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Research Article

A COMPARISION OF 3-DIMENSIONAL AND STANDARD MINIPLATES FIXATION IN THE MANAGEMENT OF MANDIBULAR FRACTURES

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ABSTRACT

Purpose: To compare and evaluate 3-dimensional (3D) and conventional 4-hole miniplates fixation in the management of mandibular fractures.

Materials and Methods: In 20 randomly selected patients who sustained mandibular fractures were selected for this study. Of the 20 cases, in 10 cases fractured fragments were stabilized using 2.0mm 3-Dimensional miniplates and in remaining 10 cases the fractured fragments were fixed with conventional 2.0mm miniplates. Post operatively cases were assessed clinically and radiographically at immediate post op, 1month and 3months.

Results: This study suggests that fixation of mandibular fracture with 3D Plates provide three dimensional stability and carries low morbidity and infection rates. The only probable limitation of these plates may be excessive implant material due to the extra vertical bars incorporated for countering the torque forces and in cases where the fracture line passing through the mental foramina region.

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. They seem to be an easy to use alternative to conventional miniplates. But the small sample size and limited follow up could be considered as the limitations of our study.

INTRODUCTION

- Fractures of mandible are most common bone injuries because of its prominence and exposed position within the facial skeleton accounting for 23% - 97% of all facial fractures. The most common mechanisms of injury to mandible include interpersonal violence, motor vehicle crashes, falls, fights and sport injuries. The body and posterior region of the mandible are more prone for fractures [1].
- During the following two decades a large number of modifications of plates were described, which led to the present use of osteosynthesis. Today, many different systems are available, ranging from the heavy compression plates for mandibular reconstruction to low profile plates for midfacial fixation. The thickness of plates ranges from 0.5 to 3.0mm and are made either of stainless steel, titanium, or vitallium. Recently, biodegradable, self-reinforced polylactide plates and screws have been used for the internal fixation of fractures of the mandible with good results [2].
- The shortcomings of rigid and semi-rigid fixation led to the development of 3- dimensional (3D) miniplates consisting of two 2-hole miniplates with gap which are interconnected by vertical cross struts. The quadrangle geometry of plates assures a good stability in three dimensions of the fracture site since it offers good resistance against torque forces[3].

MATERIALS AND METHODS

The study was conducted in the department of Oral and maxillofacial surgery at St.Joseph Dental College and Hospital at Duggirala, Eluru. 20 randomly selected patients who sustained mandibular fractures were selected for this study irrespective of sex. Of the 20 cases, the fractured fragments were stabilized using 2.0 mm 3-dimensional plates in 10 cases and in the remaining 10 cases the fractured fragments were fixed with 2.0 mm conventional miniplates.

Inclusion Criteria

- Patients of both genders within the age group of 20 to 50 years.

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- The patients who require open reduction and internal fixation for mandibular fractures with or without middle 1/3rd fractures.
- Non comminuted mandibular fractures.
- Non infected fracture site.

Exclusion Criteria

- Comminuted fractures.
- Medically compromised patients.
- Patients with gross infection at the site of fracture.

MATERIALS

The following materials were used in the study

Plates

Dimensional Miniplates

3-D plates are formed by joining two miniplates with interconnecting vertical crossbars. 2mm 4 hole 3-D stainless steel miniplates were used in this study.

Conventional Miniplates

2mm 4 hole with gap stainless steel miniplates were used in this study.

Screws

2 X8 mm stainless steel screws were used.

METHODOLOGY

In all patients Erich's arch bar fixation or eyelet fixation or IMF screws fixation was done preoperatively. As per the surgical principles all the ten patients underwent a through pre-operative evaluation comprising of

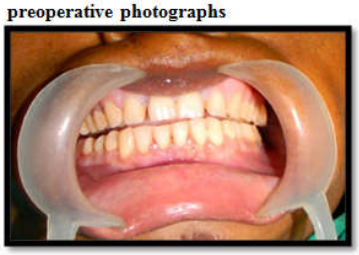
1. Detailed case history.
2. Clinical examination.
3. Radiographic examination.
4. All necessary haematological investigations.
5. Preanaesthetic evaluation.

- In 10 patients mandibular fractures were fixed with 2.0mm 3-dimensional,4-hole stainless steel plates and 2.0mm x 8mm screws and it is considered as Group-I. 10 selected patients with mandibular fractures were fixed with 2.0mm, 4-hole standard stainless steel miniplates and 2.0 mm x 8mm screws using Champy's principle and it is considered as Group-II. Closure was done with 3-0 vicryl or 3-0 chromic catgut sutures.
- Antibiotic coverage (inj. Cefotaxime - 1gm 12th hourly and inj. Metronidazole - 500mg 8th hourly) and Betadine mouthwashes were given pre-operatively from the time of admission till 5th post-operative day. All cases have been followed up for a minimum period of 3 months.

Photographs

A case of 3-dimensional plate fixation

preoperative photographs



Occlusion

Radiograph

Intraoperative Photographs

Fracture site

Fracture Fixation

Post operative Photographs

Occlusion

Radiograph

Post-operative assessment of the cases was done using the following Clinical and Radiological parameters

- Duration of operation time (Plate adaptation to plate fixation).
- Segmental mobility.
- Improper occlusion.
- Radiological evaluation of reduction and fixation.
- Postoperative complication.

RESULTS

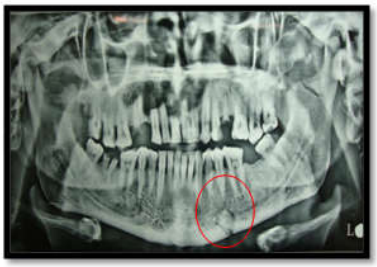
- In a sample size of 20 patients with maxillofacial trauma, 12 patients sustained mandibular fractures due to Road traffic accidents (RTA) and 8 patients due to accidental fall.
- After fixation of the fracture with 3D miniplates and conventional miniplates, routine post-operative OPG was taken 1 day after the procedure to evaluate the reduction of fracture. Follow up OPGS were taken after 1st month and 3rd month. Duration of operation time (Plate adaptation to plate fixation) was less in Group I when compared with Group II.
- Anatomical reduction of the fractured segments was good in group I than group II when compared in post operative OPG.
- Mobility of the fractured fragments was negligible with 3D plate fixation (group I) than that of the conventional miniplate (group II) during bimanual palpation.
- Adequate occlusal stability was achieved in group I patients when compared with group II patients. No mobility of fractured segments in 3-D plates as the vertical bars overcomes rotational forces.
- Postoperative infection was noticed in one patients of Group II (case no -18). The infection was subsided by incision and drainage followed by antibiotics. Plate removal was not needed.
- None of the cases had either delayed healing or non-union.
- This study shows favourable results on use of 3-Dimensional miniplates in mandibular fractures.

DISCUSSION

- FARMAND in 1992 developed the concept of 3D miniplates. Their shape is based on the principle of the quadrangle as a geometrically stable configuration for support. When the mandible is in function, primary forces of concern include bending, vertical displacement and shearing. In the 3D miniplate since the two horizontally placed miniplates are further joined by using vertical struts they further minimize bending. Since the entire plate acts as one single unit, because of its interconnections and quadrangular shape, the vertical displacement and shearing of bone is also reduced to minimal, thus holding the bone fragment in three dimensions.

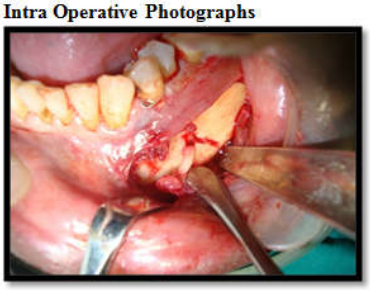
A case of Conventional Plate Fixation
Pre operative Photographs

Occlusion



Radiograph

Intra Operative Photographs



Fracture site

Fracture Fixation

Post Operative Photographs

Occlusion

Radiograph

Tables

Following table shows details of the group I and II patients who sustained mandibular fractures.

Group I Patietns (3-D Mini Plate)

Serial no	Diagnosis
CASE NO 1	Symphysis and bicondylar fracture of the mandible.
CASE NO 2	Left parasymphysis fracture of mandible
CASE NO 3	Right parasymphysis, right zygomatic and bicondylar fracture of mandible
CASE NO 4	Left parasymphysis fracture of the mandible
CASE NO 5	Left parasymphysis and right angle fracture of the mandible
CASE NO 6	Right parasymphysis fracture of the mandible
CASE NO 7	Symphysis fracture of the mandible
CASE NO 8	Right parasymphysis fracture of the mandible
CASE NO 9	Symphysis fracture of the mandible.
CASE NO 10	Right parasymphysis fracture of the mandible

Group II Patients (Conventional Mini Plate)

Serial no	Diagnosis
CAES NO 11	Right parasymphysis and left body fracture of mandible
CASE NO 12	Right parasymphysis fracture of the mandible
CASE NO 13	Left parasymphysis fracture of the mandible
CASE NO 14	Right body fracture of the mandible
CASE NO 15	Right parasymphysis and left condylar fracture
CASE NO 16	Right parasymphysis and left body fracture of mandible
CASE NO 17	Left body fracture of mandible
CASE NO 18	Symphysis fracture of mandible
CASE NO 19	Symphysis fracture of mandible
CASE NO 20	Right parasymphysis and left condylar fracture

Since the stability achieved by the geometric shape of these plates surpasses the standard miniplates, the thickness can be reduced to 1 mm. The basic form is quadrangular with 2 ×2 hole square plate and 3×2 or 4×2 hole rectangular plate. Unlike compression and reconstruction plates, their stability is not derived from the thickness of the plate. In the combination with the screws monocortically fixed to outer cortical plate, the rectangular plates form a cuboid, which possess 3D stability. The 3D plating system is based upon the principle of obtaining support through geometrically stable configuration [3].

- The 3D miniplate itself was a misnomer as the plates themselves were not 3-dimensional, but holds the fracture segments rigidly by resisting the 3-dimensional forces namely shearing, bending and torsional forces acting at the fracture site in function.
- In group I patients, out of 10 cases 7 were due RTA and 3 were due to accidental fall. In Group II patients 6 were due to RTA and 4 were due to accidental fall. Of the 20 patients with mandibular fractures 13 patients had single unilateral fractures, and 7 patients had bilateral fractures. Parasymphyseal fractures were most common type of fractures followed by symphyseal fractures. In study of 191 patients of 280 mandibular fractures frequent location was the angle region (28.21%), parasymphyseal (21.07%) in order of frequency [4] [5].
- The two groups were compared. The patients were evaluated presurgically, the day after surgery, 1month and 3months postoperatively. In group I patients, three of the patients required IMF post-operatively because of condylar fracture (Case No: 1&3) and due to gross displacement (Case No: 5); in group II, 4 patients required IMF post-operatively because of condylar fracture (Case No: 15&20) and due to gross displacement (Case No: 16).
- The time required for the adaptation and fixation of the plate at the fracture site was recorded for both the groups. In our study the operating time required for the adaptation and fixation of 3D plate was less when compared with conventional miniplates. ZIX *et al* [6] and others [7], [8] on 3D plate who reported reduced operating time because 3D plate is geometric configured plate which consist of two horizontal bars interconnected with two vertical bars. So single 3D plate stabilized the fracture both at superior and inferior border at a time, hence time is saved in plate fixation.
- Post operative radiographic evaluation in group I patient showed excellent reduction in 7 patients and good reduction in 3 patient. In group II, 5 patients showed excellent reduction and 5 patients showed good reduction.
- Seiji Nakamura *et al* [9] and others [10] noticed post operative complications like malocclusion (3.6%), exposure of miniplate (3.6%), delayed union (1.8%) and infection (1.0%) in 110 patients with mandibular fractures. Post operative complications may be due to inadequate reduction and stabilization, delay in treatment, teeth in fracture line, failure to provide antibiotics, alcohol or drug abuse[11], [12]. Claude Guimond *et al* [13] used 2mm 3-Dimensional curved angle strut plate; they noticed low morbidity and infection rate. In our study we noticed post operative infection in 1 patient in group II, which subsided on incision and drainage and medication (Case No:16)
- Lesilie R. Halpern *et al* [14] conducted a prospective study on perioperative neurosensory changes with treatment in 61 patients with 97 mandibular fracture sites. They found IAN neurosensory disturbances were unchanged or improved immediately after treatment in most patients. In our cases temporary paresthesia was noted to be present in 2 patients in group II (Case No:12 & 17)
- M.Witten berg *et al* used 3-D plates in mandibular fractures and they noticed that the use of 3-D plates easier to place intra orally [15]. Because of closed quadrangular geometric shape and ease of contouring and adapting to bony fragments it provide good stabilization in three dimensions]. So there is a low morbidity and infection rate.
- The only probable limitation may be excessive implant material due to extra vertical bars for countering the torque forces and in case where the fracture line passing through the mental foramina. This finding was true even in our study and there is a difficulty in adaptation of 3-D plate at the mental foramina area with intact nerve bundle. In case no- 5(left parasymphysis and right angle fracture) 3-D plate adaptation was good at parasymphysis region where as at angle region 3-D plate adaptation was found to be difficult through intra oral incision. So conventional plate was placed. In such cases fixation of mandibular angle fractures with a 2mm 3-D curved angle strut plate via percutaneous fixation as suggested by Claude Guimond *et al* [13] may be an alternative.

SUMMARY AND CONCLUSION

The following conclusions were drawn from the study:

1. 3D plates were indeed easy and simple to use. Significant reduction in operating time could be achieved with the use of 3D plates which makes it a time-saving alternative to conventional miniplates.
2. Patients treated with 3D plates showed a less incidence of occlusal discrepancy than Champy's miniplates.
3. 3D plate fixation showed less amount of mobility between the fractured segments than the conventional miniplate. Though slight amount of mobility persisted after fixation in both the groups, it neither caused the derangement of occlusion nor predisposed to infection. Thus though not truly rigid, the plates seems to have a sufficient rigidity to give rise to adequate healing.
4. Other complications were found to be extremely rare.

- The probable limitations of 3D plates may be excessive implant material due to the extra vertical bars incorporated for countering the torque forces, cases where the fracture line passes through the mental foramina region and angle of the mandible. So in this situation Conventional miniplates has advantage over the 3D plates.
- The results of the present study were put to comparison with previous studies on fracture mandible and were found to be in accordance with them.
- All patients in present study appreciated early recovery of normal jaw function, primary healing and good union at fracture.
- During the course of present study, 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.
- To conclude, 3D plate seems to be an easy alternative to conventional miniplates. The small sample size and limited follow up could be considered as the limitations of our study. It is hence recommended to have a multicentre study with large number of patients and correlation among these studies to authenticate our claims.

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