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Versatility of various 3D non locking miniplates in treatment of mandibular fractures

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Abstract

Context: The optimal management of mandibular fractures continues to evolve. Fractures of mandible predispose the patients to structural, functional and aesthetic compromise if not treated. The current understanding of the biomechanics and fracture healing of the mandible has influenced the modern approach to the open reduction and internal fixation of these fractures. These help us to evaluate shortcomings of compression plates and 2D miniplates leading to development of 3D plates.

Aims: To evaluate the versatility and efficacy and complication of 3 different varieties of 3D non locking plates—2x2 and 2x3 and delta plates in the treatment of mandibular fractures at different sites.

Materials and Methods: A total of 86 patients of mandibular fractures were managed by open reduction and internal fixation utilizing total 114 three dimensional plates (109 non locking 3D plates (2X2,3X2) and 5 delta plates) were used for fractures of the mandible including symphysis, parasymphysis, body, angle, ramus and condyle over a period of 3 years.

Results: The use of 3D plates provided semi-rigid fixation of fractured fragments with no immediate post-operative mobility. Immediate and subsequent postoperative clinical and radiographic evaluation was carried out at 15 days, 1 month, 3 months and 6 months. Post-operative complications observed were post-operative neurosensory deficit in 3 patients, occlusal discrepancy in 3 patients, wound dehiscence in 2 patient, plate exposure in 1 patient and parotid fistula in 1 patient which accounted for 8.6% of total patients. None of the patient suffered from Infection, segmental mobility, paraesthesia. Malunion, non-union. All these were treated successfully with definitive measures.

Conclusion: The 3D mini-plate system is a versatile and efficient method for fixation of mandibular fractures. Delta plates are efficient method for reduction and fixation of subcondylar fracture. The only contraindication for 3D plates is their use in mental foramen region (where distance between mental foramen and inferior border is less than 1.5cm).

Keywords: 3D non locking plates, delta plates, mandible fracture

Introduction

The present era is a quite swift, resulting in a race towards a result-oriented life making a definite impact on the common man. Road traffic accidents remain among the main reasons of maxillofacial injuries followed by the trauma resulting from assault and interpersonal violence [1]. Maxillofacial trauma is very common in all these unforeseen events and the unique position of the mandible on the face makes it vulnerable making isolated mandibular fractures most common, followed by isolated mid face fractures [2].

The treatment of mandibular fractures has evolved significantly over the past few years. Traditionally, the jaws were immobilized using various techniques. The use of bone plates and screw systems permitted a stable rigid or semi-rigid fixation that eliminated the necessity for maxilla- mandibular immobilisation. The concept of semi-rigid fixation was proposed by Champy *et al.*, [2,3]. He defined the “ideal lines of osteosynthesis. It consisted of mono-cortical, juxta alveolar, and subapical osteosynthesis without compression and intermaxillary fixation using miniaturized malleable plates. Small size of the plate, easy adaptability, easy placement, and use of intraoral approach led to the increased use of mono-cortical plates in maxillofacial surgery [4, 5]. The shortcomings of rigid and semi-rigid fixation were more operating time, occlusal discrepancy, more hardware and infection.

The above shortcomings led to the development of 3 dimensional (3D) miniplates, consisting of two 2-hole mini-plates which are interconnected by vertical cross struts.

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Three-dimensional plates and screws were developed and were reported first by Farmand and Dupoirieux [6-9]. In contrast to linear fixation principle of conventional miniplates along bone trajectory 3D plates are fixed in close vicinity of fracture line [9]. Used in combination with mono-cortical screws fixed to the outer cortical plate of bone, these plates provide three dimensional stability. Because of the quadrangular configuration 1 mm 3D plate provide good stability and resistance to torsional forces than compare to 2mm conventional miniplate. Easy to use, good resistance against torque forces, and compact form of the plates were some of their advantages.

Delta plates, because of geometric configuration efficiently neutralise the tensile and compressive forces and provide stable fixation of condylar fracture possible disadvantages of 3d mini-plates may include need for perfect adaption, low stress shielding effects.

Hence, this study was done to evaluate 3 different (2x2, 2x3, delta plates) types of 3d plates in exclusive fracture of mandible without associated fracture without any associated maxillofacial skeleton.

Materials and Methods

The ethical committee approval was taken. This study was carried out after approval of ethical committee and informed consent was taken from all patients. This study was done over a period of three years in 86 patients who reported to the Department of Oral and Maxillofacial Surgery at Government Dental College and Hospital, Ahmedabad with mandible fracture at different sites.

Surgery was performed patients were systematically followed up post operatively at 1 month, 3 months, 6 months. The mean age of the patients was around 35 years (range 21 to 60 years).

Inclusion criteria

- -Adult patient above the age of 18 years.
- Patients with displaced/undisplaced, non-comminuted mandibular fracture.

Exclusion criteria

- Less than 18 years of age
- Infected fractures and comminuted fracture of mandible.
- Completely edentulous patient.
- Any other associated fracture of maxillofacial skeleton.

For all the patients, detailed accurate clinical and radiological examination were done and history taken. Amongst 86 patients, 30 patients were operated under local anaesthesia and 56 were operated under general anaesthesia.

Intraoral degloving incision was used for symphysis & parasymphysis fracture. Submandibular approach was used for angle fracture. Modified Retromandibular subparotid approach was used for subcondylar fracture. In most cases 3D 2x2 plates were used. In cases with oblique fracture line 3D 3x2 plates were used. 3D Delta plates were used for subcondylar fractures.

Plate design

3D (2x2) plate and (3x2) plate is of 1x1 cm and 2x1 cm in dimension respectively. Their thickness are 1 mm and diameter of plate hole is 2 mm. 3D delta plate is 1 mm thick, 20mm long, and 5 mm wide at the top and 12 mm wide at the base. At the top of the plate is an arm with two longitudinally arranged holes; two more holes form the 2 corners of the base

of the plate.

Plate fixation

In reference to fracture line, 3D quadrangular plates were fixed in such a way that so that horizontal bar of plate are perpendicular to fracture line & vertical cross bar will be parallel to fracture line. In reference to mandible 3D quadrangular plate was placed in such a manner that lower horizontal bar will be 2 to 3mm above the lower border of mandible.

For fixation of these 3D plates, 2mm x 8mm monocortical screws were used in areas near upper border of mandible while 2mm x 10mm monocortical screws were used in areas lying in proximity to lower border of the mandible. After plate fixation, layer wise suturing was done. Post-operative elastics and IMF was not given unless occlusal discrepancy post-operatively.

Patients were prescribed postoperative antibiotics and analgesics for five days. Patients were prescribed soft diet for six weeks. Panoramic radiographs for evaluation of adequacy of surgical reduction and plate localization were taken before discharge.

Observation & Results

The efficacy of 3D plate in mandibular fractures at different regions was evaluated in terms of post-operative occlusion, segmental mobility, parotid fistula, infection, wound dehiscence, neurological deficit, mal-union, non-union.

Treatment of mandibular fractures at different regions with 3D miniplates yielded highly satisfactory results. Post-operative complications included immediate post-operative neurosensory deficit in 3 patients which resolved within 3 months in all patients, occlusal discrepancy in 3 patients which got rectified by 1 week Intermaxillary fixation, wound dehiscence in 2 patients treated by local placentrex injection and resuturing and infection in 1 patients in whom plate was removed after 6 months under local anaesthesia, parotid fistula in 1 patient. Planned follow-up intervals were done at 2 weeks, 1 month, 3 months & 6 months post-operatively. Overall results were quite satisfactory.

Discussion

Internal fixation using miniplates and screws in cranio maxilla-facial surgery is regarded as the "gold standard". Reduction is anatomically perfect and there is bone-to-bone continuity [14]. The main functional advantages of miniplates are improved jaw function (in terms of mouth opening and bite force), decreased weight loss and improved pulmonary function. Other advantages are patient comfort, improved speech and oral hygiene, leading to enhanced social interaction, and a decreased number of hospital visits [15-17].

In the present study, 86 patients were selected and total 114 3D patients were used in them. In our study road traffic accidents were responsible for the majority of cases (51.85%) of mandible fractures followed by interpersonal violence which accounts for 29.62% cases of mandible fracture and finally fall accounted for 12.96% of the cases. This coincides with the study by Bormann *et al.* [18]. There were only 2 patients injured by sports injury and 1 had pathologic fracture. Out of 86 patients in our study, 72 were male and 12 were female. This male dominance in our study is in accordance with study by Haug *et al.* [19]. The age group most commonly affected was 21-30 years (almost 41%).

Complications were encountered in only 10 patients out of 86 patients which eventually got resolved with appropriate

measures. Guimond *et al.* [20] experienced the low incidence of wound dehiscence and plate exposure with 3D plate in comparison to Champy's miniplate. Hence, to minimize the rate of postoperative complications of mandible fractures, 3-D plates could be a better option than conventional 2-mm miniplates [21].

Degloving incision was preferred for fractures treated intraorally. Incision was given at the height in such way that sufficient bulk of mentalis muscle was available on both sides for accurate layerwise closure. Brain *et al.* has suggested any of the incision, transoral or transfacial, may be used for such cases [22].

Oral hygiene was also one of the important parameters of this study and played a very important role in the post-operative healing. All the patients underwent oral prophylaxis before the plating was done and on discharge the patients were advised to continue chlorhexidine mouth rinses for regular use. Oral hygiene was assessed at every visit of the follow up. The results of this study suggest that fixation of mandibular fractures with 3D plates provides three dimensional stability and carries low morbidity and infection rates. It may seem that these plates may be incorporate excessive implant material due to the extra vertical bars present for countering the torque forces. However we need to stress on the fact that 2 miniplates and 8 monocortical screws are usually used for stabilisation of fractured fragments. While only one 3D 2*2/3*2 plate and 4/6 monocortical screws are sufficient to provide adequate rigidity and stability. Hence total implant material used for 3D plates is considerably less compared to conventional miniplates.

The only probable limitation of these plates may be for cases where the fracture line is passing through the mental foramina region.

Conclusion

The results of this study suggest that 3D plates were found to be standard in profile, strong yet malleable, facilitating reduction and stabilization at both the superior and inferior borders giving three dimensional stability and carries low morbidity and infection rates.

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