

Management Of Anterior Mandibular Fractures Using Two Different Fixation Methods

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ABSTRACT

INTRODUCTION : The aim of this study was to compare Farmands 3-dimensional (3D) miniplate and Champy's 2-dimensional miniplate fixation in the management of anterior mandibular fractures, to assess the treatment outcomes of two different plating systems and to analyze advantages and disadvantages of one over the other.

PATIENTS AND METHODS : 20 patients with clinico-radiographically confirmed anterior mandibular fractures were randomly assigned to receive 3D miniplate or 2D miniplate. Patients were followed for 2 months and parameters evaluated were, duration of operation from incision to closure, pain, swelling, wound healing, infection, segmental mobility, loosening of plate and screw, exposure of plate, post-operative occlusion, lingual splay, radiographic evaluation of reduction and fixation.

RESULTS : 10 patients in each group were treated by 3D miniplate (Group I) and 2D miniplates (Group II). Comparatively less time required for Group I with statistically significant difference (p value 0.000). There was no case of statistically significant post-operative complication. But in present study results were favourable for Group I. The 3D plate was found to be standard in profile, strong yet malleable, good stability and require significantly shorter operative time.

CONCLUSION : Extrapolating to the clinical situation, we would observe that 3D miniplate fixations with four screws, as tested in the study in mandibular anterior fractures, would probably function adequately in stabilizing such fractures, considering that they presented a good mechanical performance and viable option for fixation of mandibular anterior fractures routinely.

Keywords: 3-dimensional miniplate, Champy's miniplate, Anterior Mandibular Fracture.

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INTRODUCTION

Maxillofacial trauma is very common unforeseen events and the unique position of the mandible on the face makes it vulnerable. It is therefore, one of the most commonly fractured facial bones[1,2].

Fractures of the mandible cause both functional disabilities and social as well as cosmetic morbidities[3]. The aim of mandibular fracture treatment is the restoration of anatomical form and function, with particular care to establish the occlusion and allowing immediate return to the function[4,5]. When selecting a fixation scheme for a fracture, one has to consider many things such as size, number of fixation devices, their location, ease of adaptation and fixation, biomechanical stability, surgical approach, and amount of soft tissue disruption necessary to expose the fracture and place the fixation devices[6,7].

Champy revolutionized intraoral fixation by innovating and modifying the Michelet et al.'s [8] technique of osteosynthesis. It consisted of mono-cortical, juxta alveolar, and subapical osteosynthesis without compression and intermaxillary fixation using miniaturized malleable plates. Small size of the plate, easy adaptability, easy placement, and use of intraoral approach led to increased use of mono-cortical plates in maxillofacial surgery. Mostafa Farmand (1993)[9] introduced new 3D plating system. The shape of 3D plate is based on the principle of the quadrangle as a geometrically stable configuration for support. Because 3D stability is achieved by the geometric shape that forms a cuboid, compared with standard miniplates and reconstruction plates, the thickness of these plates is reduced to 1 mm. The basic form is a quadrangular 2-by-2 hole plate with square or rectangular segments; 3-by-2 or 4-by-2 hole plates are also available. The plates are adapted to the bone according to Champy's principles and are secured with monocortical self-cutting screws[4,10,11,12].

The newly introduced 3-D plating system provides definite advantages over conventional miniplates. The 3-D plating system uses fewer plates and screws as compared to conventional miniplates to stabilize the bone fragments. In case of conventional miniplates, two plates are recommended in symphysis and parasymphysis region, while only one 3-D plate is necessary for the same. Thus, it uses lesser foreign material, and reduces the operation time and overall cost of the treatment[7,13,14,15,16].

The purpose of present study was to compare 3-dimensional

(3D) plates and standard (Champy's) miniplate fixation in the management of mandibular symphysis and parasymphysis fractures, assessing the treatment outcomes of two different plating systems and to analyze advantages and disadvantages of one over the other.

MATERIALS AND METHODS

Total 20 patients with clinico-radiographically confirmed symphyseal / parasymphyseal (Anterior Mandibular) fracture of mandible reported to the Department of Oral and Maxillofacial Surgery, at VYWS Dental college & Hospital, Amravati (Maharashtra) who were dentulous, with no contraindications to the drugs or anesthetics used in surgical protocol, between 20-50 years of age and patients who were willing to participate in the study and come for follow up were included in the study. Ethical and research committee approval was obtained. Patients with comminuted fracture, pathology of mandible, medically compromised, edentulism were excluded. All patients underwent routine blood investigations, orthopantomogram and standard mandibular occlusal view. A pre-structured proforma was used to collect relevant information like parameters, investigations and pre and post-operative drugs given to individual patient.

The patients were randomly divided into Group I and Group II. Subjects of the two groups underwent ORIF under general anaesthesia. Surgical approach was either through existing laceration, extra-oral (Submental) or Intra-oral vestibular approach. After obtaining general anesthesia, Surgical site was infiltrated with local anesthetic solution containing 2% Lignocaine with adrenaline (1:2,00,000). Fracture site was exposed, reduction of fractured segments and Maxillo-mandibular fixation was accomplished with wires to achieve occlusion. In Group I fixation of 2mm stainless steel 4-hole rectangular 3 dimensional miniplate was done with 2 X 8 mm stainless steel screw in such a way that a horizontal bar is perpendicular and vertical bar is parallel to the fracture line and upper bar was placed in the subapical position. To treat fractures near the mental foramen involving the mental nerve, the plate was placed above the nerve and, to avoid injury to the dental root, holes are drilled monocortically, directing them into the space between the roots. In Group II fixation of 2mm stainless steel 4-hole with gap Champy's miniplate was done with 2 X 8 mm stainless steel screw in such a way that one plate at sub-apical position and one plate at inferior border of mandible. Once adequate fixation was achieved the area was irrigated with betadine and saline, MMF was released. After adequate haemostasis the wound was closed in layers with vicryl (3-0) and skin was closed with prolene (4-0) suture and extra-oral pressure dressing was given. Duration of procedure was noted. Patients were followed for the period of 7 days at the interval of operative, 2nd, 4th and 7th day for pain and swelling and for 2 months at the interval of 1st, 4th and 8th week and evaluated by blinded senior oral surgeon for wound healing, infection, segmental mobility, loosening of plate and screw, exposure of plate, post-operative occlusion, lingual splay, radiographic evaluation of reduction and fixation. Chi square Test, Mann Whitney U test and Kruskal-Wallis test were used for the statistical analysis of the results.

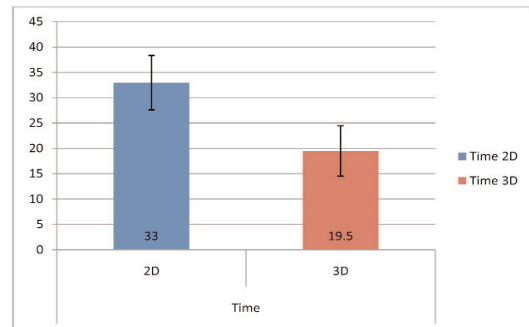
RESULTS

Present study consisted of a sample size of 20 patients with anterior mandibular fracture. Road traffic accident was the most common mechanism of injury. Parasymphysis was the most fre-

Table 1: Comparison of time required for surgery among patients treated by 3D & Champy's miniplate

Time	n	Mean	Std. Deviation	Std. Error Mean	t	p value
2D	10	33.0000	5.37484	1.69967	5.831	0.000*
3D	10	19.5000	4.97214	1.57233		

- unpaired t test (p<0.000).



quent site of fracture. The mean operation time from incision to wound closure was 19.5 minutes (range 15 min to 30 min) for group I and 33 minutes (range 25 min to 40 min) for group II. Standard deviation was 4.97 minutes for group I and 5.37 minutes for group II. The difference was found to be statistically significant (p value 0.000)[Table 1].

Pain was recorded based on the visual analogue scale for patients post operatively on operative day, 2nd day, 4th day and 7th day at parasymphysis and symphysis region of the mandible.

Table 2: Comparison of pain in patients treated by 3D & Champy's miniplate

	Type	n	Mean Rank	U	p value
Opt. day	2D	10	11.00	45.000	0.676
	3D	10	10.00		
2 nd	2D	10	11.75	37.5000	0.282
	3D	10	9.25		
4 th	2D	10	11.00	45.000	0.317
	3D	10	10.00		
7 th	2D	10	11.00	45.000	0.542
	3D	10	10.00		

- Mann Whitney U test in Opt day (p=0.676), 2nd day (p=0.282), 4th day (0.317) and 7th day (p=0.542).

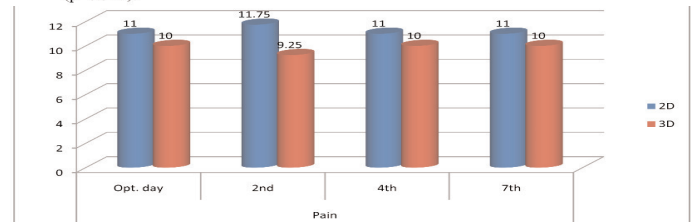
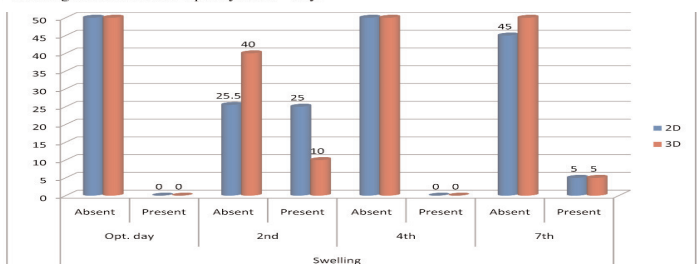


Table 3: Comparison of Swelling in patients treated by 3D & Champy's miniplate

Swelling	Opt. day		2 nd		4 th		7 th	
	Absent	Present	Absent	Present	Absent	Present	Absent	Present
2D	10	50.0	0	0.0	5	25.5	5	25.0
3D	10	50.0	0	0.0	8	40.0	2	10.0
χ^2	-		1.978		-		1.053	
p value	-		0.160		-		0.305	

Chi square test in 2nd day (p=0.282) and 7th day (p=0.542). No statistics are computed, because swelling is a constant in Opt day and 4th day.

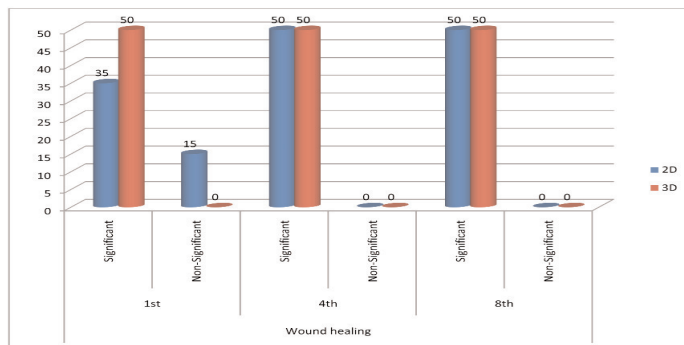


There was statistically significant decrease in pain on progressive follow-ups in group I (p value 0.017) and in group II (p value 0.013). Pain was severe on 2nd post-operative day in group II patients and minimum on 4th post-operative day in both the group. Pain was lesser in group I but there was no statistically difference between group I and group II [Table 2]. There was decrease in swelling on progressive follow-ups from operative day to 7th post-operative day. No patient had swelling on operative day in both the group. Although there was reduced amount of swelling in group I patients but no statistically significant differ-

Table 4 : Comparison of wound healing in patients treated by 3D & Champy's miniplate

Wound healing	1 st				4 th				8 th			
	Significant		Non-Significant		Significant		Non-Significant		Significant		Non-Significant	
	n	%	n	%	n	%	n	%	n	%	n	%
2D	7	35.0	3	15.0	10	50.0	0	0.0	10	50.0	0	0.0
3D	10	50.0	0	0.0	10	50.0	0	0.0	10	50.0	0	0.0
χ^2	3.529				-				-			
p value	0.060				-				-			

Chi square test in 1st day (p=0.060). No statistics are computed, because wound healing is a constant in 4th day and 8th day.



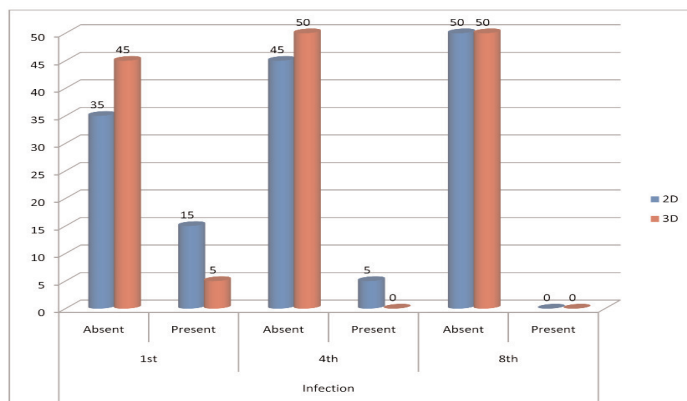
ence between group I and group II [Table 3].

Satisfactory wound healing seen in all the patients of group I on 1st, 4th and 8th week. Wound healing was not satisfactory in 3 patients on 1st week follow-up but on 4th and 8th week all patient had satisfactory wound healing in group II. No statistically significant difference between two groups [Table 4]. Postoperatively signs of infection were checked after 1 week, 4 weeks and 8 weeks. After 1 week, infection was seen in one patient (3.3%) of Group I and three patients (10%) of Group II. Signs of infection

Table 5 : Comparison of infection in patients treated by 3D & Champy's miniplate

Infection	1 st				4 th				8 th			
	Absent		Present		Absent		Present		Absent		Present	
	n	%	n	%	n	%	n	%	n	%	n	%
2D	7	35.0	3	15.0	9	45.0	1	5.0	10	50.0	0	0.0
3D	9	45.0	1	5.0	10	50.0	0	0.0	10	50.0	0	0.0
χ^2	1.250				1.053				-			
p value	0.264				0.305				-			

Chi square test in 1st day (p=0.264) and 4th day (p=0.305). No statistics are computed, because infection is a constant in 8th day.



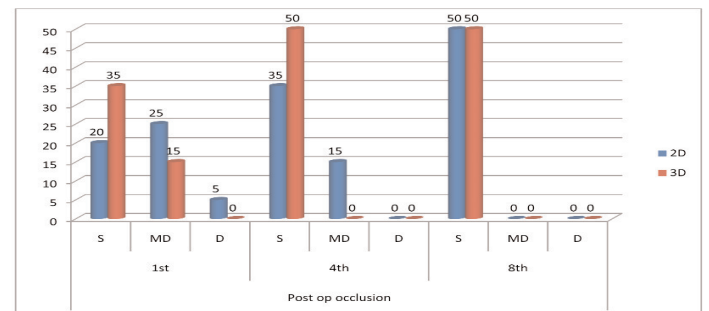
were found in one patient (3.3%) of Group II after 4 weeks. No infection was seen at the end of 8th week in both the groups. But the difference in the proportion of patients having infection, between the two groups was not statistically significant. The infections in both the groups were treated with antibiotics and resolved uneventfully [Table 5].

There was no case of wound dehiscence, segmental mobility, loosening of plate and screw, and exposure of plate in either group. Three patients in group I and five patients in group II had mild de-arrangement of occlusion after 1st week postoperatively. One patient had de-arrangement of occlusion in group II after 1st week post-operatively. Statistical analysis did not show any significant difference between the two groups (p value - 0.314). Guiding elastics were used post-operatively in those patients in order to adjust the occlusion. At the end of 4th week post-opera-

Table 6 : Comparison of post-operative occlusion in patients treated by 3D & Champy's miniplate

Post op occlusion	1 st						4 th						8 th					
	S		MD		D		S		MD		D		S		MD		D	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
2D	4	20.0	5	25.0	1	5.0	7	35.0	3	15.0	0	0.0	10	50.0	0	0.0	0	0.0
3D	7	35.0	3	15.0	0	0.0	10	50.0	0	0.0	0	0.0	10	50.0	0	0.0	0	0.0
χ^2	2.318						3.529						-					
p value	0.314						0.060						-					

Chi square test in 1st day (p=0.314) and 4th day (p=0.060). No statistics are computed, because post op occlusion is a constant in 8th day.



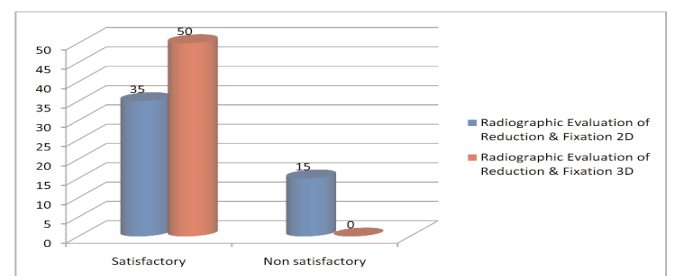
tively no occlusal disturbance seen in patient of group I while three patients of group II had mild de-arrangement who require occlusal grinding and guiding elastic to adjust the occlusion. But statistically no significant difference seen in either of the groups (p value - 0.06). All the patients in both groups had satisfactory postoperative occlusion at the end of 8th week [Table 6].

All the patients of both group did not show lingual splay in

Table 7 : Comparison of radiographic evaluation of reduction & fixation in patients treated by 3D & Champy's miniplate

	Satisfactory		Non satisfactory	
	n	%	n	%
2D	7	35	3	15.0
3D	10	50	0	0.0
χ^2	3.529			
p value	0.060			

Chi square test (p=0.060).



progressive follow-ups. Radiological evaluation shows satisfactory result of reduction and fixation of fracture site in all patients of group I but three patients of group II had non-satisfactory result. Radiological evaluation did not show any statistically significant difference in reduction and fixation between the two groups (p value - 0.06), [Table 7].

DISCUSSION

Rigid fixation has revolutionized a wide range of treatment procedures in cranio-maxillofacial surgery. Michelet's (1973) described technique of osteosynthesis and concept of semi-rigid fixation [17]. Champy et al. (1976) [8] revolutionized intraoral fixation by innovating and modifying the Michelet et al technique of osteosynthesis [18].

Champy et al. (1976) [8] described that in the anterior part of the mandible, in front of first premolar, there are mainly moments of torsion. Proximal to the first premolar, one plate is sufficient. In front of the first premolar, there should be two miniature plates separated by 4-5 mm in order to neutralize the moments of torsion.

De Oliveira KP et al. [19] conducted a research using 3D models which proved that when loads are applied to chewing points in the posterior region of the mandible where the molar teeth are located, the greatest intensity of torque forces is found in the region of the symphysis.

Mostafa Farmand (1993) [9] introduced new 3D plating system in which stability of the 3D plate is achieved by its configuration, not by thickness or length. These unique plates are composed of linear, square or rectangular units and may provide increased torsional stability.

Feledy et al. [10] and de Oliveira et al. [19] found better bending stability and more resistance to out-of-plane movement in the 3D plating system in their biomechanical experiment. Advantages of 3D miniplate system related to hardware over conventional miniplates are easy application, simplified adaptation to the bone without distortion or displacement of the fracture, simultaneous stabilization at both superior and inferior borders, and hence less operative time. Another advantage of 3D plates is their improved biomechanical stability compared with conventional miniplates [1, 4, 18, 15 and 20].

The present study compared and assessed the treatment outcomes of 3-dimensional (3D) plates and standard (Champy's) miniplate fixation in the management of anterior mandibular fractures. Study showed the overall complications are less in patients treated with 3D plate.

The present study consisted of 18 male and 2 female patients. This male dominance was also reported by Haug et al. [21], Gabrielli et al. [22], Lee [23], Bormann et al. [24] and Sehgal S et al. [3] in their studies. Road traffic accident was the most common mechanism of injury.

This distribution compared favourably with the results obtained by Schuchardt et al. [25], Kumar BP et al. [2], Bormann et al. [24], Fridrich et al. [26], Gabrielli et al. [22], Lee [23] and Van den Bergh et al. [27].

Parasymphysis was the most common site of fracture in present study. The findings of our study are consistent with those reported in the literature by Kumar BP et al. [2], Prasad R et

al. [15] and Cabrini Gabrielli MA et al. [28].

Schuchardt et al. [25], Lee [23] and Bormann et al. [24] found condylar fractures having the highest frequency. Gabrielli et al. [22] reported angle of mandible as the most common site. Huag et al. [21] found body of mandible to be the most common site (29.5%).

In present study the mean operation time from incision to wound closure was 19.5 minutes for group I and 33 minutes for group II. The difference was found to be statistically significant (p value 0.000), [Table 1].

Jain MK et al. [4], Parmer BS et al. [12] and Sauerbier et al. [29] also found operative time, less for 3D plates in comparison to standard miniplates. 3D plate is geometric configured plate which consists of two horizontal bars interconnected with two vertical bars. So, a smaller incision, single 3D plate, simultaneous stabilization at both borders and less screws are required. Therefore, time is saved in plate fixation. [1, 4, 11, 12, 14, 20].

Pain was recorded based on the visual analogue scale for patients post operatively on operative day, 2nd day, 4th day and 7th day at parasymphysis and symphysis region of the mandible. Pain was lesser in group I but there was no statistically difference between group I and group II. The studies of Barde DH et al. [1] and Kumar BP et al. [2] showed the higher pain scores on day 1 for patients treated with 2D plate. This was perhaps due to the wide surgical exposure required for adaptation and manipulation of the Champy's miniplate and more working time required for the surgical procedure. None of the patients from both groups had pain after two months.

In present study there was decrease in swelling on progressive follow-ups from operative day to 7th post-operative day. Although there was reduced amount of swelling in group I patients but there is no statistically significant difference between group I and group II [Table 3]. Amount and duration of retraction of soft tissue during the operative procedure helped to reduce the post operative swelling and pain. Reduced post-operative pain improved the post-operative quality of life and hence early rehabilitation.

Comparatively satisfactory wound healing [Table 4] and less postoperatively signs of infection [Table 5] was seen in present study in group I. No statistical significant difference between two groups was observed. The infections in both the groups were treated with antibiotics and resolved uneventfully. Farmand and Dupoirieux [16] also treated 95 fractures of the mandible using 4-holed 3 D plates; among the complications, only one Plate infection and one plate fracture were recorded. Guimond et al. [11] reported an infection rate of 5.4% (2 out of 37 patients) with the use of 3D plates, Feledy et al. [10] reported 9% infection rate (2 out of 22 patients) and Zix et al. [7] reported 0% (0 out of 20) infection rate in their study.

In present study no segmental mobility, loosening of plate & screw, exposure of plate and lingual splay was seen. Khalifa ME et al. [20] in their study, observed that two (20%) out of ten cases had mobility after conventional mini-plate osteosynthesis at 2 weeks postoperatively. This mobility decreased over a period of one month postoperatively. In the follow-up period of Sehgal S. et al. [3] study, no mobility of fragments was noted in any patient. This is in accordance with the results reported in literature by

Gabrielli et al.[22] and Mittal G et al.[30].

In present study results are favourable for post-op occlusion and radiographic evaluation of reduction & fixation in group I patients treated with 3D plate. In Farmand's study on 3D plates, 90 plates were placed in the mandible and none of the patients required additional fixation post-operatively Farmand (1995)[16]and Sehgal S et al.[3] also showed favourable results for 3D plate fixation in terms of post-op occlusion.

Stability of the present system (3D plate) makes sense because three dimensional miniplates resist torque forces due to their three dimensional property[4, 9, 12,16]. There is no need for postoperative IMF as advocated in a few studies like that by Collins et al.[31]. A broad platform is created that may increase the resistance to the torsional forces along the axis of the plate. This theory coincides with the study of Alkan et al.[32].

Advantage of 3-D miniplates over 2-D conventional miniplates is their small size and easy adaptability, which minimizes the chances of tooth damage. Postoperative complications are fewer because of less tissue disruption, greater stability, less implant material, thus reducing inflammation and infection. [2, 3, 5, 18 and 20].

CONCLUSION

The 3D plate was found to be standard in profile, strong yet malleable, facilitating reduction and stabilization at both the superior and inferior borders giving three dimensional stability at fracture site. There was significantly shorter operative time. Also our study found lower complication rates with the use of the 3D plate in the management of anterior mandibular fractures with respect to all evaluated parameters.

Thus, extrapolating to the clinical situation, we would observe that 3D fixations with four screws, as tested in the study in anterior mandibular fractures, would probably function adequately in stabilizing such fractures, considering that they presented a good mechanical performance and viable option for fixation of mandibular symphyseal and parasymphyseal fractures routinely.

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