



THREE DIMENSIONAL MINIPLATE FIXATION IN THE MANAGEMENT OF MANDIBULAR FRACTURES

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ABSTRACT

The optimal management of the mandibular fractures continuous to evolve. Mandibular fractures at different anatomical areas predispose the patient to malocclusion and disfigurement of the face if not properly treated. The current understanding of the biomechanics and fracture healing of the mandible has influenced by the approach to open reduction and internal fixation of these fractures. The study reports if there is any significance in the outcomes of using 3D plating systems in the management of mandibular fractures. The different anatomical sites of mandibular fractures need different treatment modalities. The treatment of mandibular fractures has evolved from various forms of fixation. In our study we used three dimensional titanium miniplates yielding better results than the conventional miniplates.

INTRODUCTION

Fractures of the mandible can cause both functional disabilities and social as well as cosmetic morbidities.¹

Mandibular fractures comprise most of the traumatic facial injuries, which are treated by an oral and maxillofacial surgeons.²

Maxillofacial trauma is a cause of grave concern due to the increasing road traffic accidents, violence and sports injury. The unique position of the mandible on the face makes it one of the most commonly fractured facial bones.³⁻⁵

The mandible is frequently fractured because of its prominence where it occupies a central and

vulnerable position in the face. Its architecture is complex consisting of an articulation with the cranial base, making it the only freely movable bone of the facial skeleton. It is subjected to strong biomechanical distractions by its intimate associations with the facial musculature.^{6,7}

Treatment of mandibular fractures poses a unique challenge for surgeons because they have the highest reported postoperative complication rate of any fractures of the facial skeleton. There are a number of methods used for the treatment of mandibular fractures. Traditionally the treatment modalities have ranged from conservative measures to open reduction with fixation.⁸⁻¹⁰

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The currently used conventional miniplate's technique requires maxillomandibular fixation for short period and to render three dimensional stability at fracture site. The three dimensional (3D) miniplate system is one of the internal rigid fixation for maxillomandibular surgery as these plates based on the principle of obtaining support through geometrically stability in three dimensions of the fracture side since it offers good resistance against torque forces.¹¹

Farmond and Dupoiricux,¹¹ presented 3D plates with quadrangular shape formed by joining two miniplates with interconnecting crossbars, because of the quadrangular configuration of the plates provides good stability and resistance to torsional forces and torque forces, easy use and compact form of the plates were some of their advantages as these plates possess low profile, strong yet malleable, facilitating reduction and stabilization at both the superior and inferior borders.¹¹ This study was designed for evaluating the efficiency of 3D miniplates in the management of mandibular fractures and reporting the complications during its use.

PATIENTS AND METHODS

45 patients (34 males and 11 females) their ages ranged from 18-60 years with mandibular fractures of different sites presented at the Oral and Maxillofacial Surgery Department. Faculty of Dentistry. Tanta University

Patients included in this study on the basis of the following criteria any fracture of the mandible at the symphysis, parasymphysis, body, angle and sub condylar region and also, edentulous patients.

The selected patients were with no history of medical disorders, having no other fractures of facial skeleton expect mandibular fractures at the different sites of the mandible, malunion or non-union cases of fractured mandible, patients with comminuted mandibular fractures or with local bone pathology or systemic diseases that affect bone healing were excluded from the study.

The management of the patients started with immediate resuscitation on the following of the principles of advanced trauma life support.

Thorough history was taken regarding medical problems, time, type and direction of traumatic forces and any treatment performed before arrival. All patients examined clinically by inspection and palpation both extra orally and intra orally

The radiographic findings through panoramic views preoperatively recorded for presence of tooth in the line of fracture, fracture site and presence of additional mandibular fractures, degree of displacement and presence of other pathological entities.

Accurate assessment of the fractures was performed including the site and type of fracture, amount of displacement, amount of pain, discomfort, paraesthesia in the distribution of the inferior alveolar nerve, marginal mandibular never paresis, status of dental occlusion, any associated temporomandibular joint dislocation, or any other functional deficits. All the selected cases were entailed about the surgical procedures including prognosis, potential hazards and complications. Before any procedures patient's informed consent must be obtained for all patients

All patients were managed by rigid internal fixation using three dimensional miniplates. The patients were operated under general anaesthesia via nasoendotracheal intubation by appropriate approach to the fracture site by intra-oral approach.

Prior to open reduction, arch bars were placed for intra-operative intermaxillary fixation, the plates were placed through intra oral approach. Once the fracture has been reduced to the anatomic position, intra operative maxillomandibular fixation was obtained and the plates fixed with mono cortical screws.

The 3D mini plates interconnected by vertical cross struts with the screws mono cortically fixed

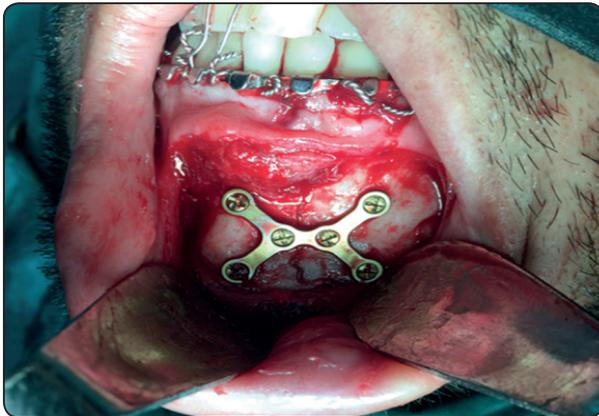


Fig. (1) Intra operative photograph showing proper reduction of the parasymphysis fracture and proper fixation using 3D miniplate.



Fig. (2) Intra operative view showing reduction of mandibular fracture at the right mandibular angle and fixation with 3D miniplate.

to the outer cortical plate, these rectangular plates form a cuboid which posse's 3-D stability as the 3D plating system is based on the principle of obtaining support through geometrically stable configuration. The quadri angle geometry of the plates assures a good stability in three dimensions of the fracture sites since it offers good resistance against torque forces. The 3D plates were adapted across the fracture line in such away that, the horizontal cross bars were prependicular to the fracture line and the vertical struts were parallel to the fracture line, after plate fixation, in all cases the surgical site was copiously irrigated with 5% povidine iodine and irrigation with normal saline, hemostasis was achieved and suturing was done with 3-0 vicryle and 3-0 silk in layers.

Pressure packs were applied and the patients were prescribed antibiotics and analgesics for 5 days. The IMF was removed after two weeks and patients were advised to maintain proper oral hygiene by rinsing the oral cavity with mouth washes as betadine. Patients were prescribed soft diet for sex weeks.

The efficacy of 3D plating system in mandibular fracture fixation was evaluated in terms of operating time coverage, time from incision to closure of the wound, average pain, postoperative

infection, occlusal derangement, wound dehiscence postoperative mobility at the fracture site and neurological deficits. Complications assessed up to 3 months including a: nonunion: persistent mobility between fracture segments on clinical manipulation, b: malunion: based on the clinical and radio graphic assessment, c: infection: case to be considered infected when having discharge with positive culture test, d-occlusal discrepancies: based on clinical examination and information obtained from the patient.

Panoramic radiographs for evaluation of adequacy of reduction and plate localization were taken before discharge. Planned follow up intervals were done at 1, 2, 4, 8, 12 and 24 weeks postoperatively, the radiographs were taken to assess the gap between the fracture segments and to determine the proper position of the 3D plates and also the proper reduction of the fractured segments.

RESULTS

45 patients included in the study their ages in between 18-60 years, with the mean of age 37 years. They comprised 38 males (85%) and 7 females (15%). The most common etiological factors of trauma were road traffic accidents (60%), followed by fall (24%), and assaults (16%). (Table 1)

The most common sites of fractures were parasymphysis (34%), angle (22%), condyle (22%), symphysis and body (11%) for both. (Table 2)

TABLE (1) Distribution of the percentage etiological factors of the mandibular fractures

Causes	Percentage (%)
Road traffic accidents	60%
Falls	24%
Assaults	16%

TABLE (2): Distribution of the percentage of the fracture sites

Fracture site	Percentage (%)
Parasymphysis	34%
Angle	22%
Condyle	22%
Symphysis	11%
Body	11%

The patients were treated within 1 to 5 days with a mean of 3.1 ± 1.27 days from the time of injury.

The mean operation time from the incision to wound closure for symphysis, parasymphysis, body, angle was 55.60 min, but for condylar region was 70.50 min

By the visual analogue scale, the average preoperative pain score was 2.93. There was significantly greater pain on day of surgery and during the 1st week, pain disappeared at the 3rd week.

Patients were evaluated post operatively at 2nd week, 4th week, 3rd and 6th months for signs of inflammation. No cases of severe infection, only three cases with mild infection which will be properly treated with the same regimen of preoperative antibiotics and anti-inflammatories.

Occlusion of the patients was evaluated preoperatively and post operatively at the end of 1st week and 2nd week, no occlusal disturbances was found in 29 cases, but minor occlusal disturbances were found in 13 cases which were corrected gradually by guiding elastics for three weeks and severe occlusal disturbances was found in 3 cases which were corrected by intermaxillary fixation for 3 weeks followed by guiding elastics for another 3 weeks.

No wound dehiscence was reported in any of the 45 patients.

Occlusal disturbances showing no significant

TABLE (3): Cross tabulation of occlusion in all cases:

Occlusion \ Region	Nodisturbances	Disturbances	Total	Chi-square value	P-value
Symphysis	5		5		
Parasymphysis	13		15		
Body	5		5		
angle	10		10		
condylar	9	1	10		
total			45	1.76	0.19

changes checked with chi-square value. The post-operative mobility at the fracture site was found in 6 patients of all cases which were found to be statistically insignificant.

The neurological deficits was reported in 3 patients only, appeared as paraesthesia of the lower lip, these patients were followed up until regained normal neurosensory function spontaneously after four weeks in two patients and after six weeks in the other patients.

In immediate postoperative radiographs taken within two days, reduction of fractures was assessed as exact in all cases but radio lucencies representing the fracture lines were still noted in all cases.

Radiographic examination at 1st month post operatively revealed no changes in the position of the fractured segments and the fracture lines were still noted in all cases.

Radiographic examination at the 3 months post operatively revealed no changes in the position of the fractured segments and the fracture lines are hardly detected. At the end of the follow-up period none of the patients showed any signs of malunion or nonunion. Figs (3-7)

The fracture line could not be detected on the radiographs after six month. No signs of adverse effects were seen around the screws, and no external callus was detected.

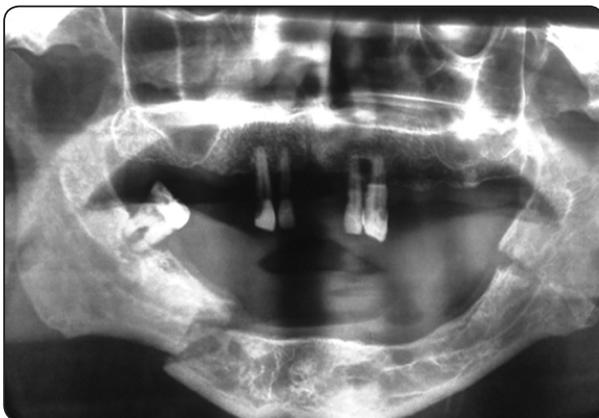


Fig. (3) Ortho pantomograph showing bilateral mandibular Fractures (right body left angle)



Fig. (4) Ortho pantomograph showing proper reduction of the bilateral mandibular fractures and proper fixation using mini 3D plates

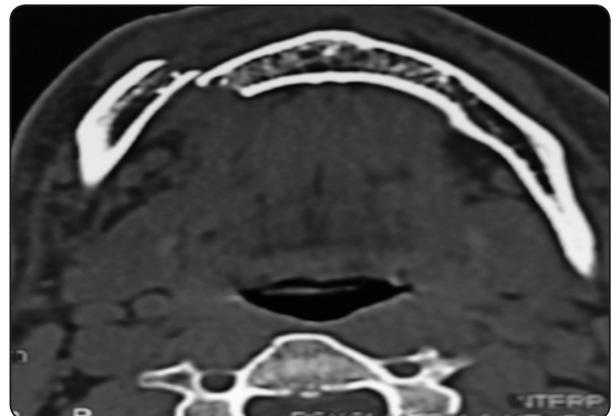


Fig. (5) Axial view (CT) scan showing parasymphysis fracture of the mandible.



Fig. (6) Orthopantomograph showing bilateral mandibular fractures (right body and left angle)



Fig. (7) Orthopantomograph showing proper reduction and fixation of mandibular body and subcondylar fractures and fixation with 3D miniplates.

DISCUSSION

The objectives in the treatment of fracture mandible are to re-establish normal occlusion and masticatory function with minimal disability and complications, this is performed by immobilizing the mandible for the accurate healing period by intermaxillary fixation which is achieved by dental wiring, arch bars, cap splints, gunning splints. Operative treatment of mandibular fractures involves intraoral or extraoral opening of the fracture sites and direct osteosynthesis with transosseous wires, lag screw or bone plates. A number of fixation methods have been advocated for the mandibular fractures treatment.

Methods of osteosynthesis may be evaluated not only by the reduction achieved and the stability of fixation, but also by their technical applications, economic aspects involved, and increasingly by the extent of trauma resulting from the used surgical approach. Methods should be selected only when they ensure early full rehabilitation of the patient in combination with minimally invasive surgery and economic use of materials and time. The less technical input required for a particular method, the more it will be accepted. Also, adequate knowledge

of biomechanics and static and dynamic forces acting in the region being restored are important factors for successful management many factors are usually taken in consideration when selecting the methods of fixation of mandibular fractures. The nature of injury, presence of other associated fractures, medical and economic status of the patient and surgeons experience are some of these factors. Also, the site of injury dictates to great extent the selected method of fixation.¹²

Rigid internal fixation with metal plates and screws is used extensively to secure bone fragments in fracture surgery. Development of more biocompatible osteosynthesis materials such as titanium has led some to recommend leaving these materials in situ favor.^{14,15}

In a recently published survey of 104 North American and European Ao/AsIF surgeons, emphasizing the 3D-related advantages over conventional mini plates and reconstruction plates include easy application, these advantages to the bone with out simplified distortion or displacement to the fracture, simultaneous stabilization at both superior and inferior borders and hence less operative time.¹²⁻¹⁴

In this study, the time required for adaptation of these plates at different fracture sites of the mandible was recorded, as the operating time for adaptation and fixation for 3D plating was short when comparing with the time for conventional miniplates. This led to reduction of the total operating time in this study with this plating system of internal fixation this result was in agreement with Guimond et al, 2005¹⁶ and Babu et al, 2007.¹⁷

In our study, road traffic accidents were responsible for majority of cases of (60%) of mandible fracture followed by fall injury accounts (24%) and assaults represent about (16%) of cases of mandible fractures, this is in accordance with the study achieved by Bormann et al., 2009¹⁸.

In our study there is male dominance as the male reported 85% off all cases of our study and the age commonly affected was 22-38 years and this was as reported by Haug et al.,1990.¹⁹

Open reduction with internal fixation with metal plates used to immobilize fragments of the jaw, morbidity of the procedure is low with the advantage that the patient returns to normal functions within days of treatment.¹³ The intra oral approach is preferred unless indicated other wise it is time saving and less traumatic.²⁰

The 3D miniplates is amisnomer as the plates are not three dimensions namely shearing, bending and torsional forces. The stability is gained over a defined surface area and is achieved by its configuration and not by thickness or length. The large free areas between the plate arms and minimal dissection permit good blood supply to the bone.¹¹ The 3D plating system provides definite advantages over conventional miniplates. The 3D plating system uses fewer plates and screws as compared to conventional miniplates to stabilize the bone fragments. Thus it uses lesser foreign materials, reduces the operation time and overall cost of treatment as described by Zix et al., 2007.²¹

The 3D plating system is easy to use. The 1.0 mm thickness 2.0 mm miniplates. This offers better bending stability and more resistance to out of plane movement or torque.²¹

In this study, all fractures were found to be adequately fixed when checked intra operatively after fixation. No immediate postoperative inter maxillary fixation was required for any patient, none of the patients had complications of malunion or nonunion.

The present study showed that, all cases treated with miniplating system allows no movements at the superior and inferior borders with maximal torsional and bending forces as apposed to a single linear plate applied to superior border area.

There was no wound dehiscence, the cases of wound dehiscence were due to infection in particular cases, patients were kept on antibiotics for a week and continous follow up with close irrigation with normal saline which led to satisfactory healing. Three patients had mental nerve damage at the time of trauma which led to complete loss of sensation throughout the treatment period.

Oral hygiene was also one of the important parameters of this study and played a very important role in the postoperative healing of all patients as all patients under went routine oral prophylaxis measures before plating was done as this will help in proper healing.

The results of our study suggest that fixation of mandibular fractures with 3D plates provides three dimensional stability and carries low morbidity and also decreased the implant material due to the extra vertical bars incorporated for countering the torque forces.

In the present study it is seen that 3D plating systems are effective in the treatment of mandibular fractures and over all complications are less as compared to conventional miniplates, 3D plating system uses lesser foreign materials and reduces the overall cost of the treatment.

CONCLUSION

The 3D plating system 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 the fracture site. They seem to be an easy alternative to conventional champy's miniplates.

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