Titanium Three Dimensional Miniplate versus Conventional Titanium Miniplate in Fixation of Anterior Mandibular Fractures

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Abstract: The optimal management of symphyseal and parasymphyseal fractures continues to evolve. Fractures in this area of the mandible predispose the patients to malocclusion and widening of the face if not properly 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. A total of 20 patients were managed by open reduction and internal fixation utilizing the conventional titanium mini-plate and 3dimensional mini-plate for fractures of anterior mandible. The patients were randomly divided into two equal groups according to the type of hardware used for fracture fixation. Group I: (10 patients) were treated with two 2.0 mm titanium mini-plates, Group II: (10 patients) were treated with 3D rectangular mini-plates. Intraoperatively duration of surgery was measured from the time of incision till the closure of wound. Subsequent postoperative clinical follow up for malocclusion, neurosensory deficit, wound breakdown, infection and presence of mal-union/non union was performed. Postoperative radiographs were taken to assess the gap between fracture segments. All patients were followed up clinically and radiographically for 6 months postoperatively. The mean duration of surgery (hours) was 1.88 ± 0.38 for group I and 1.61 ± 0.27 for group II. The difference was found to be statistically significant (p value 0.001). There was no clinical evidence of neurosensory deficits due to surgery in all cases. No problems of wound healing, swelling, discoloration, or discharge were seen during follow-up expect one patient in group I showed slight wound dehiscence with exposure of upper plate at the second post-operative week. Post-operative radiographic examination revealed that the fracture line could not be detected on the radiographs after 6 months in six patients (60%) patients in group I and eight patients (80%) patients in group II. The 3D mini-plate system is a better and easier method for fixation of mandibular fractures, compared to the conventional mini-plate. But there is limitation to use in cases of oblique fractures and those involving the mental nerve as well as there is excessive implant material because of the extra vertical bars.

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Key words: symphyseal mandibular fracture, parasymphyseal mandibular fracture, titanium miniplate, titanium 3D miniplate.

1. Introduction

Fractures through the mandible at the level of the Symphysis and or parasymphysis are relatively common and account for approximately 20% of mandibular fractures [1]. These fractures are often associated with a second fracture of the mandible, especially in the subcondylar region [2]. Fractures of the symphyseal region are often associated with the clinical findings of a widened intragonial distance with resultant malocclusion [1].

Fractures of the anterior mandible lack two of the stabilizing factors provided to fractures of the posterior tooth-bearing mandible: the splinting effects of the masseter and internal pterygoid muscles, which form a natural sling, and the interlocking cusps and fossae of bicuspid and molar teeth [3].

Although the techniques of fracture management have changed, the goals have not changed significantly. Accurate reduction of the fractures, maintenance of premorbid occlusion, and early return to function are the keys to successful management of these fractures. The technique of fracture repair and hardware choice will depend on the fracture pattern, fracture severity, and patient factors, such as residual dentition, coexistent lacerations, and associated injuries [4].

The treatment of symphyseal and parasymphyseal mandibular fractures has evolved significantly over the past few years. Historically, mandibular fractures were treated with closed reduction and a course of prolonged maxillomandibular fixation. The next phase of mandibular fracture management involved open reduction and internal fixation using wire osteosynthesis, then titanium hardware including lag screws and plates [5, 6].

Aim of the Study

This study was aimed to compare titanium 3D miniplates versus conventional miniplate in fixation of anterior mandibular fractures.

2. Patients and Methods

Twenty patients with anterior mandibular fractures were included in this study. The management started with immediate resuscitation following the principles of advanced trauma life support (ATLS). Plain anteroposterior (AP), lateral cephalometry radiographs and Orthopantomogram (OPG) were made for all the cases. An axial, coronal and 3-D CT scan were obtained for patients with associated mandibular condyle or subcondylar fractures.

An accurate assessment of the fractures was performed including the site and type of fracture, amount of displacement, amount of pain or discomfort, paraesthesia in the distribution of inferior alveolar nerve, marginal mandibular nerve paresis, status of dental occlusion, any associated temporomandibular joint (TMJ) dislocation, or any other functional deficits. All the selected patients were entailed about the surgical procedure. They were informed about the surgical procedure including prognosis, potential hazards and complications. They gave their approval to participate in a written informed consent. The study protocol was reviewed and approved by the central regional ethics committee.

Surgical Technique

All operations were performed under general anesthesia by nasotracheal intubation. The surgeries were performed by the same surgeon with same operating team. Erich-type arch bars were first applied to the upper and lower dentition. The fracture was approached through a vestibular incision between the mental foramina. (Fig.1). The segments were reduced and fixed temporarily using a special reduction forceps[9]. Once the fracture has been reduced to the anatomic position, intraoperative maxillomandibular fixation was obtained. The patients were randomly divided into two equal groups according to the type of hard ware used for fracture fixation. Group I: (10 patients) were treated with two 2.0 mm titanium mini-plates system and Group II: (10 patients) were treated with 3D rectangular mini-plates system.

The operating time taken for plate adaptation and fixation to last screw placed was recorded and also the total operating time of surgery was measured from the time incision was placed till the closure of wound. Principles of 3D plates fixation was followed; the horizontal bar perpendicular to the fracture line while the vertical bars parallel to it. (Fig.2 A&B)

Figure 1: The surgical approach to the anterior mandible

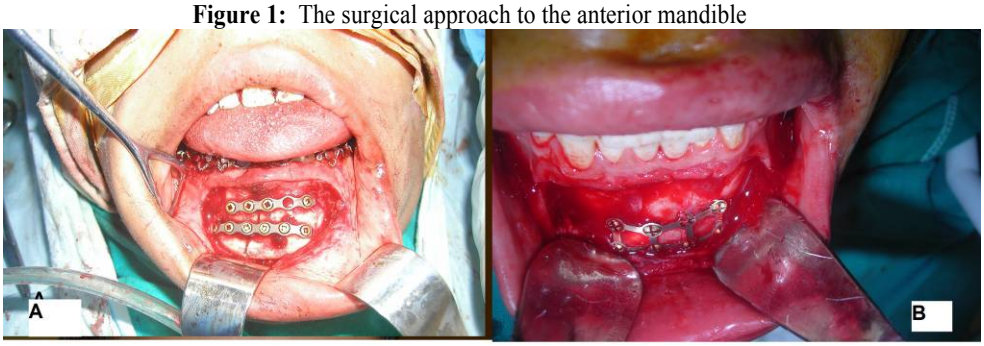

Figure 2: A, patient in GI with 2miniplates fixation. B, patient in G II with 3D miniplates fixation.

Once the hardware has been placed, the occlusion was checked and attention was turned to closure. After copious irrigation, the intraoral incision was closed with care taken to reattach the mentalis muscle. A watertight closure of the mucosa was achieved with absorbable sutures.

Postoperatively; the patients were assessed clinically for wound breakdown, neurosensory deficit, mobility of fractured segments occlusion discrepancy, and mal-union/non-union. Postoperative radiographs were taken to assess the gap between fracture segments. Patients were followed for 6 months to insure accurate reduction and proper occlusion during the fracture healing.

3. Results

Twenty patients (14 Males and 6 Females) with anterior mandibular fractures were included in this study. The patient age ranged from 15-50 years with mean of 32.5

y. Road-Traffic accidents were the cause of fractures in 16 patients out of total 20 patients, 2 from fall and 2 resulted from interpersonal violence.

Parasymphysis was the most frequent site of fracture, 17 out of 20 patients had parasymphyseal fractures, out of which 7 patients had isolated parasymphyseal fracture and rest 10 patients had other associated fracture (4 angles and 6 condyles) of the mandible. Symphysis fractures were present in 3 patients; all of them had associated condylar fracture of the mandible

In this study, the mean duration of plate adaptation and fixation (minutes) was 19.4±2.75 for group I and10.8±1.93for group II. The mean duration of surgery (hours) was 1.88 ± 0.38 for group I and 1.61 ± 0.27 for group II. The difference was found to be statistically significant (p value 0.001).

All patients were followed up clinically and radiographically for 6 months postopertively.

No problems of wound healing, swelling, discoloration, or discharge were seen during follow-up expect in one patient in group I showed slight wound dehiscence with exposure of the upper plate started at the second post-operative week. This patient was treated by continuous irrigation with warm normal saline, antiseptic mouthwash and keeping good oral hygiene until complete wound healing was achieved in ten days.

There was no clinical evidence of neurosensory deficits due to surgery in all cases. Paresthesia of the lower lip, before surgery, encountered in three patients one in group I and two in group II, these patients were followed up until regained normal neurosensory function spontaneously after four weeks in two patients and after six weeks in the other patient.

Three patients in group I and two in group II had mobility of the fracture fragments at 2 weeks follow up that was not detected at the end of the first month.

Postoperatively, two patients in each groups had slight occlusal discrepancy which was successfully corrected by simple selective coronoplasty in two patient and guiding elastics with selective girding in two cases.

In immediate post-operative radiographs taken within two days, reduction of the anterior fractures was assessed as exact in all cases in both groups Radiolucencies representing the fracture lines were still noted in all cases.

Radiographic examination at the first month post-operatively revealed no changes in the position of the fractured segments and the fracture lines are hardly detected (Fig.3). At the end of the follow up period none of the patients showed any signs of non-union in both groups. The fracture line could not be detected on the radiographs after 6 months in six patients (60%) patients in group I and eight patients (80%) patients in group II . No signs of adverse effects were seen around the screws. No external callus was detected in the both groups.

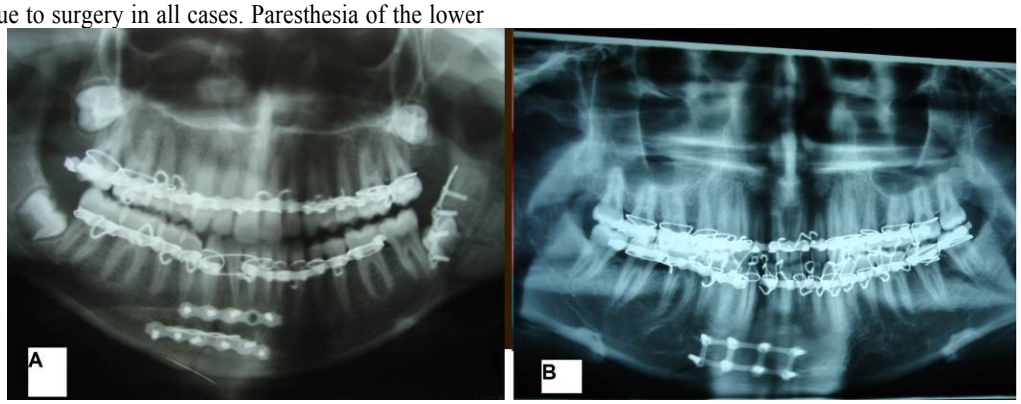

Figure 3: Six months postoperative radiographs A, patients in B, patient in GII

4. Discussion

Methods of osteosynthesis may be evaluated not only by the reduction achieved and the stability of fixation, but also by their technical application, 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 [10].

Treatment of mandibular fractures using open reduction and internal fixation (ORIF) through an intraoral approach in our study provided the advantage of simultaneous visualization of the fracture line and occlusion relation. It also eliminated extraoral incision and the risk of scar formation [11-14].

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* forever. [15]

In a recently published survey of 104 North American and European AO/ASIF surgeons, only 6% stated that they use 3D plates. Moreover, only a few follow-up series are presented in the literature, with few studies [16-18] emphasizing the hardware-related advantages over conventional miniplates and reconstruction plates. These advantages include easy application, simplified adaptation to the bone without distortion or displacement of the fracture, simultaneous stabilization at both superior and inferior borders, and hence less operative time.

In this study the time required for the adaptation and fixation of the plate at the fracture site (Parasymphysis & symphysis region) was recorded for both the groups. The total time was also recorded. The operating time for adaptation and fixation for 3D plating was short when comparing with time for conventional mini-plates this lead to reduction the total operating time in group II comparing with group I this result was in agreement with Guimond et al., 2005[19] and Babu et al., 2007. [20]

In group I, conventional mini-plates required longer time because these are linear plates and two plates are required for fixation at parasymphysis or symphysis region. On the other hand in group II, 3D plate is geometric configured plate which consists 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. This is in agreement with Jain et al., [21] as he stated that a geometric plate is much broader and has to be bent in 3 dimensions, whereas a linear plate has to be bent only in 2 dimensions and so it is trying to adapt a "plane" rather than a "line" to a curved surface.

In cases of oblique fracture or the fracture running through the mental foramina required more time in placement of 3D plate. This might be due to difficulty in achieving principles of 3D plate fixation (horizontal bar perpendicular and vertical bar parallel to fracture line) which result in limitation in using 3D plate in such cases. In such cases the plate was placed either inferior or superior to the foramina, and care was taking while placing the plate superior to the foramina is that the screws are placed between the roots of the teeth. Another limitation of 3D plates as we saw in this study was excessive implant material resulting from extra vertical bars incorporated for countering the torque forces which is in agreement with Babu et al.[20] and Wittenberg, [22] in a prospective study, reported the stabilization of 20 fractures of the mandibular angle; 12 were associated with additional fracture of the body using 3D plates.

Wound dehiscence occurred in one patient in group I. The improvement of plate stability might be a way to minimize wound healing complications. Guimond et al., [19] also experienced the low incidence of wound dehiscence and plate exposure with 3D plate in comparison to conventional miniplate that might be as a result of reduced operating time in 3D miniplate fixation.

Paresthesia of the lower lip, before surgery, encountered in three patients one in group I and two in group II, nerve was entrapped in the fracture fragment which was retrieved during the operation .These patients were followed up until regained normal neurosensory function spontaneously after four weeks in two patients and after six weeks in the one patient.

Preoperatively all patients of Group I and Group II had mobility of fracture fragment. In our study, it was observed that two cases (20%) out of 10 cases of group I had mobility after conventional mini-plate osteosynthesis at 2 weeks postoperative this mobility decreased over a period of one month postoperatively,. In Group II, one of ten patients had mobility at 2 weeks postoperative. By the end of the 3rd month postoperatively none of the patients in both groups showed any mobility in fractured segments.

Postoperatively two patients in each groups had slight occlusal discrepancy which were successfully corrected by simple selective coronoplasty in two patients and guiding elastics with selective girding in two cases. All patients with post-operative occlusal discrepancy had some other associated fracture of the mandible. The occlusal discrepancy was seen as a result of the imbalance between the muscular activities of the muscles of mastication after the trauma and due to the edema at the TMJ region post operative. By using guiding elastics this problem was solved. This incidence of occlusal discrepancy was compared between the two groups and the results showed no statistically significant difference. 3D plates and mini-plates (semi rigid type of fixation) reported less occlusal disturbances. Whatever post operative occlusal discrepancy encountered in the patients of both groups, were the fracture associated with other part of the mandible such as condyle and the angle. As these plates are self adaptable and non-compressive, they do not fix the fragments rigidly, hence self correction due to action of oro- facial musculature can take place.

Conclusion

Methods of fixation for anterior mandibular fractures 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.

To conclude, 3D miniplate system is a better and easier method for fixation of mandibular fractures, compared with the conventional miniplate. The 3D miniplate system provides good stability in most cases and operative time is shorter because of simultaneous stabilization at both superior and inferior borders. But there is limitation to use in cases of oblique fractures and those involving the mental nerve as well as there is excessive implant material because of the extra vertical bars incorporated for countering the torque forces.

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5. References

1. Boole JR, Holtel M, Amoroso P, et al. (2001): 5196 mandible fractures amount 4381 active duty army soldiers 1980 to 1998. Laryngoscope, 111:1691-1696.
2. Zachariades N, Mezitis M, Mourouzis C, et al. (2006): Fractures of the mandibular condyle: a review of 466 cases. Literature review, reflections on treatment and proposals. J Craniomaxillofac Surg., 34:421-432.
3. Clark WD, Simko EJ. (1998): Mandibular fractures. In: Gates GA, ed. Current Therapy in Otolaryngology. Philadelphia: Mosby; 150-152:
4. Farwell D G (2008): Mangement of Symphyseal and Parasymphyseal Mandibular Fractures .Operative Techniques in Otolaryngology, 19: 108-112.
5. Ellis E, Ghali G. (1991): Lag screw fixation of anterior mandibular fractures. J Oral Maxillofac Surg.; 49:13-21.
6. Spiessl B. (1989): Rigid internal fixation of the mandible. A manual of AO/ASIF principles. Berlin, Germany: Springer Verlag.
7. Champy M, Lodde JP, Jaeger JH, et al. (1976): Mandibular osteosynthesis according to the Michelet technic. I. Biomechanical bases [in French]. Rev Stomatol Chir Maxillofac, 77:569-576.
8. Farmand M, Dupoirieux L (1992): The value of 3-dimensional plates in maxillofacial surgery. Maxillofac Surg 93:353.
9. Kallela I, Lame P, Iizuka T, et al.(1996): Lag-screw fixation of mandibular para symphyseal and angle fractures. Oral Surg Oral Med Oral Pathol Oral Radio1 Endod., 81:510.
10. Champy M, Lodde JP, Schmitt R, et al.(1978): Mandibular osteosynthesis by iniature screwed plates via a buccal approach. J Maxillofac Surg., 6: 14.
11. Hussein M M, Gadala S A, Khidr BM (2007): Evaluation of 3.2 mm stainless steel lag screw in the management of anterior mandibular fractures. Egyptain Dental Journal, 53: 1611-1616.
12. Nishioka, G. and Van Sickels, J. (1988): Trans-oral plating of mandibular angle fractures technique. Oral Surg Oral Med Oral Pathol. 66:531.
13. Undt, G., Kermer, C., Rasse, M. and et al. (1999): Trasoral miniplate osteosynthesis of condylar neck fractures. Oral Surg Oral Med Oral Pathol Oral Radiol Endodo. 88:534.
14. Schon, R., Gutwald, R., Schramm, A. and et al. (2002): Endoscopy assisted open treatment of condylar fractures of the mandible: Extraoral vs Intraoral approach. Int J Oral MxilloFac Surg., 31(3):237-43.
15. Toma, V., Mathog, R., Toma, R. and Meleca, R. (2003): Transoral versus extraoral reduction of mandible fractures: A comparison of complication rates and other factors. Otolaryngol Head Neck Surg., 128 (2):215-9.
16. Gear AJ, Apasova E, Schmitz JP (2005): Treatment modalities for mandibular angle fractures. J Oral Maxillofac Surg; 63 (5):655-63.
17. Farmand M (1995): The 3-dimensional plate fixation of fractures and osteotomies. Facial Plast Surg., 3:39.
18. Feledy J, Caterson EJ, Steger S, et al. (2004): Treatment of mandibular angle fractures with a matrix miniplate. A preliminary report.Plast Reconstr Surg; 114(7): 1711-6.
19. Guimond C, Johnson JV, Marchena JM (2005): Fixation of mandibular angle fractures with a 2.0-mm3-dimensional curved angle strut plate. J Oral Maxillofac Surg; 63 (2):209-14.
20. Babu S, Parmar S, Menat M, Raghani, Kapadia T (2007): Three dimensional miniplate rigid fixation in fracture mandible. Journal of Maxillofacial and Oral Surg., 6:2: 14-16.
21. Jain M K, Manjunath K.S,. Bhagwan B.K. Shah, DK (2010): Comparison of 3-Dimensional and Standard Miniplate Fixation in the Management of Mandibular Fractures J Oral Maxillofac Surg., 68(7): 1568-72.
22. Wittenburg JM (1994): Treatment of mandibular angle fractures with 3-D titanium miniplates. J Oral Maxillofac Surg., 52:106, (suppl 2).

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