

EVALUATION OF CLINICAL OUTCOME OF PATIENTS WITH MANDIBULAR ANGLE FRACTURES TREATED BY RECTANGULAR GRID MINIPLATE

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**ABSTRACT:** **Aim of the study:** This study was conducted to evaluate the efficacy of rectangular grid 3-d miniplates in the treatment of mandibular angle fractures.**Methods:** The study included 10 patients with mandibular angle fractures. A 2mm X 4hole titanium rectangular grid Miniplate was used to fix the fracture. Intraoral approach for fracture reduction and Transbuccal approach were used for plate fixation. Patients were evaluated for Fracture stability, Occlusion, Mouth opening, Complications like infection, plate loosening, plate fracture, malunion on 7<sup>th</sup> post operative day, 1<sup>st</sup> month, and 3<sup>rd</sup> month postoperatively.**Results:**Only one patient had mild occlusal derangement at end of the follow-up period of 3 months. One patient developed post-operative infection on the 7<sup>th</sup> post-operative day which resolved on antibiotic therapy. No cases of hardware failure were reported. All the patients had adequate mouth opening at the end of follow-up period.**Conclusion:** The rectangular grid miniplates used in this study were stable for the treatment of simple mandibular angle fractures with sufficient interfragmentary contact. The patients also had minimal complications. The armamentarium needed and cost of the hardware is also low. Further clinical studies with larger sample size are required to arrive at a more comprehensive conclusion about these plates.

**KEYWORDS:** Fractures, Mandible, Angle, Grid plate

INTRODUCTION

Mandibular angle fractures contribute to a considerable share (30 %) among all mandible fractures <sup>1</sup>. Even with the advancements in methods of internal fixation, management of these fractures is still controversial due to varying anatomical and biomechanical considerations. Different treatment modalities have been considered with contrasts in difficulties, yet no agreement has been achieved prompting discussion on perfect techniques for treatment <sup>2-4</sup>. Utilization of single monocortical miniplate at the superior border was considered as the standard strategy for treatment with insignificant complexities, however in view of recent clinical and experimental studies, a few specialists had a state of conflict regarding stability due to splaying of inferior border during application of loading forces <sup>5</sup>. Farmand and Dupoireux <sup>6</sup> developed 3-D plates considering these factors. The stability of the 3-D plate is derived from the combination of the screws fixed monocortically to the outer cortex forming cuboid. 3-D plates hold the fracture segments rigidly and

they resist the shearing, bending, torsional forces that act around the fracture. They also minimize the Buccolingual splaying and gap formation in lower border <sup>7</sup>. This study was performed to evaluate the efficacy of rectangular grid 3-d miniplates in treatment of mandibular angle fractures.

Materials and methods:

A prospective study was done in 10 patients with mandibular angle fractures reporting to the Department of Oral and Maxillofacial Surgery, from January 2014 to October 2015. Inclusion criteria of this study were: Simple mandibular angle fractures without gross displacement, unilateral or bilateral mandibular angle fractures, unilateral mandibular angle fracture along with other fractures of mandible, fractures of mandibular angle along with fractures of other maxillofacial regions not involving occlusion. Patients who are medically compromised, edentulous and not willing for surgery were excluded from

the study. Detailed case history was recorded and all necessary hematological and radiological investigations were done.

Ethical committee approval from institutional review board was obtained and a structured informed consent was taken from the patients. All patients were treated by a 2mm X 4hole titanium rectangular grid Miniplate for fixation of mandibular angle fractures. Concomitant fractures were treated by using 2mm x 4 hole miniplates. Erich arch bars or eyelets were placed preoperatively for necessary cases and IMF screws were placed to assist in intermaxillary fixation in all other cases. (Fig.1 and Fig.2)

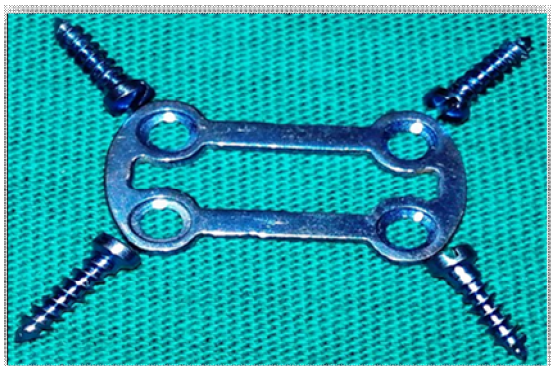


Fig. 1: Rectangular grid miniplate with Titanium screws



Fig. 2: Armamentarium

General anesthesia was administered with nasotracheal intubation and under aseptic conditions intraoral incision for exposure of angle fractures was placed. After complete mucoperiosteal elevation and exposure of the fracture, reduction of the fracture was done and occlusion was secured with the help of intermaxillary fixation. A small extraoral stab incision was given to permit the insertion of the transbuccal cannula. The location of the extraoral stab incision was guided by the location of the fracture line and the position of the facial vessels. The trocar was advanced into the operative site with blunt dissection through the stab incision, perforating the periosteum in the area planned for plate

fixation. The cheek retractor was applied to stabilize the trocar assembly during movement towards and away from the fracture site. A drill bit that was 11.5 cm in length and 1.6 mm in diameter was inserted through the drill guide to drill the holes. Fractured segments were stabilized and fixed with a 2 mm 4-hole titanium rectangular grid miniplate(Fig.3) and were secured with monocortical screws that were 2mm in diameter and 8 mm in length. These screws were threaded in position to the proper depth. The occlusion was checked in all patients by releasing MMF after fixation of the fractured fragments. The extraoral skin incision was sutured with 5.0 ethilon.(Fig.4 and Fig.5) Intraoral incision Closure was done with 3-0 vicryl. All patients were hospitalized for 5 days and were placed on a liquid diet for 1 week, followed by a soft diet for another 4 weeks. Patients were followed at 1 week, 1 month, and 3 months and were evaluated for (a) fracture stability—assessed by single operator by digital palpation with the help of thumb and index finger of both hands, considered to be stable if there was no interfragmentary mobility and unstable if mobility was present. (b) Occlusion—measured with help of metric gauze in mm by measuring the gap between upper and lower molars, categorized into satisfactory (no gap), mild derangement (1–2 mm) and deranged (more than 2 mm). (c) Mouth opening—measured with help of metric gauze and categorized into adequate ( $\geq 30$  mm) and inadequate ( $< 30$  mm). (d) Complications such as infection, paresthesia, plate fracture, screw loosening, malunion and non union were assessed and recorded. OPG and PA view of the skull were taken for all the patients' pre and post operatively.(Fig.6 and Fig.7)

Data was analyzed using SPSS software version 19 and statistics were plotted with Mann–Whitney U test. The results were considered statistically significant if  $P \leq 0.05$ .

Results

A total of 10 patients were observed. 90 % of patients (n = 9) were males and 10 % (n = 1) were females. The age ranged from 23 to 60 years with the mean age being 34.5 years. Out of the 10 patients, 8 patients were below 40 years (80%) and 2(20%) patients were above 40 years. RTA was the principle cause of fracture of mandibular angle in 80 % (n = 24) patients, followed by assault in 20 % (n = 2) patients. 40 % (n = 4) patients had isolated angle fractures, out of which isolated left angle was 20 % (n = 2) patients and isolated right angle was 20 % (n = 2) patients and remaining 60 % (n = 6) patients were associated with other fractures of mandible. The parasymphysis fracture on right side accounts for 46% (n=5) and 18% patients (n=2) had fractures of zygomatic bone on the left side. Out of the 10 patients, 9 patients had involvement of third molar in the line of fracture. Out of these nine patients third molar has been removed in 5 cases and retained in 4 cases. All patients have been inspected by digital palpation for verifying Interfragmentary mobility at the end of 1 week, 1 month and 3 months. No patients have showed interfragmentary mobility at the end



Fig. 3: Rectangular grid 3D miniplate fixed for angle fracture on left side



Fig. 4: Extraoral stab incision for transbuccal approach suture



Fig. 5: Post-op occlusion after plate fixation

of 3 months follow-up. Pre-operatively all cases had deranged occlusion. 1 patient had Mild Derangement of occlusion even after 3 months of follow-up. All the patients at the end of 3 months follow-up have showed adequate mouth Opening (>30 mm).the improvement of mouth opening was compared between the follow- up periods were compared and had significant values. None of the patients had plate fracture, screw loosening, non union or mal-union. One patient developed post-operative infection on 7<sup>th</sup> post-operative day which resolved after antibiotic therapy.

Discussion

Michelet et al <sup>8</sup> in 1960 developed the concept of miniplate osteosynthesis. The principle of miniplate technique is to identify the line of tension within the mandible at the site of fracture, plate is adapted across the fracture along this line without compression and screw penetrates usually only buccal cortical plate. The osteosynthesis by plate screwed on outer cortical plate is solid enough to support strains developed by masticatory muscles. The anatomic location of the tensile zone corresponds to the mandibular alveolus and external oblique ridge. The compressive zone is located at the inferior border of the mandible. Champy's ideal line of osteosynthesis also suggests the external oblique ridge as the most effective plate location for mandibular angle fractures.

But Kroon et al <sup>9</sup> showed that single miniplates poorly controlled the bending and torsional forces. Also when an occlusal load was placed on ipsilateral molars, splaying was produced along the inferior border of angle of the mandible, and posterior open bite resulted on the fracture side. Farmand and Dupoireux developed the 3-D plates. These plates simplified the plate adaptation to bone without distortion and also aided in simultaneous fixation of both the borders. In case of 3-D plates the stability gained over a defined surface area in three dimensions is due to its configuration and not by thickness or length.

Feledy et al <sup>10</sup> through their study concluded that 3-d miniplates demonstrated an overall better intrinsic stability, more resistance to torsional movement. In our study fracture stability was assessed through simple digital palpation on either side of the fracture line and checked for the fragments mobility. No fragment mobility (100%) was elicited at the end of 3 months follow up.

Guruprasad Yadavalli et al<sup>11</sup> conducted a study to determine the relationship of postoperative complications and presence of tooth in the line of fracture in two separate groups, those with tooth retained developed less complications than those with tooth extracted. In our study 5(55.55%) patients had their third molar extracted and in 4(44.44%) patients third molar retained in the fracture line. Teeth in the line of fracture can be conservatively treated only when the fracture has a favorable prognosis and

Table 1: Comparison of Post-operative mouth opening between 1 week, 1 month and 3 months by Mann-Whitney U-Test

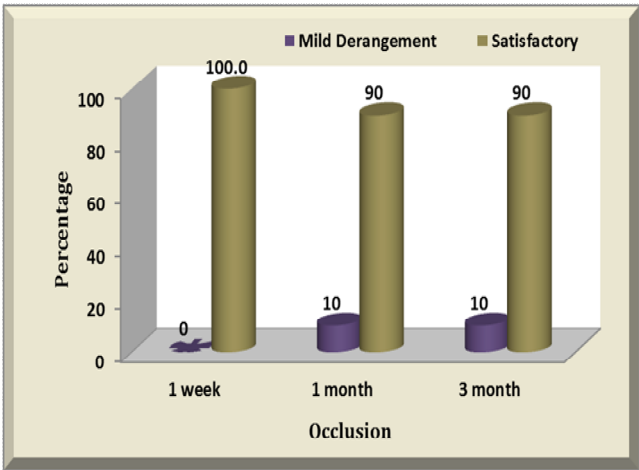
Variable		Z value	P-value	Inference
Mouth opening	1 week	3.80	<0.01	HS
	1 month			
	1 month	3.79	<0.01	HS
	3 month			
	1 week	3.79	<0.01	HS
	3 month			

Table 2: Incidence of complications in the immediate postoperative period (7<sup>th</sup> post-operative day)

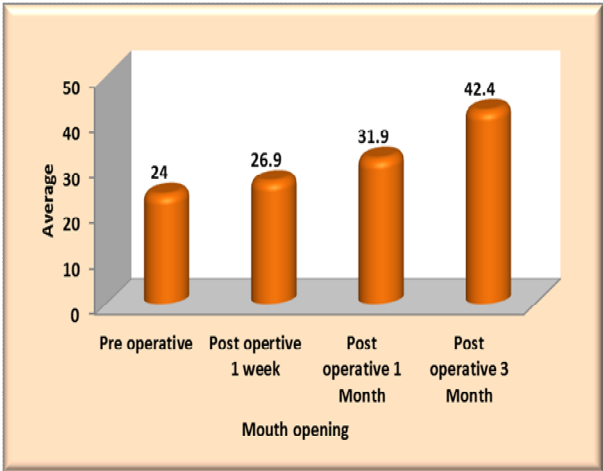
Complication		Frequency	Percent
Loosening	Absent	10	100.0
Infection	Absent	9	90.0
	Present	1	10.0

Table 3: Incidence of complications at the end of follow-up period (3 months follow-up)

Complication		Frequency	Percent
Loosening	Absent	10	100.0
Infection	Absent	10	100.0
	Present	0	0



Graph 1: Comparison of post-operative occlusion at the end of 1 week, 1 month and 3 months follow-up



Graph 2: Comparison of mouth opening at Pre-operative and Post-operative 1 week, 1 Month and 3 months follow-up





Fig. 6: Pre-operative opg showing fracture in the angle region of mandible on left side

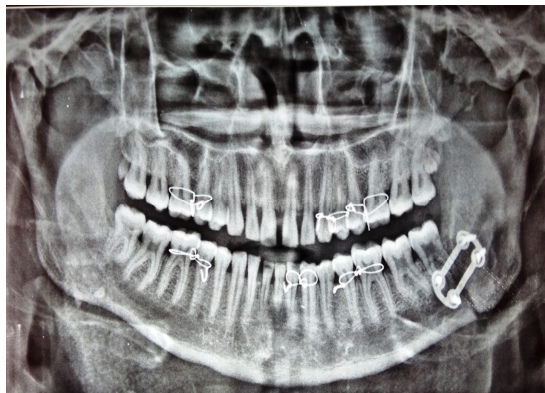


Fig. 7: Post-operative opg showing 3d rectangular grid miniplate fixation in the angle region of mandible on left side

optimal reduction of displacement between the fragments has been achieved. In our study patients were assessed for establishment of maximal mouth opening (inter incisal width) pre and postoperatively. All the patients had an adequate mouth opening (inter incisal width greater than 3cm) after 3 months follow up. Restoration of pre-morbid occlusion is one of the most important goals of the management of fractures of Dentofacial region. In our study, 1 patient had mild derangement of occlusion even after 3 months post operative follow up. All the other patients had satisfactory occlusion at the end of follow-up period. A possible explanation for post fixation malocclusion is presence of other associated fractures of mandible. These associated fractures act as a confounding factor as there is a change in biomechanics between isolated and combined fractures of mandible due to attachment of different muscles in and around the mandible.

Complication rates associated with osteosynthesis for mandibular fractures range from 3.8% to 28% as per the studies published in the literature<sup>12, 13</sup>. In our study 1 patient (10%) had post operative infection at the fracture site which was managed by necessary antibiotics and analgesics. By the end of 3 months follow up none of the

patients had any infection from the surgical site. **Mittal et al**<sup>14</sup> conducted a study on 24 patients with mandibular angle fractures using 3-D plates and reported no postoperative development of infection at surgical site during follow up of 6 months. Stability is considered as the best protection against infection, as movement in the presence of foreign bodies (i.e. loose screws) usually leads to infection and malunion. For 3D plate fixation in mandibular fractures the complication rates reported so far range from 0 % to 10 %. **Wittenberg**<sup>15</sup> in 1994 also reported a very low complication rate in his study on 3-D plates. Hence taking into account the small sample size in our study infection rate of 0% is favorable.

Hardware failure is one of the complications associated with 3-D plate. **Zix et al**<sup>16</sup> reported fracture of a straight 3-D plate in 1 patient in a series of 20 patients treated by this method. **Farmand and Dupoireux** also reported the incidence of plate fracture in 1 patient out of 95 patients treated by using 4-hole square plate<sup>6</sup>. Non union and delayed union are usually the result of infection or conditions that decrease the blood supply. No cases of either hardware failure or malunion and nonunion were reported in our study.

CONCLUSION

Rectangular grid plates used in this study not only showed similar benefits of conventional miniplate but also satisfied biomechanical requirements for occlusal loading and preventing inferior border splaying with additional advantages of easier handling and fewer complications. Further experimental and clinical studies with larger sample size and similar parameters in multicenter studies having long term follow up should be carried out to derive a more comprehensive conclusion for application of these plates in mandibular angle fractures.

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