

TITANIUM MINIPLATE OSTEOSYNTHESIS OF MANDIBULAR FRACTURES

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Abstract

Background: The treatment of mandibular fractures (#s) had traditionally involved re-establishment of occlusion by Intermaxillary Fixation (IMF). In order to eliminate the morbidity associated with IMF. IMF has associated morbidity such as weight loss, interference with oral hygiene measures and patient discomfort. Increasingly over the three past decades, oral and maxillofacial surgeons have developed techniques of treating mandibular fractures using internal fixation. The routine use of miniplates in oral and maxillofacial surgery has gained popularity since Champy reported modification of the original technique of Michelet.

Objective: Evaluation of titanium miniplate osteosynthesis in treatment of mandibular fractures and comparison of the outcome, advantages, disadvantages and complications between intra oral and extra oral approach for the application of titanium miniplates.

Methods: This study was performed prospectively on 24 patients with 28 isolated mandibular fractures and treated by open reduction and titanium miniplate

osteosynthesis. Ten patients had intra oral approach and fourteen patients had extra oral approach.

Result: The overall complication rate was 25%. In the group, in which extra oral approach was used, the complication rate was 21.4% (3patients): 2 patients with facial scarring and 1 patient with malocclusion. In the group, in which intra oral approach was used, the complication rate was 30% (3 patients): 1 patient with paraesthesia of the lip, 1 patient with postoperative infection and 1 patient with root injury.

Conclusion: Miniplate osteosynthesis gives acceptable result, and it can be recommended as a routine method for treatment of all mandibular #s. Intra oral approach is advantageous to, and gives comparable results with extra oral approach. Experience in the technique is an important factor in the outcome.

Key words: Trauma-Mandibular fracture-Miniplate osteosynthesis

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Introduction

In an attempt to overcome the disadvantages of intermaxillary fixation (IMF) several authors described the use of bone plates without IMF but the complication rate was unacceptably high, notably, infection, external scar, occlusal derangement and the need for the plate removal. The initial plate either made of stainless steel or of vitallium, suffered from a major disadvantage by lacking malleability, which easily resulted in

fracture of the plate when attempts were made to bend them^[1-3].

The first compression osteosynthesis was performed by Luhr in 1967; he achieved axial compression of the fracture (#) segments by eccentric compression holes and bicortical screws performed exclusively via extra oral approach. Luhr in 1985 demonstrated a significantly reduced rate of infection with an intra oral approach^[4].

Michelet in 1973 described osteosynthesis of mandibular #s utilizing miniaturized non-compression plates and self-tapping monocortical screws applied intra orally and the sulcus just medial to external oblique line was used for angular #s, and a juxta-alveolar position in body #s^[5].

Champy in 1976 modified Michelet technique using miniaturized malleable non-

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compression plates without IMF based on theoretical, biomechanical and experimental studies; he was able to develop **ideal lines of osteosynthesis**. Anterior to mental foramen: 2 miniplates are used, one subapical and another 5mm below to resist the strong torsional forces on this area. Posterior to mental foramen: 1 miniplate is placed subapically.

In the angle region, the vestibular osseous flat area located medial to external oblique line is chosen. He suggested that fixation along alveolar border is stronger than that along the lower border and that only the tractional strains at the alveolar border are needed to be neutralized^[6].

We have moved from an era when our primary concern is bony healing and stabilization while preserving maximal periosteal blood supply, to an era when precise reduction and stabilization can be achieved with absolute rigid internal fixation (RIF)^[7].

Patients and Methods

This study prospectively reviewed and discussed the result of 24 patients with mandibular # who were admitted to the Maxillofacial Department in Al-Kadhihymia Teaching Hospital during the period from November 2001 to November 2002.

The age of patients ranged from 16-45years, 15 patients were males and 9 were females. Only patients with #s of symphyseal, parasymphyseal, body and angular parts of the mandible were selected (excluding ramus, coronoid and condylar #s) patients in whom mandibular #s were associated with mid-facial #s were also excluded. Diagnosis was based on history, clinical examination and radiographical examination.

Every patient was requested about past medical history to reveal any pre-existing systemic disease that may adversely affect healing or that could be a contraindication to surgery. Level of consciousness and pupil size and reaction were assessed and intracranial nerves

examinations were performed to exclude the presence of head injury.

The patients were examined for the presence of blood stained saliva, foeter oris, ecchymosis, sublingual haematoma, and for the presence of pain tenderness on palpation. The oral hygiene was evaluated and classified into good, fair and bad oral hygiene.

Dental status of the patients was evaluated for the presence of missing teeth, badly broken teeth, mobile teeth, painful or tender teeth; periodontally involved teeth and impacted teeth. Electric pulp testing was done to check the vitality of teeth. The occlusion was examined for the presence of step deformity, overriding, posterior gagging, posterior openbite and displacement of midline.

Radiographs were taken to confirm the diagnosis of #s, and to assess the direction of # line, displacement, comminution and the state of teeth in the # line. The radiographs that were commonly used are the orthopantomographs (OPG), oblique lateral mandible, and postero-anterior (PA) mandible. periapical, occlusal and CT-scans were sometimes used. The # site was approached either intra orally or extra orally (including approach through the scar). Combined approach was not used in this study.

Intra oral approach: Wide mucogingival incision through only mucosa, then blunt dissection was done before incising periostum to facilitate subsequent suturing. Periosteum was separated from bone using periosteal elevator exposing, and taking care not to damage the mental nerve.

Extra-oral approach: for symphyseal and parasymphyseal #s, submental incision 1 cm behind the mandible was used. For mandibular body #s, submandibular incision 2cm bellow the inferior border of mandible, the platysma muscle and the deep cervical fascia were incised and reflected to preserve the marginal mandibular branch of facial nerve, the facial artery and vein may have to be ligated. For angular #s, a retro-

mandibular (Risdon) incision was used 2cm behind and below the angle of mandible.

When extra-oral was used, the plate was placed at the inferior border of the mandible. However, when an intra oral approach was used, the plate was placed along the Champy's ideal line of osteosynthesis, that is Anterior to the mental foramen, 2 miniplates were used, one sub-apical and another 5mm below. If the # was minimally displaced or when segmental arch bar used, 1 miniplate was used. Posterior to the mental foramen 1 miniplate was placed subapically above the inferior dental canal.

Result

From the 24 patients in this study, 15(62.5%) were males and 9(37.5%) were females. The age of patients ranged between 16-45 years. The mean age of the patients was 26.6 years.

The distribution of the etiological factors of mandibular #s, reveals that road traffic accidents (RTA) (11 patients), followed by altercation (9 patients) were the most common etiological factors. Sports, bullet injury, occupational and fallen from height (FFH) were the least common etiological factors in the study with one patient for each.

From the 24 patients in the study, there was a total of 28 #s, which was treated by RIF. Twenty-one patients (87.5%) had only 1# line, 2 patients (8.33%) had 2# lines and only one patient (4.16%) had comminuted #.

The distribution of the 28 #s was as follow:

1. Symphyseal and parasymphyseal region, 11 #s (39.28%).
2. Mandibular body region, 7 #s (25%).
3. Mandibular angular region, 10 #s (35.71%).

The patients were grouped into two groups according to the approach to the # site.

Group I included 10 patients in which intra oral approach was used. The vestibular incision was used to approach the body,

parasymphyseal and symphyseal #s. The mental nerve was identified in all the patients except in the case of symphyseal # and another patient in whom the area of the nerve was surrounded by fibrosis, postoperative IMF was not used in any patient in this group, and the patients resume normal function soon after operation. This group included 1 patient with symphyseal #, 6 patients with parasymphyseal #s and 3 patients with mandibular body #s. all the patients in the group had a single # line.

Group II included 14 patients in which extra oral approach was used. The submental incision was used for symphyseal and parasymphyseal #s. the submandibular incision was used for mandibular body #s. the angular #s was approached through retromandibular (Risdon) incision. There was one patient in which the parasymphyseal # was approached through the trauma scar. IMF was used for variable periods ranging between 2-6 weeks. In this group, there were seven patients with isolated angular #, two patients with isolated body # and 2 patients with isolated parasymphyseal #. There was one patient with body and contra lateral angular #s, and another patient with angular and contra lateral parasymphyseal #s. There was only one patient with comminuted # involving angle and body in one side, and parasymphyseal region in the other side. This group included 4 parasymphyseal #s, 4 mandibular body #s and 10 mandibular angular #s.

In the group in which extra oral approach was used, IMF was used for 2-6 weeks because the plate was applied along the inferior border of mandible. Only in one patient, in whom the approach was through the trauma scar, IMF was not used. When a single # is present, IMF was used for 2 weeks postoperatively, while when 2 # lines are present, IMF was used postoperatively for 3 weeks. IMF for 6 weeks postoperatively was used in 2 patients, the first one had comminuted # and the other one had a delay in treatment of 70 days. The

mean period of IMF in this group was 2.57 weeks (18 days).

In the group in which intra oral approach was used, IMF was not used postoperatively in any patient. Intra operative IMF was done in five patients, while the other five patients, manual reduction were used to establish occlusion.

In the group, in which extra oral approach was used, the complication rate was 21.4% (3 patients): two patients with facial scarring (14.2%) and one patient with malocclusion (7.14%).

In the group, in which intra oral approach was used, the complication rate was 30% (3 patients): one patient with paraesthesia of the lip (10%) and one patient with postoperative infection (10%) and 1 patient with root injury (10%). The overall complication rate in both groups was 25% (6 patients).

Discussion

Many authors have documented the advantages of miniplates, compared with conventional IMF, IMF is either unnecessary or shorter period is needed. Therefore, it allows immediate or early return of function.

In one patient the # was treated by closed reduction and IMF. Postoperatively, radiographs show mal-reduction, the patient was returned to theatre and RIF was used. So we agree with Jaque et al (1997)^[8] that closed reduction is more likely to require secondary open reduction than primary open reduction.

We agree with Cawood (1985)^[9] that the miniplate system was easy to use, it require less surgeon experience than other systems (compression plates, reconstruction plates, microplates and resorbable plates).

We agree with Baker (1997)^[10] and Prein (1998)^[11] in that titanium miniplates dose not interfere with CT scanning. However, we did not see any starburst artifact associated with miniplates, instead the view was very clear. Three-dimensional (3D) reconstructions of CT scans were very clear and were not degraded by artifacts.

However, the only disadvantages were that the miniplate could not be differentiated from bone (it appears as bone). We conclude that titanium miniplates should be used when subsequent imaging will be needed in the future.

IMF was applied in all patients in which extra oral approach was used because the plates can only be placed along the inferior border of mandible and not along the ideal lines of osteosynthesis. If IMF is not applied, a gap will be created along the superior border of the mandible during function; this movement may lead to infection and delayed healing. The mean period of IMF in this group is 18 days, which is shorter than the time required for healing if IMF is used alone (6 weeks).

IMF was not applied in the patients in whom intra oral approach was used, as the plates were placed along the ideal lines of osteosynthesis. However, the patients were instructed to use soft diet for 2 weeks.

The intraoral vestibular incision is easily and readily performed without the fear of marginal mandibular nerve injury or scar formation. It readily exposes the #. However, the access is limited rendering the plating technique more difficult especially in the mandibular body and angular regions. In addition, there is increased risk of postoperative infection and injury to the inferior alveolar nerve and the roots of teeth. All of these complications occurred in our sample. These complications should not occur with increased in operator experience in the technique.

The extra oral approach is more difficult and there is fear of marginal mandibular nerve injury and scar formation, and is uncomfortable to the patient. However, it provides wide access rendering the plating technique easier. In addition, it eliminates the risk of postoperative infection and injury to the inferior alveolar nerve and the roots of teeth.

The complication rates observed in this study (25%) were above the previous reports. Nakamura (1994)^[12] reported 15.5% complication rate, while Jaque et al

(1997)^[8] reported 7% incidence, our limited experience may cause this relatively high complication rates.

However, all the complications in this study (except the case of malocclusion 4.16%) were minor. There was no case of nonunion, no case of severe infection, and no case of motor nerve injury. In addition, there were two cases of unacceptable facial scarring. In addition, the small sample of the study makes the interpretation of the results unreliable. Another cause is that most of the studies are retrospective and many of the complications are not mentioned especially injury to the sensory nerve and roots of teeth.

There was no case of wound dehiscence in the study, this agree with the results of Smith in 1991^[13] but in contrast to Cawood in (1985)^[9] who reported 12% wound dehiscence. This mostly occur when intra oral approach is used for the posterior parts of the mandibular body angular regions, as the plates, in this situation, is positioned high on the alveolar process near the vestibule. This explains the absence of wound dehiscence in this study.

No patients complained of unusual sensory abnormality, spontaneous pain, hypoesthesia or hyperesthesia in the region of the retained miniplate.

Conclusion

We conclude that

1. The short-term retention of titanium seems to be harmless and without complications.
2. With exception of condylar #s, miniplate osteosynthesis gave acceptable results, and it can be recommended as a routine method for the treatment of mandibular #s.
3. Miniplates produce no scattering during CT. scanning and this is advantageous when subsequent imaging will be needed.
4. Miniplates are rigid enough for stabilization of comminuted fractures especially when supplemented with IMF.
5. Its preferable to place the miniplate along the Champyl' ideal lines of osteosynthesis

than along the lower border to avoid postoperative IMF.

6. Intra oral approach is advantageous to, and gives comparable results with extra oral approach.

7. The application of miniplates is associated with many technically related failures, which can be reduced largely by increasing the experience in its application.

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