



Conventional 2.0 mm Miniplates versus 3D Miniplate in Mandibular Fracture Fixation

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ABSTRACT

The aim of the present study was to clinically and radiographically compare and evaluate the treatment outcomes using 3D miniplate versus conventional 2.0 mm miniplates in fractures fixation of the anterior mandible. The study enrolled 16 patients with a total of 18 fractures; suffering from anterior mandibular fractures (symphysis and/or parasymphysis) requiring open reduction and internal fixations through an intra-oral approach. Group I patients were fixed using 3D titanium miniplates and screws. Group II patients were fixed using two 2.0 mm titanium miniplates and screws. Postoperative primary clinical treatment outcome points for comparative evaluation for all patients were fracture stability, the need for additional IMF, the need for minor occlusal adjustments and satisfactory occlusion. Secondary assessment points were infection, wound dehiscence and neurosensory deficit. Radiographic evaluation postoperatively was in terms of reduction adequacy, bone union and condylar positional change measurement. With respect to all the evaluated parameters, statistical analysis showed no statistically significant difference between the two groups in terms of clinical and radiographic treatment outcomes.

INTRODUCTION

The treatment of mandibular fractures has been in a constant state of evolution over the past few decades, with the optimal management of anterior mandibular fractures continuing to change. Accurate reduction of the fractures, maintenance of premorbid occlusion, and early return to function are the keys to successful management of these fractures.^[1]

KEYWORDS

3D plates,
Anterior mandible fracture,
Miniplates,
Condylar positional changes.

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Trans-orally placed miniplates have gained wide acceptance by their small size and their ease of adaptability and placement.^[2] However, the Association for Osteosynthesis/Association for the Study of Internal Fixation (AO/ASIF)^[3] felt that miniplates did not offer adequate stabilization of the fractures, thereby necessitating the need of further inter-maxillary fixation. In 1992 Mustafa Farmand and Dupoirieux^[4] presented 3D plates with quadrangular shape formed by joining two mini-plates with interconnecting crossbars, to meet the requirements of semi-rigid fixation with lesser complications. Because of the quadrangular configuration of the plates, they provided three dimensional stability and resistance to torsional forces. Considering the above, this study is carried out to compare 3D miniplates and conventional miniplates in terms of anterior mandibular fracture treatment outcomes and prevention of postoperative complications.

PATIENTS AND METHODS

Sixteen patients suffering from anterior mandibular fractures (symphysis and/or parasymphysis) were included in this study. Emergency care was provided and routine laboratory investigations and anesthetic fitness tests were carried out.

Preoperative clinical evaluation points included the site and type of fracture, degree of mobility of fractured segments and the presence or absence of malocclusion. While radiographic evaluation using OPGs and MSCT/CBCT assessed the overall dental condition, degree of displacement of fractured segments and condylar positional change measurement. Findings were recorded in a specially prepared case history proforma. The surgical procedure and follow up protocol was explained and a written consent was taken before the operation for all patients. All patients were anaesthetized under general anesthesia using

nasotracheal intubation and temporary IMF was done using Erich's arch bars. The fracture was approached through a trans-oral vestibular incision. The segments were reduced and fixed temporarily using bone forceps. The patients were divided into two groups according to the type of hard ware used for fracture fixation. Group I: (seven patients) were treated with 3D mini-plates system and Group II: (nine patients) were treated with two 2.0 mm titanium mini-plates system. IMF was released, occlusion was verified and the wound was closed using resorbable sutures.

Principles of 3D plate fixation were followed; the horizontal bars perpendicular to the fracture line while the vertical bars parallel to it.

Postoperative clinical parameters: Primary assessment points: A. Mobility of fracture fragments – assessed through bimanual digital manipulation, (i. Stable – no movement of fragments. ii. Unstable – movement present.) B. Need for additional guidance elastics – assessed if there was any derangement of occlusion. If indicated, guidance elastics were placed for a period of 1-2 weeks. C. Need for minor occlusal adjustments – assessed through the use of articulating paper and selective spot grinding of high spots interfering with occlusion. D. Stability of occlusion – assessed according to the following criteria: (i. Satisfactory – No gap between upper and lower first molars. ii. Mildly deranged – Gap of 1-2 mm between upper and lower first molars. iii. Deranged – Gap more than 2 mm between upper and lower first molars.) Secondary assessment points: infection, wound dehiscence and neurosensory deficit. Postoperative radiographic parameters: All the patients were evaluated radiographically using either MSCT or CBCT. Immediate postoperative to evaluate, a) Reduction adequacy, & b) Measurement of condylar positional changes. At three months to evaluate, a) Bone union, b) Plate integrity & c) Measurement of condylar positional changes.

Data was collected and tabulated using Microsoft Word. Statistical analysis of the results

was performed using Social Science Statistics (SSS), and included both chi-square tests and standard deviation. Results were considered statistically significant if $p < 0.05$.

RESULTS

Sixteen patients with anterior mandibular fractures were included in this study. Among those

16 patients there were 13 males (81.2%) and three females (18.7%) with a mean age of 42.5 years, (range of 17-68 years), Standard Deviation = 14.08. The most common etiology was road-traffic accidents (63%), followed by injured pedestrians (16%), interpersonal violence (11%), fall from height (5%) and missile bombing (5%), with the average injury-treatment interval being six days.

Primary assessment points

A. Mobility of fracture fragments: Fracture mobility, was seen in six patients (85%) of group I and all patients (100%) of group II preoperatively. This was not statistically significant (p -value = 0.30). None of the patients showed fracture mobility postoperatively.

B. Need for additional guidance elastics: assessed on the 1st postoperative day. When indicated,

elastics were placed for a period of 1 – 2 weeks to help the patient find proper occlusion. In this study one patient in group I and three patients in group II showed the need for additional guidance elastics. This was statistically insignificant (p -value= 0.38).

C. Need for minor occlusal adjustments: Three patients among group I and one patient in group II required mechanical spot grinding of high spots to reach optimal occlusion. This was statistically insignificant (p -value = 0.14).

D. Stability of occlusion: In this study, five patients in both groups showed satisfactory occlusion at the 2nd postoperative week follow up visit. Two patients in group I and three patients in group II showed mild derangement with a 1-2 mm gap between upper and lower 1st molars, while only one patient in group II showed occlusal derangement. This was statistically insignificant (p -value = 0.61). At the end of the follow period none of the patients in group I had any occlusal derangement while only two patients in group II had mildly deranged occlusion. This was also statistically insignificant (p -value = 0.18). (Table.1)

Table (1) Cross tabulation of occlusion in both groups at 2 weeks and 3 months postoperatively

	2 nd week occlusion stability			3 rd month occlusion stability		
	Satisfactory	Mildly deranged	Deranged	Satisfactory	Mildly deranged	Deranged
Group I	5	2	0	0	0	0
Group II	5	3	1	7	2	0
Total	10	5	1	14	2	0
Chi Square	0.96			1.77		
p -Value	0.61			0.18		
Result	NS			NS $P < 0.05$		

Secondary assessment points

- a. Infection: Patients were evaluated preoperatively and postoperatively at the end of the 1st week, 2nd week, and again at three months for signs of infection. Swelling, local inflammation and pus discharge were considered as positive indicators for the presence of infection. No signs of infection were reported in any of the cases of either group.
- b. Wound dehiscence: One patient in group I and three patients in group II showed signs of wound dehiscence at the end of the 1st postoperative week. This was statistically insignificant (p-value = 0.38).
- c. Neurosensory deficit: There was no clinical evidence of neurosensory deficits due to surgery in any of the cases of either group. Paresthesia of the lower lip, before surgery was encountered in one patient in group II, this patient was followed-up until he regained normal neurosensory function spontaneously after eight weeks.

Radiographic evaluation

- a. Reduction adequacy: Immediately postoperative, all patients exhibited adequate reduction with no gap between the fracture segments (100%).
- b. Measuring the intercondylar distance, in this study, all patients showed an increase in the intercondylar distance measurement immediately following osteosynthesis. Group I showed an increase average of 1.21mm, while group II had a 1.39mm increase on average. However, at the end of three months, all the patients showed a decrease in all the intercondylar distance measurements. Group I showed a decrease average of 2.72mm while group II had a 2.55mm decrease on average.
- c. Measuring the intercondylar angles, in group I, showed a decrease average of 1.11° immediately

postoperatively after osteosynthesis, followed by an increase average of 0.28° at the end of the follow up period. In group II, however, there was an increase average of 1.89° immediately postoperative, followed by a decrease average of 1.04° at the end of the follow up period.

- d. Bone union and plate integrity: At the end of the follow up period none of the patients showed any signs of non-union, plate fracture or bending, adverse effects around the screws nor was there any external callus detected in both groups.

DISCUSSION

Based on the selection criteria, this study included only anterior mandibular fractures in which parasymphysis was the most common site of fracture (78%) followed by symphysis fracture (22%). In our study, the main cause for mandibular fractures was road traffic accident (63%). This is in accordance with previous literature studies [5-7]. A male predominance was noted; the percentage of males with mandibular fracture was 81.2% and that of females was 18.7%, which is also consistent with other literature findings [8, 5, 6].

Post reduction infection at the fractured site usually can be regarded as the result of not only contamination but also to reduced stability of the fracture i.e. mobility of fractured segments. Fortunately, in spite of preoperative mobility of fragments in six patients (88.5%) in group I and in all patients in group II (100%), no mobility of fragments was noted in any patient during the follow up period of the study, this is in accordance other studies [9, 5].

In this present study, none of the patients in group I or group II showed any signs of infection during the follow up period. Regarding group I results, a previous study [9] also reported no signs of infection in a study conducted on 24 patients treated with 3D titanium miniplates. Regarding group II results, our results are consistent with those reported by a previous study. [10]

In the present study, one patient in group I (14.3%) required additional guidance elastics to find proper occlusion. These results are consistent with the literature.^[11] The occlusal discrepancy was seen as a result of the imbalance between the muscular activities of the muscles of mastication after the trauma and due to the edema at the TMJ region post-operative. By using guiding elastics this problem was solved. At the end of the follow up period, three months postoperatively, all patients in group I showed satisfactory occlusion, which is in accordance with the results by several researchers.^[9,12,13]

In our study, in group II, occlusal dysfunction in the form of mildly deranged and deranged occlusion up to the 2nd postoperative week was 44.4%. At the 3rd postoperative month, two patients still had mildly deranged occlusion. This is in accordance to the results obtained by another study^[10], where the average occlusal dysfunction until the 30th postoperative day in their study was 46.6%.

Immediately postoperative, both groups exhibited an increase in intercondylar distance values. Group I patients had an average increase of 1.21mm while group II had a 1.39mm increase. This maybe the result of the lateral kinking of the fracture fragments following application of the osteosynthesis at the outer surface of the mandible. Comparing our results to those previously published in the literature, these results are consistent with other studies.^[14, 15] At the end of three months there was a significant intercondylar distance decrease for both groups. This result may be due to healing that compensates the post reduction lateral kink and leads to a decrease in intercondylar distance.^[14] Group I had an average decrease of 2.72mm and group II had a 2.55mm decrease. This is consistent with the results of a previous study^[16] where a 3mm decrease was found after only three weeks of miniplate fixation. Statistical analysis between the two groups in the mean difference values was insignificant. Group I showed slightly less increase in the intercondylar distance values by 0.2mm than group II and allowed for more compensatory healing by 0.35mm than conventional miniplates.

A change in the intercondylar angle is said to be brought about by condylar torqueing along its long axis following rigid fixation.^[17] A lateral torque brings about an increase in the intercondylar angle while a medial torque decreases it. In group I, the intercondylar angle showed a decrease average of 1.11° immediately postoperatively which was slightly compensated through an increase average of 0.28° after three months. On the contrary group II showed an increase average of 1.89° immediately postoperatively that was compensated through a decrease average of 1.04° after three months. Statistical analysis between the two groups in the mean difference values was insignificant. However, the overall effect of 3D plates was medial torqueing of the condyles while miniplates had lateral torqueing, which might mean that 3D results tend to be more towards the normal values of the human condylar long axis which is medially and slightly backwards. This result also indicates that the condyle shows a tendency to move towards its normal position in the glenoid fossa when good occlusion is obtained after reduction of the fracture and compensates for any minor changes.^[18, 19] This is consistent with the literature.^[16]

CONCLUSION

With regard to this particular study, we conclude that the use of 3D miniplate technically seems to be a better and an easier alternative to formerly used miniplates for routine fixation of non-comminuted anterior mandibular fractures regardless of the degree of preoperative displacement. The only exception would be in cases of oblique fractures and those involving the mental nerve. However, the results obtained in the present study were not statistically significant between the two groups with respect to all the evaluated parameters. A more detailed study using a larger homogenous sample with a long term follow up may show a statistically significant difference with respect to 3D plates providing better inter-fragment stability for specific fracture sites in the mandible.

REFERENCES

1. Khalifa, M.E., El-Hawary, H.E., and Hussein, M.M., Titanium 3Dimensional Miniplate versus Conventional Titanium Miniplate in Fixation of Anterior Mandibular Fracture. *Life Sci J*, 2012, 9:1006.
2. Cawood, J.I., Small plate osteosynthesis of mandibular fractures. *Br J Oral Maxillofac Surg*, 1985, 23:77.
3. Luhr, H.G. Vitallium Luhr systems for reconstructive surgery of the facial skeleton. *Otolaryngol Clin North Am* 1987, 20:573.
4. Farmand M and D. L., The value of 3-dimensional plates in maxillofacial surgery. *Rev Stomatol Chir Maxillofac.*, 1992, 93:353.
5. Gabrielli, M.A., Gabrielli, M.F., Marcantonio, E., Hochuli-Vieira, E., Fixation of mandibular fractures with 2.0-mm miniplates: review of 191 cases. *J Oral Maxillofac Surg*, 2003, 61:430.
6. Bormann, K.H., Wild, S., Gellrich, N.C., Kokemüller, H., Stühmer, C., Schmelzeisen, R., Five- year retrospective study of mandibular fractures in Freiburg, Germany: Incidence, etiology, treatment, and complications. *J Oral Maxillofac Surg*, 2009, 67:1251.
7. Van der Bergh, Treatment and complications of mandibular fractures: a 10-year analysis. *J Craniomaxillofac Surg*, 2012, 40:108.
8. Haug, R.H., J. Prather, and A.T. Indresano, An epidemiologic survey of facial fractures and concomitant injuries. *Journal of Oral and Maxillofacial Surgery*, 1990, 48(9):926.
9. Mittal, G. and R.R. Dubbudu, Three dimensional miniplates in oral and maxillofacial surgery: a prospective clinical trial. *J Maxillofac Surg*, 2012, 11:152.
10. Sehgal, S., Lalitha, R., Kavitha, P., Ranganath, K., Three-dimensional v/s standard titanium miniplate fixation in the management of mandibular fractures - A randomized clinical study. *J Oral Maxillofac Surg*, 2014, 7:1292.
11. Barde, D.H., Mudhol, A., Ali, F., Efficacy of 3-dimensional plates over Champy's miniplates in mandibular anterior fractures. *J Int Oral Health*, 2014, 6:20.
12. Parmar, B., Menat, S., Raghani, M., Kapadia, T., Three dimensional miniplate rigid fixation in fracture mandible. *J Oral Maxillofac Surg*, 2007, 6:2.
13. Tangavelu, A. and Shankar, S., Role of indigenous 3-dimensional titanium plating system in oral and maxillofacial surgery *J Oral Maxillofac Surg*, 2004, 3:24.
14. Randzio, J., Ficker, E., Wintges, T., The accuracy of osteosynthesis repositioning of the mandible – a stereophotogrammetric study. *Oral Surg Oral Med Oral Pathol.*, 1990, 69:6.
15. Michael L.K., Brian, N., and Paul, W.M., Temporomandibular Joint Morphology Changes with Mandibular Advancement Surgery and Rigid Internal Fixation: A Systematic Literature Review. *The Angle Orthodontist*, 2003, 73:79.
16. Ibrahim, S.M., Fouda, A.A. and Heider, A.M., Condylar head position following open reduction and miniplate osteosynthesis in management of fracture of anterior region of the mandible. *Egyp Dent J*, 2012, 58:421:428.
17. Alex, M.G., and Joachim, P., *Craniomaxillofacial Reconstructive and Corrective Bone Surgery: Principles of Internal Fixation Using the AO/ASIF Technique.*, Verlag New York, Inc.: Springer, 2002.
18. Lindorf, H.H., Sagittal ramus osteotomy with tandem screw fixation -technique and results. *J Maxillofac Surg* 1986; 14: 311.
19. Spitzer, W.J. and Sitzmann, F., Computed tomographic study to assess the alteration of the TMJ after Ramus osteotomy with rigid fragment fixation. *Germ Dent J*, 1984, 39: 929.