BD, instructions to follow a soft diet for five days, and maintain rigorous oral hygiene till the end of the study period. Patients were admitted to the ward for a maximum of three days, as they could take semi-solid food and could follow diet and medicine charts. All

patients were examined postoperatively at 2<sup>nd</sup> month to assess posttreatment occlusion. Occlusion was considered satisfactory with maximum intercuspation of teeth at 2<sup>nd</sup> postoperative month visit. Findings were recorded by the resident doctor on the proforma.

## STATISTICAL ANALYSIS

The data was analyzed in Statistical Package for the Social Sciences (SPSS) version 24. Age was presented as mean±SD. Qualitative variables like gender and occlusion were presented as percentage & frequency. Chi-square test was applied to compare occlusion at the 2<sup>nd</sup> month between 3D and 2D miniplates and data stratified for age & gender. A p-value ≤0.05 was considered significant.

## RESULTS

The mean age of the patients was 34.04±12.19 years. Seventy seven (85.56%) patients were males and 13(14.44%) patients were females. The male-to-female ratio was 6:1. In the 3D plate group, the mean age of the patients was 35.18±11.45 years whereas, in the 2D plate group, the mean age of the patients was 32.91±12.92 years. This difference was statistically insignificant (p-value=0.381). In the 3D plate group, 36(80%) patients were male whereas, in the 2D plate group 41(91%) patients were male. Similarly, in the 3D plate group, 9(20%) patients were female whereas, in the 2D plate group 4(9%) patients were female. Statistically insignificant difference was found when both groups were compared regarding genders (p-value=0.134).

After 2<sup>nd</sup> postoperative month, the outcome (occlusion) was achieved in 67(74.44%) patients. In the 3D plate group, the occlusion was achieved in 38(84.4%) patients whereas the outcome was not achieved in 7(15.6%). In patients treated with 2D miniplate, the occlusion was achieved in 29(64.4%) patients whereas, in 16(35.6%) patients, occlusion was not achieved. A statistically significant difference (p-value=0.030) was found when posttreatment occlusion was compared in both groups at the 2<sup>nd</sup> postoperative month (Figure 1).

In patients aged ≤30 years, in the 3D plate group, the outcome was achieved in 17(100%) patients while in the 2D plate group the outcome was achieved in 17(70.8%) patients (p-value=0.014). In patients >30 years of age, in the 3D plate group, the outcome was achieved in 21(75%) patients while in the 2D plate group, the outcome was achieved in 12(57.1%) patients (p-value=0.228) (Table 1).

## DISCUSSION

Mandibular fractures are the second most prevalent

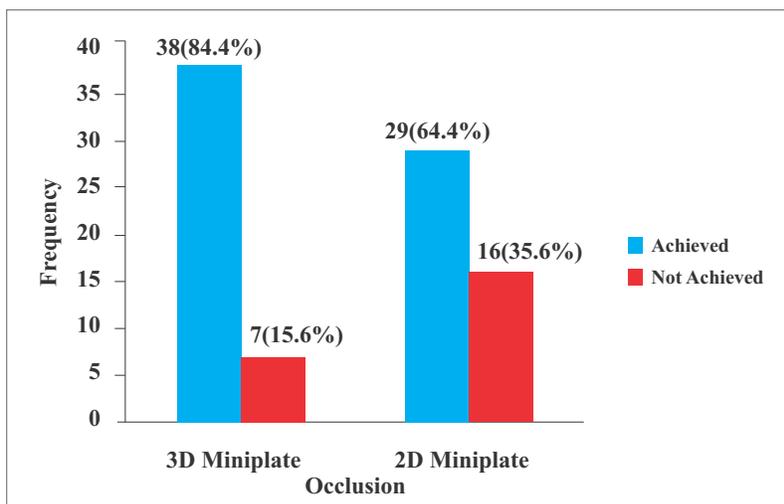


Figure 1: Frequency of Occlusion at 2<sup>nd</sup> Postoperative Month in Both Groups

Table 1: Comparison of Outcome after 2<sup>nd</sup> Postoperative Month between Study Groups Stratified by Demographic Data

Demographic Variables		Study Groups			
		3D Miniplate		2D Miniplate	
		Outcome		Outcome	
		Yes	No	Yes	No
Age Groups (Years)	≤30	17(100%)	0(0%)	17(70.8%)	7(29.2%)
	>30	21(75%)	7(25%)	12(57.1%)	9(42.9%)
p-value		0.014*		0.228	
Gender	Male	31(86.1%)	5(13.9%)	28(68.3%)	13(31.7%)
	Female	7(77.8%)	2(22.2%)	1(25%)	3(75%)
p-value		0.065		0.071	

\* Significant p-value

type of face fractures, accounting for 15.6-59% of all facial fractures.<sup>9</sup> Direct fixation using different methods of plate and screw osteosynthesis has gained popularity. Various plate and screw osteosynthesis have been introduced such as the association of osteosynthesis (AO) bicortical plating system, 2D miniplating system & screws, and 3D miniplating system.<sup>10</sup>

In this study, we compared the 2D miniplating system and screws with the 3D miniplating system in patients with mandibular angle fractures. Our results showed that occlusion was attained in 38(84.4%) patients in the 3D plate group and 29(64.4%) patients in the 2D plate group at the 2<sup>nd</sup> postoperative month. This difference was statistically with a p-value of 0.030.

Another study conducted at Cairo University

compared the outcome of 2D and 3D miniplates and it was noticed that the complication rate was comparable in both groups i.e. 30% in both groups.<sup>3</sup>

A prospective randomized control trial was conducted in India to compare the 3D miniplate with conventional miniplate fixation in the management of mandibular fractures. The trial included 50 patients and all the patients were followed-up postoperatively for 12 weeks. Patients were randomly divided into two groups. Group A was treated with 3D miniplate and group B with conventional miniplate. They concluded that no statistically significant difference was found between the two groups. According to the study, both 3D and conventional miniplate were equally effective for the treatment of mandibular fracture.<sup>11</sup>

The 3D plate has a distinctive design since it is made up

of two linear plates united by strengthening vertical struts. As a consequence, strut plates may give stronger resistance to gaps forming at the superior border owing to masticatory force.<sup>12</sup> However, as compared to traditional miniplates, the 3D plating process requires fewer plates and screws to hold the bone fragments together because just one 3D plate is required. As a result, it employs less foreign material, decreases operation time, and lowers overall treatment cost.<sup>13</sup>

In another study, the 3D miniplate achieved mean decreased occurrences of malocclusion (p-value=0.05) and hardware failure (p-value=0.05) as compared to the regular miniplate. The author concluded that the 3D miniplate outperforms the standard miniplate in terms of lowering the postoperative complication rates.<sup>14</sup>

According to Mittal et al., there was no statistically significant difference between 3D and 2D miniplate osteosynthesis of mandibular parasymphysis fractures. Three-dimensional miniplates outperformed two-dimensional miniplates in terms of cost, the convenience of operation, implant materials, and duration of the operation.<sup>15</sup>

In another study, 3-dimensional plates were used to treat mandibular symphysis, parasymphysis, and angle fractures. They reported that 3D plate gave 3-dimensional stability with minimal morbidity and infection rates.<sup>16</sup> Singh et al. reported that the 3D miniplates system is a reliable & effective treatment modality for mandibular angle fractures as compared to traditional 2D miniplates. Patients with 3D miniplates had reduced sensory deficit and more mouth opening.<sup>17</sup>

Another study conducted in 2019 showed that both the 2D and 3D plating were equally effective and no major difference in surgical outcomes was found between these two plates. They also concluded that 3D miniplate is more economical and less time taking in symphysis and parasymphysis fractures. However, it is difficult to place a 3D plate in angle fractures and fractures involving the mental nerve.<sup>18</sup>

### CONCLUSION

This study concluded that 3D titanium miniplate showed significantly better occlusion as compared to conventional 2D miniplate fixation in the management of isolated mandibular angle fractures.

### LIMITATIONS & RECOMMENDATIONS

It was a single-centered study with a follow-up of two months only. Surgical complications can occur after two months, so a multi-centered or randomized control trial with prolonged follow-up is required to validate the results of our study.

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