



# MANDIBULAR SYMPHYSIS FRACTURES; COMPARISON OF CONVENTIONAL MINI PLATES VERSUS 3D MINI PLATES IN THE FIXATION OF ISOLATED MANDIBULAR SYMPHYSIS FRACTURES IN ABBASI SHAHEED HOSPITAL KARACHI-- A CLINICAL STUDY

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**Article received on:**  
05/12/2017

**Accepted for publication:**  
25/03/2018

**Received after proof reading:**  
02/06/2018

**ABSTRACT... Introduction:** Mandible is one of the most commonly fractured bones in maxillofacial trauma. Mandibular symphysis is a common site of mandibular fractures. Compare to conventional miniplates, three dimensional plates were found more effective in terms of post operative occlusion, post operative mobility of reduced fractured segments and the degree of anatomic reduction. **Objectives:** Compare the conventional 2.0mm mini plates versus 3D mini plates in the fixation of isolated mandibular symphysis fractures. **Study Design:** Interventional study. **Setting:** Oral & Maxillofacial Surgery Department, Abbasi Shaheed Hospital Karachi. **Period:** Two years from 1<sup>st</sup> January 2013 to 2<sup>nd</sup> January 2015. **Material & Methods:** One hundred and fifty four patients were randomly selected and allocated into two groups. Group 'I' in which patients were treated with conventional mini plates and group 'II' where patients were treated with 3D mini plates. **Results:** Mean ( $\pm$ SD) age of patients was 29.53 ( $\pm$ 7.88) years. Among 154 patients in this study, majority (75.3%) of cases had age 20 - 35 years. Majority, 124 (81.2%) were males and 29 (18.8%) were females. In Group I, anatomic reduction at 3 month post-operative was observed in 30 (39%). In Group II (3D Plates) at 3 months post-operatively, ideal molar relationship was higher (89.6% Vs. 98.7%; p-value = 0.016), fracture mobility was lower (14.3% Vs. 2.6%; p-value = 0.009) and higher anatomic reduction. **Conclusion:** Three dimensional miniplates are more effective compared to conventional miniplates.

**Key words:** Maxillofacial Trauma, Mandibular Symphysis, 3D Plates, Conventional Plates.

**Article Citation:** Ali Z, Shakeel J, Furqan M. Mandibular symphysis fractures; comparison of conventional mini plates versus 3d mini plates in the fixation of isolated mandibular symphysis fractures in Abbasi Shaheed Hospital Karachi-- a clinical study. Professional Med J 2018; 25(6):815-822.  
DOI:10.29309/TPMJ/18.4561

## INTRODUCTION

Maxillofacial trauma is a common consequence of road traffic accidents followed by assaults, falls and sport injuries.<sup>1</sup> Mandible is one of the most commonly fractured bones in maxillofacial trauma<sup>2</sup> between the age range of 20 to 50 years, with a definite male predilection.<sup>3</sup> Parasymphysis, followed by symphysis, is the commonest site of mandibular fractures in South Asian population<sup>3</sup>, while in the West, angle is the commonest site of mandibular fracture.<sup>4-5</sup>

The treatment options for the reduction and fixation of mandibular symphysis fractures has evolved significantly over the past few years.<sup>1</sup> The trends have changed from the methods of closed reduction and external fixation to the methods of open reduction and internal fixation.<sup>1</sup> Open reduction and internal fixation has the advantage

of early restoration to normal masticatory function, without the need for inter maxillary fixation. Even in the techniques for open reduction and internal fixation, there has been a transformation in the trends from rigid fixation in 1968 to semi rigid fixation in 1973.<sup>4</sup> Semi rigid fixation is achieved by conventional mini plates and 3D mini plates.

Conventional mini plates for the fixation of mandibular fractures were introduced in 1973.<sup>6</sup> The drawback of fixation via conventional mini plates is a doubt that whether this fixation is sufficiently stable for fractures that cannot be adequately reduced.<sup>1</sup> The shortcomings of conventional mini plates led to the development of 3D plates by Farmand Mostafa and Dupoirieux in 1992.<sup>7</sup>

3D plates are based on the principle of quadrangle

as a geometrically stable configuration for support.<sup>1</sup> 3D plates have definite advantages over conventional mini plates. It uses fewer plates and screws to stabilize the bone fragments, therefore, it uses lesser bulk of material, reduces the operation time as it is easily adaptable because of its thin vertical struts, and reduces the overall cost of treatment, due to the lesser number of plates and screws required, as described by Zix et al<sup>8</sup> and Farmand.<sup>7</sup> The screws adapt each part of the 3D plate separately without any tension to the bone.<sup>1</sup> There is no need for exact adaptation of the plates as is necessary with the thicker plates.<sup>1</sup> Moreover its compact design is easy to use. The large free areas between the plate arms and minimal dissection permit good blood supply to bone.<sup>3</sup> Despite of all the advantages, there were some crucial drawbacks of 3D plating system; extra implant material being incorporated in patients body in the form of vertical struts and the difficult adaptability of 3D plates to oblique fracture lines and to fracture lines passing through the mental foramen.

Previous available studies have reported better outcomes for 3D mini plates in the fixation of mandibular fractures, when compared with conventional mini plates.<sup>3,9</sup> It has been reported that, post operatively, ideal molar relationships were achieved in 90% cases treated with 3D mini plates in comparison to 70% cases treated with conventional mini plates.<sup>3</sup> Similarly, 60% of

cases treated with 3D mini plates had a precise anatomic reduction in comparison to 40% cases treated with conventional mini plates.<sup>9</sup> There was no mobility of fractured segments reported in both the plating systems used.<sup>3</sup>

The rationale of this study was to compare the two different plating systems so that there can be a suitable alternative of conventional mini plates for the fixation of isolated mandibular symphysis fractures. The evidence from the literature review suggests a better outcome of 3D mini plates for the fixation of isolated mandibular symphysis fractures in terms of post operative occlusion, post operative mobility of reduced fractured segments and the extent of anatomic reduction.<sup>3,9</sup>

In our local population, conventional mini plates have been used successfully for the open reduction and internal fixation of mandibular fractures. Since the world has now moved on to an alternative of conventional mini plates for the open reduction and internal fixation of mandibular fractures with better outcomes at a lower cost of treatment, we need to follow the same path in this regard. Unfortunately till today, no research data is available on the fixation of isolated mandibular symphysis fractures with 3D mini plates, in our local population. Considering the fact that there was no local data available and previous studies conducted have limited sample size the randomised controlled clinical trial was conducted to compare the outcomes for both the plating systems (conventional and three dimensional miniplates), so that a better treatment modality will be established and provide evidence based guidelines to clinicians for the fixation of isolated mandibular symphysis fractures.

## MATERIAL AND METHODS

This study was conducted in the Oral and Maxillofacial Surgery Department of Abbasi Shaheed Hospital, Karachi from 1<sup>st</sup> January 2013 to 2<sup>nd</sup> January 2015. Total 154 Patients were selected and they are divided randomly into group I and Group II. Gp I consisted of 77 patients were treated with conventional miniplates and Gp II that also consisted of 77 patients were treated with 3D mini plates. Considering the inclusion criteria, only isolated symphysis fractures within two weeks of trauma were included while edentulous and severe medically compromised patients were excluded from this study. Informed consent was obtained from all study subjects. All patients were treated by single researcher (Dr zahid Ali) with same plating system manufacturers; "leforte plating systems".

## Data Analysis

All the data from the proforma was entered and analyzed in the SPSS version 21. The descriptive statistics like age were presented in the form of mean + standard deviation. Frequency and percentage were calculated for gender. Chi square test was applied to determine statistical difference in both groups (Conventional miniplates vs. 3D

plates) regarding outcomes (Occlusion, Mobility of fracture segments, and Anatomic reduction or approximation) on the 1st post operative day and then at the end of 3 months. Data was stratified for age and gender to address the effect modifiers. Post-stratification chi square test was applied at the end of 3 months data. P-value < 0.05 was considered as significant.

**RESULTS**

Seventy seven patients were allocated to Group I, and similar number of patients to Group II. GP-I, were treated with conventional mini plates and in Gp-II patients were treated with 3D mini plates. The age range of patients was between 21 to 49 years with overall mean (±SD) age of patients was 29.53 (± 7.88) years. Majority (75.3%) of cases had age 20 - 35 years {59 (76.6%) in group I and 57 (74%) in group II}. Out of 154 patients 125 (81.2%) were males and 29 (18.8%) were females (Graph 2). Overall male to female ratio was 4.31: 1. The outcome variables (ideal molar relationship, fracture mobility and anatomic reduction) at 1st post operative day were observed in 127 (82.5%), 23 (14.9%) and 47 (30.5%) patients. In Group I, ideal molar relationship at 1st post operative day was observed in 62 (80.5%) while in Group II, ideal molar relationship at 1st post operative day was observed in 65 (84.4%) [Table-I]. In Group I, fracture mobility at 1st post operative day was observed in 13 (16.9%) while in Group II, fracture mobility at 1st post operative day was observed in 10 (13%) [Table-II]. In Group I, anatomic reduction at 1st post operative day was observed in 26 (33.3%) while in Group II, anatomic reduction

at 1st post operative day was observed in 21 (27.3%) [Table-III].

Ideal molar relationship, fracture mobility and anatomical reduction were observed during 1<sup>st</sup> week, 4th week and 12<sup>th</sup> week consecutively.

The ideal molar relationship at 3 month post-operative was observed in 145 (94.2%) patients. In Group I, ideal molar relationship at 3 month post-operative was observed in 69 (89.6%) while in Group II, ideal molar relationship at 3 month post-operative was observed in 76 (98.7%) [Table-IV].

The fracture mobility at 3 month post-operative was observed in 13 (8.4%) patients In Group I, fracture mobility at 3 month post-operative was observed in 11 (14.3%) while in Group II, fracture mobility at 3 month post-operative was observed in 2 (2.6%) [Table-V].

The anatomic reduction at 3 month post-operative was observed in 86 (55.8%) patients. In Group I, anatomic reduction at 3 month post-operative was observed in 30 (39%) while in Group II, anatomic reduction at 3 month post-operative was observed in 56 (72.7%) [Table-VI].

In Group II (3D Plates) at 3 months post-operatively, ideal molar relationship was higher (89.6% Vs. 98.7%; p-value = 0.016), fracture mobility was lower (14.3% Vs. 2.6%; p-value = 0.009) and higher anatomic reduction (39% Vs. 72.7%; p-value = 0.001).

Ideal Molar Relationship on 1st Post Operative Day	Group I (Conventional Miniplates) (n = 77)	Group II (3D Miniplates) (n = 77)	P-value
	n (%)	n (%)	
Yes	62 (80.5)	65 (84.4)	0.525
No	15 (19.5)	12 (15.6)	

**Table-I. Ideal molar relationship on 1st post operative day (N = 154)**

Fracture Mobility on 1st Post Operative Day	Group I (Conventional Miniplates) (n = 77)	Group II (3D Miniplates) (n = 77)	P-value
	n (%)	n (%)	
Yes	13 (16.9)	10 (13)	0.498
No	64 (83.1)	67 (87)	

**Table-II. Fracture mobility on 1st post operative day (N = 154)**

Anatomic Reduction on 1st Post Operative Day	Group I (Conventional Miniplates) (n = 77)	Group II (3D Miniplates) (n = 77)	P-value
	n (%)	n (%)	0.382
Yes	26 (33.8)	21 (27.3)	
No	51 (66.2)	56 (72.7)	

Table-III. Anatomic reduction on 1st post operative day (n = 154)

Ideal Molar Relationship on 3 Month Post Operatively	Group I (Conventional Miniplates) (n = 77)	Group II (3D Miniplates) (n = 77)	P-value
	n (%)	n (%)	0.016
Yes	69 (89.6)	76 (98.7)	
No	8 (10.4)	1 (1.3)	

Table-IV. Ideal molar relationship on 3 month post operative (n = 154)

Fracture Mobility on 3 Month Post Operatively	Group I (Conventional Miniplates) (n = 77)	Group II (3D Miniplates) (n = 77)	P-value
	n (%)	n (%)	0.009
Yes	11 (14.3)	2 (2.6)	
No	66 (85.7)	75 (97.4)	

Table-V. Fracture mobility on 3 month post operative (n = 154)

Anatomic Reduction on 3 Month Post Operatively	Group I (Conventional Miniplates) (n = 77)	Group II (3D Miniplates) (n = 77)	P-value
	n (%)	n (%)	0.001
Yes	30 (39)	56 (72.7)	
No	47 (61)	21 (27.3)	

Table-VI. Anatomic reduction on 3 month post operative (n = 154)

**DISCUSSION**

In this study, the three dimensional (3D) mini plates for the fixation of isolated mandibular symphysis fractures were effective in terms of post operative occlusion, post operative mobility of reduced fractured segments and the extent of anatomic reduction.

The results of the present study reported that in Group II (3D Plates) at 3 months post-operatively, ideal molar relationship was higher (89.6% Vs. 98.7%; p-value = 0.016). Similarly, fracture mobility was higher in Group I (14.3% Vs. 2.6%; p-value = 0.009). Finally, anatomic reduction at 3 month post-operatively was higher in Group II (39% Vs. 72.7%; p-value = 0.001). The findings were found consistent with the previous clinical studies. Previous available studies have reported better outcomes for 3D mini plates in the fixation of mandibular fractures, when compared with

conventional mini plates.<sup>3,9</sup> It has been reported that, post operatively, ideal molar relationships were achieved in 90% cases treated with 3D mini plates in comparison to 70% cases treated with conventional mini plates.<sup>3</sup> Similarly, 60% of cases treated with 3D mini plates had a precise anatomic reduction in comparison to 40% cases treated with conventional mini plates.<sup>3</sup> There was no mobility of fractured segments reported in both the plating systems used.<sup>3</sup>

The meta-analysis that compared the 3D plate with the standard 2-miniplate technique at varying follow-up periods found no statistically significant differences regarding infection, malocclusion, wound dehiscence, nonunion or malunion, hardware failure, and paresthesia. The cumulative analysis showed that there were advantages of the 3D miniplate over the standard 2-miniplates technique in the fixation of fractures but this

advantage did not reach statistical significance (OR = 0.94; 95% CI, 0.47 to 1.87; P = .86).<sup>10</sup> Another study comparing conventional miniplates with 3D plates reported that preoperatively all patients of Group I and Group II had mobility of fracture fragment. In their study, it was observed that two cases (20%) out of 10 cases of group I had mobility after conventional mini-plate osteosynthesis at 2 weeks postoperative this mobility decreased over a period of one month postoperatively.<sup>10</sup> In Group II, one of ten patients had mobility at 2 weeks postoperative. By the end of the 3rd month postoperatively none of the patients in both groups showed any mobility in fractured segments.<sup>10</sup>

The findings of another Clinical trial reported that out of 14 patients treated by conventional 2-mm miniplates, 2 patients developed occlusal discrepancy, another 2 had postoperative mobility at fracture site, and 1 developed plate failure and subsequent infection, which was treated by removal of the plate under antibiotic coverage.<sup>11</sup> One patient treated by 3-dimensional plates had tooth damage. The results of this study suggested that the treatment of mandibular fractures (symphysis, parasymphysis, and angle) with 3-dimensional plates provided 3-dimensional stability and carried low morbidity and infection rates.<sup>11</sup> The results of this study suggest that fixation of anterior mandibular fractures with 3D plates provides three dimensional stability and carries low morbidity and infection rates.<sup>11</sup> Thus, three dimensional miniplates are more effective compared to conventional miniplates. The 3D miniplates system is a better and easier method for fixation of mandibular fractures, compared with the conventional miniplates.<sup>11</sup>

Another recent retrospective study concluded that the 3D miniplate is superior to the standard miniplate on the reduction of postoperative complication rates for the management of MFs. More holes in the 3D miniplate might contribute to a successful treatment.<sup>12</sup>

Another metaanalysis was conducted last year.<sup>13</sup> The results showed no significant differences in overall complications (odds ratio [OR], 0.92; 95%

confidence interval [CI], 0.552-1.542; P = 0.81), postoperative infections (OR, 0.99; 95% CI, 0.40-2.48; P = 0.89), wound dehiscence (OR, 0.96; 95% CI, 0.13-7.37; P = 0.96), paresthesia (OR, 0.47; 95% CI, 0.20-1.07; P = 0.11), or malocclusion (OR, 1.8; 95% CI, 0.39-8.32; P = 0.47) between standard miniplates and 3-dimensional miniplates for treating mandibular fractures.<sup>13</sup> Mandibular fractures treated with 3-dimensional miniplates and standard miniplates presented similar short-term complication rates, and the low postoperative maxillomandibular fixation rate of using standard miniplates also indicated that the standard miniplate has a promising application in the treatment of mandibular fractures.<sup>13</sup>

Our results were also consistent with a recent metanalysis. The aims of the this study were to 1) evaluate clinical outcomes between standard and three-dimensional (3D) miniplate fixation in the management of mandibular fractures and 2) determine which fixation method is the best option for the treatment of mandibular fractures.<sup>14</sup> The results of this meta-analysis showed that the use of 3D miniplates was superior to the two-miniplate technique in reducing the incidence of postoperative complications in the management of mandibular fractures.<sup>14</sup>

Aim of another research was to study the effectiveness of 2 mm three-dimensional (3D) titanium miniplates and 2 mm conventional titanium miniplates in osteosynthesis of mandibular fractures by comparing the change in bite force. Bite force recordings showed increasing values at subsequent follow-ups, corresponding to the healing of the fracture in both groups.<sup>15</sup> At follow-up III (6 weeks) and IV (8 weeks), bite force values reached near to those in healthy individuals. A significant difference was observed in change in bite force of Group A and Group B at incisor left molar and right molar on subsequent followups.<sup>15</sup> 3D titanium miniplate requires less surgical exposure of the underlying fracture site, with a minimal traction of the surrounding soft tissue. 3D miniplates in mandibular fractures are efficacious enough to bear masticatory loads during the osteosynthesis of fractures. It gives the advantage of greater stability, increased bite

force, reduced implant material, and 3D stability.<sup>15</sup>

A simple nonrandomized and observational study was conducted to evaluate the efficacy of single three-dimensional (3D) plate for the treatment of mandibular angle fractures without maxillomandibular fixation.<sup>16</sup> A total of 30 patients with noncomminuted fractures of mandibular angle requiring open reduction and internal fixation were included in the study. 3D plating system is an easy to use alternative to conventional miniplates to treat mandibular angle fractures that uses lesser foreign material, thus reducing the operative time and overall cost of the treatment. Better fracture stability and occlusion was also achieved using the 3D plating system.<sup>16</sup>

Mithal et al conducted a study and concluded the results which were also consistent with our present study.<sup>17</sup> 3D miniplates were found to be better than 2D miniplates in terms of cost, ease of surgery and operative time. However, 3D miniplates were unfavorable for cases where fracture line was oblique and in close proximity to mental foramen, where they were difficult to adapt and more chances for tooth-root damage and inadvertent injury to the mental nerve due to traction.<sup>17</sup>

The results of another study suggest that fixation of anterior mandibular fractures with 3D plates provides three dimensional stability and carries low morbidity and infection rates.<sup>18</sup> The only probable limitation of these 3D plates may be excessive implant material, but they seem to be easy alternative to Champy's miniplate.<sup>18</sup> This study was done in 40 patients with anterior mandibular fractures. Group I consisting of 20 patients in whom 3D plates were used for fixation while in Group II consisting of other 20 patients, 4 holes straight plates were used. The efficacy of 3D miniplate over Champy's miniplate was evaluated in terms of operating time, average pain, post operative infection, occlusion, wound dehiscence, post operative mobility and neurological deficit.<sup>18</sup>

Another study constituted a comparative assessment of the mechanical resistance of square

and rectangular 2.0-mm system 30 dimensional-miniplates as compared to the standard configuration using two straight miniplates. 90 polyurethane replica mandibles were used for the mechanical trials.<sup>19</sup> Groups 1, 2, and 3 simulated complete symphyseal fractures characterized by linear separation of the central incisors; groups 4, 5, and 6 simulated parasymphyseal fractures with an oblique configuration. Groups 1 and 4 represented the standard method with two straight miniplates set parallel to one another.<sup>19</sup> Square miniplates were used in groups 2 and 5, and rectangular miniplates in groups 3 and 6. A universal testing machine set to a velocity of 10mm/min and delivering a vertical linear load to the first left molar was used to test each group. Maximum load values and load values with pre-established dislocation of 5mm were obtained and submitted to statistical analysis using a calculated reliability interval of 95%. The mechanical performances of the devices were similar, except in the case of rectangular plates used in the parasymphyseal fractures. The innovative fixation methods used showed significantly better results in the case of symphyseal fractures.<sup>19</sup>

A prospective study was conducted on 40 patients.<sup>20</sup> It was seen that 3-D titanium miniplates were effective in the treatment of mandibular fractures and overall complication rates were lesser. In symphysis and parasymphysis regions, 3-D plating system uses lesser foreign material than the conventional miniplates using Champy's principle.<sup>20</sup>

## LIMITATIONS

Of our study were that the patients couldn't be followed up after 3 months, due to lack of patient's compliance and facilities in government hospitals. Secondly the 3D plates couldn't have been used in the area of mental foramen and oblique fractures. Poverty was a major governing factor in treatment planning since many patients preferred intermaxillary fixation for treatment of mandibular fractures due to financial restraints. There was no data available on the same topic for our local population, which could have been a source of guidance while conducting the research on local population.

## CONCLUSION

1. 3D miniplates are more effective compared to conventional miniplates.
2. The 3D miniplate system is a better and easier method for fixation of mandibular fractures, compared with the conventional miniplates.
3. The study generated evidence that the 3D plates are more effective compared to conventional for the fixation of isolated mandibular symphysis fractures. Thus, 3D plates should be preferred over conventional miniplates for the treatment of mandibular symphysis fracture. This will produce improved outcomes in terms of ideal molar relationship, decrease fracture mobility and anatomic reduction.

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*A man who asks a question is a fool for a minute.  
The man who does not ask, is a fool for life.*

– Confucius – ”

**AUTHORSHIP AND CONTRIBUTION DECLARATION**

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