

A Comparative Assessment of the Efficiency of Three-Dimensional plates over single Superior Border Plating in the management of Mandibular Angle Fractures

Rohini Kanitkar Kamat^{1*} I Nalini Sailaja² Rahul VC Tiwari³ Koustabh Kumar⁴ Ashwin Hiremath⁵
Nandini Dayalan⁶

¹Consultant Oral and Maxillofacial Surgeon, Dr. Bhimsain's Family Dental Clinic, Gurgaon, Haryana, India.

²Senior Lecturer, Department of Oral and Maxillofacial Surgery, Sri Venkateswara Dental College and Hospital, Thalambur, Chennai, India.

³PhD Scholar, Department of Oral and Maxillofacial Surgery, Narsinhbhai Patel Dental College and Hospital, Visnagar, India.

⁴Senior Lecturer, Department of Oral and Maxillofacial Surgery, Krishnadeveraya College of Dental Sciences and Hospital Bangalore, Karnataka, India.

⁵Senior Lecturer, Department of Oral and Maxillofacial Surgery, Al Ameen Dental College and Hospital, Bijapur, Karnataka, India.

⁶Senior Lecturer, Department of Oral & Maxillofacial Surgery, Dr. Syamala Reddy Dental College Hospital & Researches Center, Bangalore, Karnataka, India.

ABSTRACT

Background: This study is intended to assess and compare the efficiency of three-dimensional (3D) miniplates over single conventional miniplate at the superior border in the management of mandibular angle fracture.

Materials and Methods: This study comprised of 30 patients diagnosed clinically and radiographically to have sustained mandibular angle fracture and subsequently underwent open reduction and internal fixation (ORIF). All participants were divided randomly into two groups. Group A included 15 patients who underwent ORIF for the management of angle fracture with the aid of conventional single miniplate at the superior border by means of 2 mm 4 holes with gap miniplate whereas Group B included 15 patients who underwent ORIF with the aid of a rectangular 3D miniplate placed through an intraoral incision in conjunction with the use of a trocar through percutaneous route for fixation of the plate.

Results: The results of this study show that those patients who underwent surgical intervention with the aid of 3D plates experienced more pain on visual analogue scale score. In addition to this, it was also noticed that these patients had restricted mouth opening in the immediate postoperative phase. Nevertheless, the stability at the fracture site was superior to that of those treated by conventional single miniplate at the superior border.

Conclusion: Based on the results of this study it can be concluded that the 3D plate is typical in configuration, robust however flexible, enabling reduction and stabilization not only at the superior but also at the inferior borders giving 3D stability at the fracture site in addition to facilitating early return to normal function.

Keywords: Angle fracture, 3D plates, fracture stability.

INTRODUCTION

The mandibular angle region is distinctive compared to the various anatomical regions of the facial skeleton due to its unique anatomy, attachments of the muscles and the cortical bone

thickness.¹ Hence, previous studies have stated that fractures of the mandibular angle region may not be reduced sufficiently by closed reduction.² Therefore, it is advocated that the fractures of the mandibular

Received: Apr. 15, 2020; Accepted: July. 8, 2020

*Correspondence Dr. Rohini Kanitkar Kamat.

Dr. Bhimsain's Family Dental Clinic, Gurgaon, Haryana, India.

Email: drheenatiwari@gmail.com

angle region should be managed surgically by open reduction and internal fixation with the aid of a single miniplate placed at the superior border of the mandible at the superior oblique ridge.³ It is believed that this method would deliver adequate support and stability to the fractured bony fragments and facilitate early return to function.³

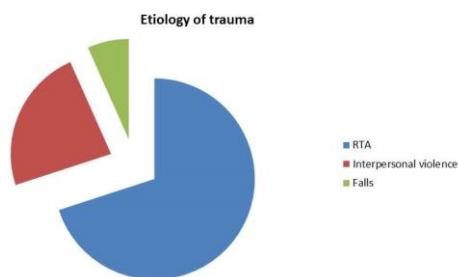


Fig 1: Graph showing the etiology of trauma.

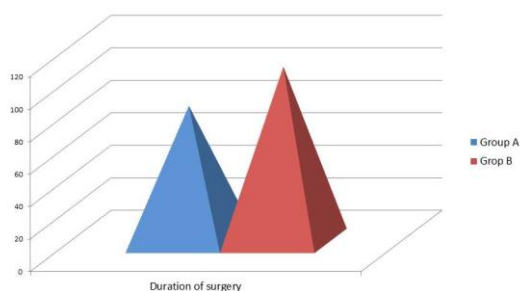


Fig 2: Graph showing the duration of surgery between both the groups.

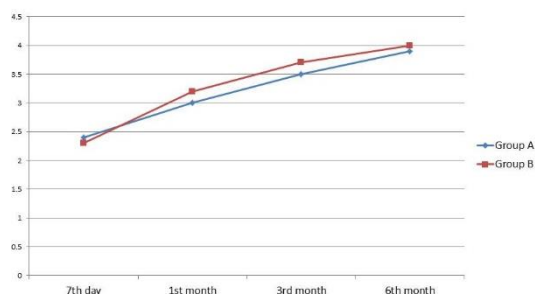


Fig 3: Graph showing the mean VAS score between both the groups.

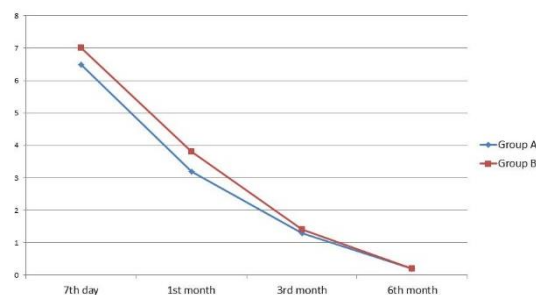


Fig 4: Graph showing the man mouth opening between both the groups.

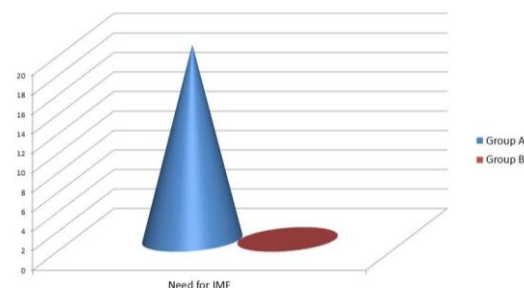


Fig 5: Graph showing the need for postoperative IMF between both the groups.

Over a period of time, numerous studies evaluated the effectiveness of conventional superior border plating in the management of mandibular angle fractures. Different kinds of osteosynthesis, like lag screws, compression plates, etc., were employed for the management of mandibular angle fracture but with diverse results.⁴ Few authors advocated that conventional superior border plating is insufficient to counter the muscle forces that are delivered at the mandibular angle region and that the three-dimensional (3D) stability at the fracture site can be better achieved by the use of a 3D plate.¹ However, few authors reported that two-plate fixation might not offer advantages over single-plate fixation.⁵ So, the management of mandibular fractures continues to be a never-ending dilemma. Therefore, this study is aimed to assess and compare the efficiency of three-dimensional (3D) mini plates over single conventional miniplate at the superior border in the management of mandibular angle fracture.

MATERIALS & METHOD

This study comprised of 30 patients who were diagnosed clinically and radiographically to have

sustained mandibular angle fracture and underwent open reduction and internal fixation (ORIF) during the period of November 2017 – February 2020. Ethical committee clearance was obtained from the Institutional Ethics Committee. Informed and written consent was obtained from the patients using standard surgical protocols patients were treated.

All the patients involved in this study were allocated into two groups randomly. Group A included 15 patients who underwent ORIF for mandibular angle fracture with the aid of superior border plating (superior oblique ridge) by means of 2 mm 4 holes with a gap while Group B included 15 patients who underwent ORIF with the aid of rectangular 3D miniplate (2.0 mm) placed through an intraoral incision in conjunction with the use of a trocar through percutaneous route for fixation of screws. Those patients who sustained a mandibular angle fracture with or without displacement of fracture segments and not associated with other fractures of the facial skeleton necessitating surgical intervention within 7 days from the time of trauma are included in this study. Those patients in whom the fracture sites were infected or associated with comminuted fractures leading to extensive damage of bony segments and patients with atrophic mandibular angle fractures were excluded.

On the basis of case history recording, clinical examination and radiographic interpretation, the diagnosis was made. Haematological and radiological investigations were carried out, and following thorough systemic evaluation, patients were taken up for surgery.

The following clinical parameters were evaluated –

1. Duration of surgery: It is measured from the time of the first incision to final closure (in minutes)
2. Pain assessment: Postoperatively at regular intervals with the aid of VAS scale with values ranging from 0 (no pain) to 10 (strongest pain or discomfort) on the 1st & 7th postoperative days, 1 month, 3rd month, 6th-month postoperative period respectively.
3. Postoperative occlusion: Occlusal stable / no occlusal stability

4. Requirement for Maxillo-mandibular fixation (MMF) postoperatively: Required / not required

5. Mouth opening: Measured in millimetres with the help of scale.

6. Stability of the fracture segments: Present/absent

The following clinical parameters were evaluated –

1. Reduction of the fractures: Satisfactory/unsatisfactory

2. Need for any other additional fixation method.

The patient was followed up periodically, and the parameters were analyzed and compared.

RESULTS

This study comprised of 30 patients, who were diagnosed with clinically and radiologically, to have sustained mandibular angle fracture. A total of 15 patients were treated by stainless steel miniplate (Group A) while 15 patients were treated by 3D stainless steel miniplate (Group B). The age group of all patients ranged from 19 years to 55 years of age, with the mean age of the patients being 26.7 years in Group A and 27.80 years in Group B, respectively. Amongst the 30 patients, males were 27, and females were three who were allocated randomly into two groups. The etiological factor for the mandibular angle fracture was a road traffic accident in 21 patients, interpersonal violence in 7 patients and fall in 2 patients, as shown in Figure - 1. The mean duration of the surgical intervention in Group A was 83.20 minutes while in Group B, the mean duration of the surgical intervention was 107.30 min, as shown in Figure - 2. It was statistically significant ($P = 0.001$). Mann-Whitney U-test was applied to compare the results between the two groups. Statistical analysis did not show any significant difference of mouth opening during 1st postoperative day; however, it was significantly higher on postoperative follow-up during 7th postoperative day, one month and three months, respectively as shown in Figure - 3. With regard to the mouth opening, the mean mouth opening in the immediate postoperative phase in both the groups was found to be statistically not significant ($P = 0.217$).

Mann-Whitney U-test was applied to compare the VAS score between two groups. There was no significant difference in the mean VAS score between both the groups when compared from the immediate postoperative day to 3rd month follow-up, as shown in Figure - 4. However, with regard to paresthesia of the inferior alveolar nerve, two patients in Group A reported paresthesia postoperatively and none of the patients in Group B reported with paresthesia. With regard to the requirement for postoperative IMF, due to deranged occlusion and mobility of the fractured segments, three patients (20%) in Group A required postoperative IMF but none in Group B as shown in Figure - 5.

DISCUSSION

The lower third molar tooth is usually positioned at a point of angulation between the posterior body and ramus of the mandible. In clinical scenarios where the third molars are unerupted or partially erupted, this region becomes an area of inherent weakness, leading to an increased incidence of mandibular angle fracture.⁶ The fracture line often encompasses the third molar tooth socket.^{6,7} Owing to the thickness and the strength of the outer cortex at the mandibular angle region, a good anchorage can be obtained for the osteosynthetic screws.^{7,8} A never-ending dilemma still prevails pertaining to the type of fixation device to be employed, the number of fixation devices to be employed and anatomic positioning of fixation devices in addition to the surgical approach to be used.

Previous studies advocated the use of a single miniplate at the superior border since it is a simple and reliable technique with a relatively low rate of associated complications.^{2,3} However, it was observed based on the results of these studies that the placement of a single plate at the superior border lead to the opening of the fracture line at the inferior border with lateral displacement and subsequent posterior open bite on the affected side.^{5,6,9} In contrary to this, few studies have advocated that the mandibular angle fractures are under a great degree of a torsional strain than any other anatomical area in the mandible and hence 3D plates afford greater stability in this region.^{8,10} Hence, this study was designed to assess and

compare the efficiency of three-dimensional (3D) mini plates over single conventional miniplate at the superior border in the management of mandibular angle fracture.

The mean duration of the surgical intervention in Group A was much lesser than in Group B since the patients in Group B required the use of a trocar through percutaneous route for fixation of screws at the lower arm of the 3D plate in addition to the intraoral approach for fixation of screws at the upper arm is contrary to Group A who required only an intraoral approach for the adaptation and fixation of the miniplate. With regard to the mouth opening, the mean mouth opening in the immediate postoperative phase in both the groups was found to be almost similar. However, there was an increased mouth opening noted in Group B patients when compared to Group A patients during follow-up periods which was found to be comparable and statistically significant.

With regard to the pain score, in the immediate postoperative phase pain was higher in both the groups with a mean value of 7.20 and 8.00 while in the late postoperative phase, the pain gradually came down a mean value of 0.15 and 0.2, respectively. Patients in Group B encountered a mildly higher pain scale due to the wide surgical exposure required for adaptation and fixation of the plates in addition to the extra working time required for the surgical procedure in these patients. It was observed that in general, there was minimal or no difference in the pain scales when patients in both groups are compared.

A previous study evaluated the treatment outcome in patients treated for fractures of the mandibular angle with a single, thin, malleable miniplate placed on the superior border and reported 10.8% of plate fracture with 1.3 mm malleable non-compression mini plates which in turn results in interfragmentary mobility and nonunion.¹¹ Another study treated 140 patients with 3D titanium miniplate and reported only one case of plate fracture.⁸ Mobility of the fracture segments was examined postoperatively in patients of both the groups by simple digital palpation on either side of the fracture line. It was observed that three patients of Group A out of 15 patients had slight mobility of the fractures segments and later decreased over a period of 8 weeks, and by 3rd month and 6th month

postoperatively, none of the patients showed mobility. These patients were put on MMF for additional stability for a period of 3 weeks. None of the patients in Group B had a mobility of fractured segments.

Another study reported that the matrix miniplate provides sufficient stability for the fracture healing compared to a single plate resulting in reduced risk of the plate failure, fracture motion, and infection.¹² Recently, an in vitro study evaluated the biomechanical behaviour of four different types of rigid fixation with semirigid fixation system that is currently used for angle fracture.¹⁰ This study demonstrated that 3D plates had greater resistance to compression loads than the mini plates using by Champy's technique. With respect to occlusion, 3 patients in Group A had a mild occlusal discrepancy postoperatively, whereas, in Group B, all patients had normal satisfactory occlusion without any occlusal discrepancy. The occlusal discrepancy in patients in Group A was treated successfully by placing guiding elastics for a period of 4 weeks.

The results of this study suggest that the fixation of mandibular angle fracture with 3D plate provides better stability with less morbidity and fewer infection rates. On comparing the parameters of both the groups, patients treated with 3D plating have more feasible of postoperative pain, swelling, and reduced mouth opening due to increased masseter muscle stripping till the lower border for adaption of the plate. However, better stability of the fracture segments was achieved in these patients whereas in superior border plating as the plate was placed on external oblique ridge less surgical exposure was needed which in turn causes better postoperative comfortability to the patient. However, there was a mild interfragmentary movement leading to mild occlusal discrepancy requiring additional attention in the postoperative phase. The geometry of 3D plate assures a 3D stability of the fracture site and offers good resistance against torque forces acting on the fracture site, thereby reducing the chances of occlusal discrepancy and avoiding the need for MMF for early restoration of angle function. The only probable limitation of 3D plates may be excessive implant material where an extraoral approach is needed for adaptation and fixation. Hence, in these situations, miniplate has an advantage over 3D plates.

CONCLUSION

Based on the results of this study it can be concluded that the 3D plate is typical in configuration, robust however flexible, enabling reduction and stabilization not only at the superior but also at the inferior borders giving 3D stability at the fracture site in addition to facilitating early return to normal function. They appear to be a viable alternative to the conventional mini plates for providing satisfactory osteosynthesis. However, it necessitates a greater sample size to validate the results of this study.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

- 1) Kumar ES, Sinha R, Uppada UK. Are three-dimensional plates as effective as superior border plating in mandibular angle fractures? A comparative evaluation of effectiveness. *J Dent Res Rev* 2018;5:88-92
- 2) Singh S, Fry RR, Joshi A, Sharma G, Singh S. Fractures of angle of mandible-A retrospective study. *J Oral Biol Craniofac Res* 2012;2:154-8
- 3) Schierle HP, Schmelzeisen R, Rahn B, Pytlik C. One- or two-plate fixation of mandibular angle fractures? *J Craniomaxillofac Surg* 1997;25:162-8.
- 4) Haug RH, Fattahi TT, Goltz M. A biomechanical evaluation of mandibular angle fracture plating techniques. *J Oral Maxillofac Surg* 2001;59:1199-210
- 5) Champy M, Loddé JP, Schmitt R, Jaeger JH, Muster D. Mandibular osteosynthesis by miniature screwed plates via a buccal approach. *J Maxillofac Surg* 1978;6:14-21
- 6) Revanth Kumar S, Sinha R, Uppada UK, Ramakrishna Reddy BV, Paul D. Mandibular third molar position influencing the condylar and angular fracture patterns. *J Maxillofac Oral Surg* 2015;14:956-61
- 7) Miloro M, Ghali GE, Larsen PE, Waite PD. Principles of Oral and Maxillofacial Surgery. 2nd

- ed. Hamilton, London: BC Decker Inc; 2004. p. 401.
- 8) Farmand M, Dupoirieux L. The value of 3-dimensional plates in maxillofacial surgery. *Rev Stomatol Chir Maxillofac* 1992;93:353-7
 - 9) Michelet FX, Deymes J, Dessus B. Osteosynthesis with miniaturized screwed plates in maxillo-facial surgery. *J Maxillofac Surg* 1973;1:79-84
 - 10) Alkan A, Celebi N, Ozden B, Baş B, Inal S. Biomechanical comparison of different plating techniques in repair of mandibular angle fractures. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;104:752-6
 - 11) Potter J, Ellis E 3rd. Treatment of mandibular angle fractures with a malleable noncompression miniplate. *J Oral Maxillofac Surg* 1999;57:288-92.
 - 12) Wan K, Williamson RA, Gebauer D, Hird K. Open reduction and internal fixation of mandibular angle fractures: Does the transbuccal technique produce fewer complications after treatment than the transoral technique? *J Oral Maxillofac Surg* 2012;70:2620-8.