

Comparative Evaluation For Efficacy of 3d Cortical Plates Versus Conventional Cortical Miniplates For Internal Fixation Of Parasymphysis And Symphysis Fractures Of Mandible.

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ABSTRACT- Mandibular fractures usually result from direct impact to the lower jaw. The present study was conducted to compare conventional 2D miniplates vs 3D miniplates in mandibular symphysis & parasymphysis fractures. **Materials & Methods:** 40 cases of mandibular fractures of both genders were equally divided into 2 groups. Group 1 patients were treated with 2.0mm conventional 2D miniplates & group 2 patients were treated with 2.0mm 3D miniplates. **Results:** Both groups showed similar outcomes in terms of treatment efficacy, fixation stability, and postoperative complications. **Conclusion:** The 3D miniplates offer advantages such as three-dimensional stability, resistance against torque forces, and reduced infection rates. However, they do not significantly differ from 2D miniplates in terms of morbidity or complications. Further research is needed to conclusively determine if one system provides extra benefits over the other.

KEYWORDS: TRAUMA, OPEN REDUCTION & INTERNAL FIXATION, CONVENTIONAL 2D MINIPLATES, 3D MINIPLATES, MANDIBLE FRACTURE.

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I. INTRODUCTION

The individuality of a man is represented by his face. The face is crucial and injuries to face results in divesting physical and emotional sequelae. Fast convergence of rapid cars with helpless street conditions, viciousness, sports related wounds has alarmingly expanded in the previous few decades. The other causes of maxillofacial injuries are interpersonal violence, falls, and industrial trauma¹. Prominence of the mandible on the face makes it more prone to injury in such circumstances and is hence, one of the most usually broke facial bones. The treatment of trauma has significantly advanced over time, progressing from supportive bandages to semi-rigid and then rigid fixation methods. After World War II the treatment modality has changed from closed reduction and a course of prolonged maxillomandibular fixation to open reduction and wire osteosynthesis². Wire osteosynthesis was subsequently replaced by open reduction and rigid internal fixation with bone plates and screws including Luhr's Vitallium compression plates, Schmoker and Spiessl's dynamic compression plate [DCP], eccentric dynamic compression plates [EDCP], reconstruction plates, monocortical noncompression miniplates, lag screws, 3-dimensional [3D] plates and locking plates³. Rigid internal fixation of mandibular fractures removes the necessity for intermaxillary fixation, enabling stable anatomical alignment and minimizing the risk of postoperative displacement of fractured fragments. This approach supports immediate restoration of normal function. Champy's miniplates utilizes effectively bendable mono-cortical, juxta alveolar small malleable plates with monocortical screws along an ideal osteosynthesis line⁴. Posterior to the mental foramen, a single plate is placed below the dental roots and above the inferior alveolar nerve. Anterior to mental foramina two plates are necessary to neutralize the torsional forces⁵. They showed that miniplates achieve the goal of osteosynthesis by neutralizing undesirable tensile forces while retaining favourable compressive forces during function. There were some limitations like: torsional movements of fracture segments under functional loading, wound dehiscence, loosening of screws leading to failure of fracture treatment, plate pressure following disturbance of vascular supply, and necrosis of bone, especially around the screws. The shortcomings of rigid and stable fixation have led to the development of 3 dimensional (3D) miniplates⁶. Use of 3D was first reported by Farmand and Dupoirieux in 1993. It consists of two conventional miniplates, which are interconnected by vertical cross struts. A 3D plating system works on the principle of providing support through geometrically stable dimensions of the fracture site

offering resistance against torque forces⁷. This study compares the efficacy of 2mm 3D miniplates versus 2mm conventional cortical miniplates for internal fixation of parasymphysis and symphysis fractures of mandible.

II. MATERIALS AND METHODS

The study was conducted in the Department of Oral and Maxillofacial Surgery of People's Dental Academy, Bhanpur, Bhopal on 40 patients with clinical and radiological evidence (orthopantomogram) of mandibular symphysis and parasymphysis fracture. The patients were assigned randomly into 2 groups; 20 patients in group1 were treated by open reduction and internal fixation using 2.0 mm 2D conventional miniplates, and 20 patients in group 2 were treated by using 2.0 mm 3 Dimensional miniplate under general anaesthesia (GA) / local anaesthesia (LA). Results were evaluated by statistical analysis to meet the objectives of the study after obtaining ethical clearance. All patients provided written consent after receiving detailed information. Patients with isolated fractures of mandibular symphysis and parasymphysis, aged between 18-50 years and with satisfactory general health conditions without any systemic disease were included in the study. The intraoral mandibular vestibular degloving approach/extraoral existing wound was used. The mucoperiosteal flap was raised carefully keeping the mental neurovascular bundle intact. Fracture site was exposed adequately. Intermaxillary fixation (IMF) was applied. The segments were manipulated and reduced anatomically to achieve occlusion. Then fractured segments were fixed using two 2mm miniplates in group1. One plate was fixated at the lower border of mandible with 2.0X10 mm screws. The upper plate was placed below the root apices of mandibular teeth and fixed with 2.0X10 mm screws. In the group2, a single 2mm 3D miniplate was used and fixed with 2.0X10mm screws. IMF was released after checking occlusion. Closure was completed with a single layer using 3.0 RB vicryl sutures. Pressure dressing was done. Postoperatively IV antibiotics, analgesics & anti-inflammatory were given for 5 days. Subsequent follow ups were done at 7th day, 15th day and 4th week postoperatively. All the patients were subjected for post operative OPG at the interval of 1 & 4th week.

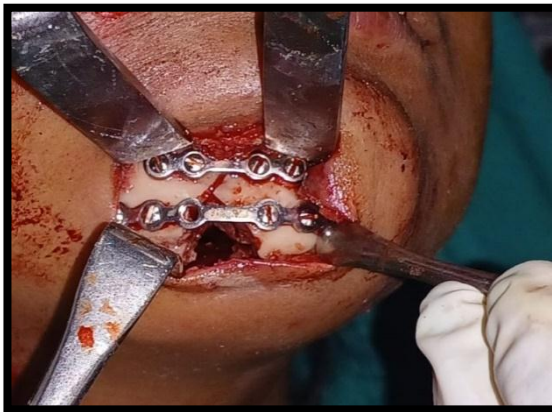


Fig.1. Case 1. Fixation of fracture segments with 2mm SS 2D miniplate using 2x10mm screws



Fig.2. Case 1. Post operative OPG showing fracture reduction with 2D miniplates

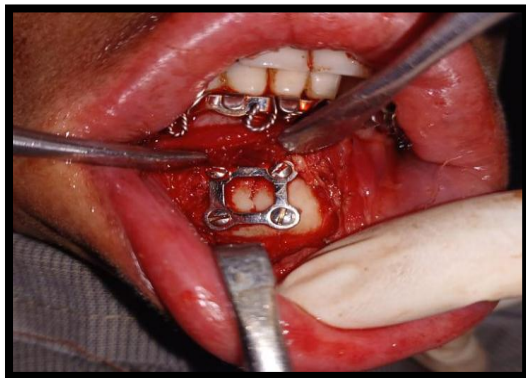


Fig.3. Case 2. Fixation of fracture segments with 2mm SS 3D miniplate using 2x10mm screws

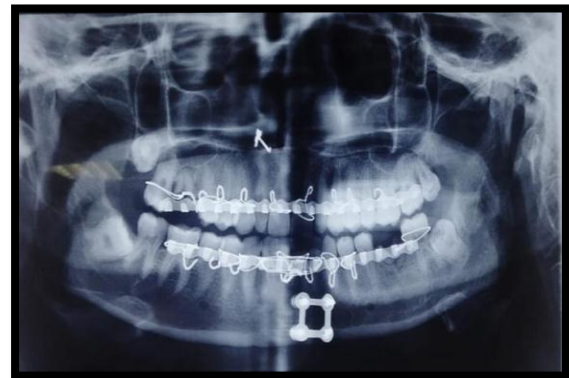


Fig.4. Case 2. Post-operative OPG showing fracture reduction with 3D miniplate

III. RESULTS

Fig.5. Comparison between the study groups according to various study variables

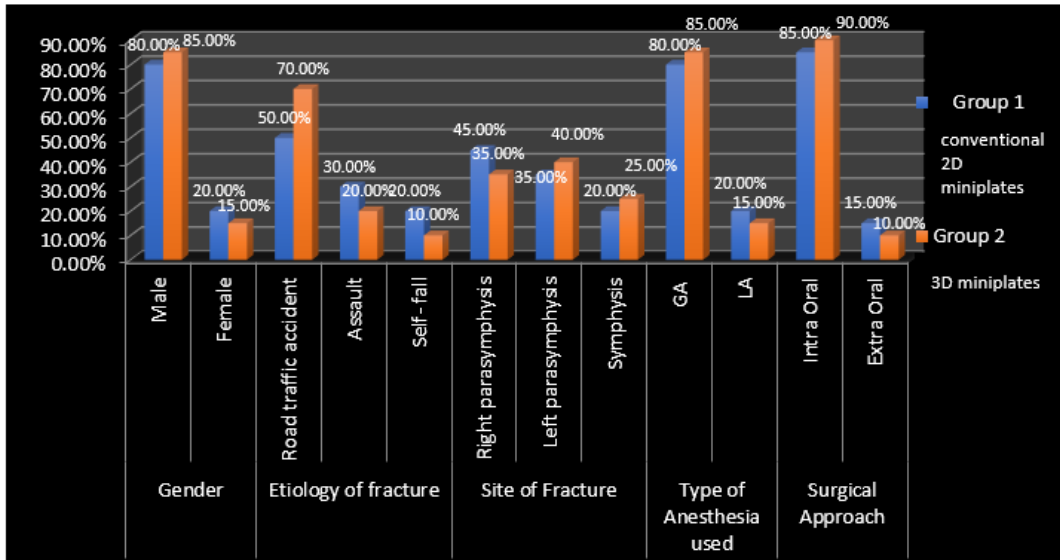
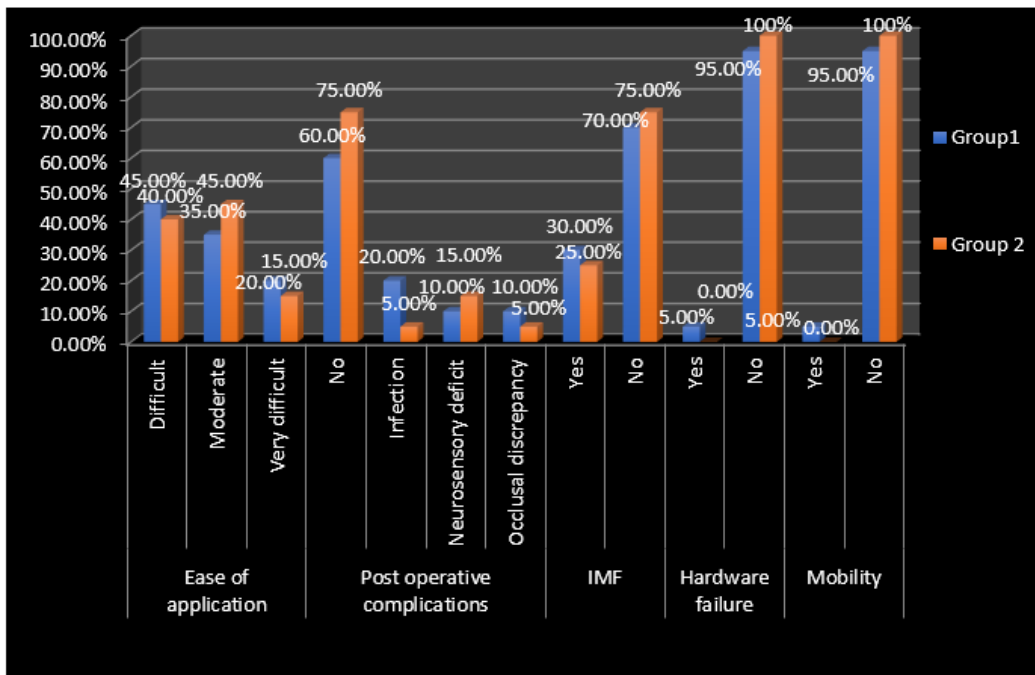


Table 1. Comparison between the study groups according to intra-operative time taken for the procedure

Groups	Time (Minutes)	Minimum time	Maximum time	p- value
	Mean±SD	Mean	Mean	
Group 1 (Conventional 2D miniplates) (n=20)	62.00±14.66	55.1350	68.8650	0.000*
Group 2 (3D miniplates) (n=20)	52.75±11.86	47.1981	58.3019	

*Statistically Significant

Fig.6. Comparison between the study groups according to various post-operative variables



Statistical Analysis was carried out using Statistical Package for the Social Sciences (SPSS) software, version 25.0, (IBM SPSS, Inc. Chicago, Illinois). Pearson's Chi-squared test and Student t- test was used to compare the groups. For all statistical purposes, a p-value of ≤ 0.05 was considered significant.

In the present study, a total of 40 participants divided equally into two groups of 20 participants each, out of which 82.5% were men and 17.5% were women. The average mean age of the study participants was 36.47 years. Road traffic accident was the most frequent cause of fractures reported by patients (60%) followed by assault (25%) and self-fall (15%). In group 1, the right parasymphysis was the most prevalent site (40.5%), followed by the left parasymphysis (35%) and the symphysis (20%). In group 2, the left parasymphysis (40%) was the most frequent site, followed by the right parasymphysis (35%) and the symphysis (25%), albeit the difference was not statistically significant ($p=0.807$). General anesthesia (GA) and local anesthetic (LA) made up 82.5% and 17.5%, respectively, of the anesthesia used in the current study. In groups 1 and 2, respectively, the intraoral technique was employed most frequently (85% and 90%) and the extra oral approach less frequently (15% and 10%), although there was no statistically significant difference between the groups ($p=0.633$) (**Fig. 5**). In the current study, group 1's mean intraoperative procedure time was 62 minutes and group 2's was 52.75 minutes (**Table 1**). In the current study, when comparing post-operative factors such ease of application, group 1 cases were difficult in 45% of cases, moderately difficult in 35% of cases, and very difficult in 20% of cases. In group 2, 15% of the instances were very difficult, 40% of the cases were difficult, and 45% of the cases were moderately difficult. The difference between the groups was not statistically significant ($p=0.798$). When assessing post-operative complications in the current study, group 1 included 60% of cases reporting no issues, 20% of cases reporting infection, 10% of cases reporting neurosensory loss, and 10% of cases reporting occlusal discrepancy. In group 2, where 75% of cases reported no problems, 5% of cases reported infection, 15% of cases reported neurosensory loss, and 5% of cases indicated occlusal discrepancy. The difference between the groups was not statistically significant ($p=0.446$). In the current study, there were 30% IMF (Intermaxillary fixation) reports in group 1 and 25% in group 2. Regarding the postoperative hardware failure & plate mobility, although there were no instances reported in group 2 compared to group 1, only one patient reported to hardware failure, the difference between the groups was not statistically significant ($p=0.311$) (**Fig.6**).

IV. DISCUSSION

Over time, treatment methods for mandibular fractures have undergone numerous improvements. The adoption of 3D miniplates for mandibular fractures has not yet been widely accepted.

Using a simple cantilever beam model, **Champy et al (1978)**⁶ showed that the superior border of mandible was subjected to tension and splaying, and the inferior border was subjected to compression. The transition zone between the areas of tension and compression has been referred to as a "Line of Zero Force" running along the inferior alveolar nerve. Champy's experiment with miniplates further delineated the "Ideal Line of Osteosynthesis" with the mandible. Plates positioned along these lines were considered to offer the best fixation & stability. Few surgeons predominantly use 3D locking titanium plates for fixation of the mandibular angle region. Recently **Hughes (2000)**⁸ extended its use to the anterior mandible. Its use in the maxilla has remained skeptical, with **Farmand (1993)**⁷ being the only surgeon to have used them for the maxillary fracture osteosynthesis. Our study evaluated the use of 3D miniplates for fixation of the mandible fracture in symphysis and parasymphysis region.

In the present study there were two groups of 20 participants each, totaling a total of 40 participants in the study. In total, 82.5% men and 17.5% women participated in the study. The average mean age was 36.47 years. Road traffic accident was the most frequent cause of fractures reported by patients (60%) followed by assault (25%) and self-fall (15%) in this study. **Rajendra Prabhu Abhinav et al (2019)**⁹ concluded that young males are more prone to fractures due to road traffic accidents because young adults have a higher social activity and are more likely to engage in contact sports, alcohol consumption, and vehicular travel. **Fabio Rocchia et al (2022)**¹⁰ & **Haug et al (2002)**¹¹ also concluded the same. In our study, right parasymphysis (40%) was the most often fractured area, followed by the left parasymphysis (37.5%) and the symphysis (22.5%). **T Sarvanan et al (2020)**¹² did a cross sectional study including 50 patient of mandibular fractures and found parasymphysis to be the most common site of injury (44.83%). In our study, mean intraoperative procedure time for group 1 was 62 minutes and for group 2 was 52.75 minutes. **Hughes (2000)**⁹ in their clinical study stated, that the easier application of 3D locking plates was reflected in a reduced average operating time. In our study, it was observed that 30% patients required postoperative IMF in group 1 and 25% in group 2. Displacement of fracture and associated condyle fracture was also responsible for post operative IMF. We recommend postoperative IMF if required for a period of 5 days, which is supported by many other studies **Edward Ellis III and John Graham (2002)**¹³. When assessing post-operative complications in the current study, group 1 included 60% of cases reporting no issues, 20% of cases reporting infection, 10% of cases reporting neurosensory loss, and 10% of cases reporting occlusal discrepancy. In group 2, where 75% of cases reported no problems, 5% of cases reported infection, 15% of cases reported neurosensory loss, and 5% of cases indicated occlusal discrepancy. **Guimond, Johnson and Marchena**

(2005)¹⁴, a total of 37 patients with mandibular angle fracture fixated with a transorally placed curved 2.0 mm 3D titanium strut plate, two patients developed infection. **Zix, Lieger and Ilizuka (2007)**¹⁵, a total of 20 patients with mandibular angle fracture fixated with a transorally placed curved 2.0 mm 3D titanium strut plate, 2 patients developed mucosal dehiscence with no consequences, 2 patients had neurosensory disturbance after 3 months and none developed an infection. In our study, treatment outcomes for group 1 & group 2 were comparable. But on comparing, we found no significant differences between the two groups.

V. CONCLUSION

In our study we compared and evaluated the efficacy of 2mm 3D miniplates to conventional cortical 2mm 2D miniplates in the osteosynthesis of symphysis and parasymphysis fracture of mandible on the basis of treatment outcome, stability of fixation and post operative complications. Quadrangle geometry of 3D plate assures a three-dimensional stability of fracture sites and offers good resistance against torque forces, thereby avoiding the need for inter-maxillary fixation, ensuring early restoration of mandibular function, and reduced rate of infection and implant failure at fracture site postoperatively. Simplicity, malleability, low profile and reduced infection rate are its advantages over conventional 2-D miniplates. Precise adaptation of 3-D miniplates is not required and does not affect their mechanical behavior. As a result, placement of plate becomes easier and less time-consuming. But in mental region, we can adapt the 2D miniplates easily and thus we can prevent nerve injury without altering the ideal line of osteosynthesis. No significant differences were found between the two groups in terms of overall morbidity or specific complications. The two systems seen to confer no extra benefit to patients, but a much longer trial would be required to show this conclusively.

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