Single Miniplate Fixation for Mandibular Symphysis and Parasymphysis Fracture as a Viable Alternative to Conventional Plating Based on Champy's Principles: A Prospective Comparative Clinical Study

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Received: 15 September 2015 / Accepted: 17 May 2016 / Published online: 31 May 2016
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Abstract To compare long term and short term outcomes of fixing mandibular symphysis and parasymphysis fractures with single mini plate and conventional fixation using two mini plates. Study design: in this prospective clinical comparative study, 30 patients with fracture in study region were randomly divided into two groups. Group A patients received single 2.5 mm titanium miniplate and Group B patients received two 2 mm titanium miniplates as per Champy's lines of osteosynthesis. Patients were followed up at intervals of 1, 12 and 24 weeks. Parameters assessed were: duration of surgery, fracture stabilization, paresthesia, occlusion and wound dehiscence. Statistically significant difference was observed in mean duration of surgery and wound dehiscence ($P < 0.05$). No significant difference was observed with respect to other parameters. Single 2.5 mm miniplate for mandibular symphysis and parasymphysis fractures is a time saving and cost effective technique with post-operative outcomes similar to conventional 2 plate fixation.

Keywords Champy's lines · Parasymphysis fractures · Single miniplate · Two miniplates

Introduction

Current patterns of maxillofacial trauma suggest that mandibular fractures occur 2–3 times more often than other facial fractures. Their incidence and aetiology are influenced by social, cultural, and environmental factors [1].

Review studies reveal that motor vehicle accidents (MVA) and interpersonal violence are the most common causes of mandibular fractures followed by falls and sports injuries [2]. The objectives of mandibular fracture management include the restoration of the pre-existing anatomical form, functional occlusion and facial aesthetics.

Two general treatment philosophies emerged for plate and screw fixation of mandibular fractures in the 1970s and 1980s. The first one is AO/ASIF philosophy, which promotes sufficient rigidity at the fracture site to prevent interfragmentary mobility during mandibular function [3]. A second philosophy, popularized by Champy et al. [4], emphasizes “the ideal lines of osteosynthesis” in the mandible which uses noncompression monocortical miniplates in the region of optimal stress to neutralize tension. This principle dictates the need for two plates for adequate fixation for fractures in the symphysis and parasymphysis region to ensure optimal balance of forces. Successful stabilization of a fracture depends in varying degrees on at least two factors: the amount of bone contact and the rigidity of the fixation device.

The purpose of this study is to compare the clinical efficacy and long term outcome of using a single 2.5 mm (4 holes with gap) miniplate and two 2 mm miniplates (4 holes with gap) in symphysis/parasymphyseal fractures.

Materials and Methods

The study group comprised of 30 patients with fractures of mandibular symphysis or parasymphysis region who reported to the department of Oral and Maxillofacial Surgery of our institution. The study was granted approval by the institutional review board and the institutional ethical committee.

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Inclusion Criteria

- Age group: 20–50 years
- Simple or compound (unfavourable) fracture in the symphysis or parasymphysis region of the mandible
- Fractures amenable to treatment using intra-oral approach

Exclusion Criteria

- Medically compromised patients who are unfit for the procedure under general anesthesia
- Patients with comminuted fractures
- Patient with additional fractures at other sites on the mandible
- Pan facial trauma
- Edentulous patients

Thirty random numbers were generated from a random sampling table and were then alternatively assigned into two groups—Group A and Group B. The patients were then asked to choose from the 30 random numbers that were generated and depending upon the number they chose they were divided into the two groups.

Group A: Fracture in this group of patients was treated using a single 2.5 mm (4 holes with gap) titanium miniplate fixed at Champy's 'neutral' zone.

Group B: Fracture in this group of patients was treated using two 2 mm (4 holes with gap) titanium miniplates fixed according to the principles of Champy's lines of osteosynthesis and zones of compression and tension.

Study Design: Prospective comparative clinical study.

Study Duration: 2 years.

Statistical Tool Used: Chi square test.

Pre-operative evaluations were carried out as per protocol. Informed written consent was obtained from each patient.

Pre-operative Radiographs Ordered: Orthopantomogram (OPG) and an occlusal view of the mandible radiograph.

All patients received one dose of antibiotic (inj. Amoxicillin + Clavulanic acid, 1.2 g) pre-operatively. All patients were also given Inj Dexamethasone 8 mg pre-operatively which was later tapered down over a period of 2 days.

Surgical Technique

Based on the pre-operative radiographs, the fracture site was analysed (Figs. 1, 2, 3, 4). A standard vestibular

Fig. 1 Group A pre-op OPG

Fig. 2 Group A pre-op occlusal view

Fig. 3 Group B pre-op OPG

incision was used in all patients to access the fracture site. The fractured segments were manipulated and reduced into position. Intra-operative inter-maxillary fixation (IMF) was done using Erich arch bars and 26 gauge stainless steel wires in all cases along with circumferential loop wiring using 26 gauge stainless steel wire to include 2 or 3 teeth on each side (as deemed necessary by the operator). Split arch bars were used when the operator deemed it was necessary for reduction. Fixation was done according to the group to which the patient belonged, with either a single

Fig. 4 Group B pre-op occlusal view

2.5 mm titanium (4 holes with gap) miniplate and 2.5 × 8 mm screws or two 2 mm titanium miniplates (4 holes with gap) and 2 × 8 mm screws. Once fixation was done, the IMF was released. Closure was done in layers using 3-0 polyglycolic acid sutures (Vicryl®). The lower arch bar was kept in place for 3 weeks. Patients were given strict instructions to maintain proper oral hygiene. All patients were given oral Amoxicillin + clavulanic acid (625 mg) twice a day for 5 days and Diclofenac sodium (50 mg) + Paracetamol (325 mg) thrice a day for 3 days post-operatively.

Clinical follow-up of all patients was done by an independent observer (blinded) at intervals of: 1st post-operative day, 1 week, 12 weeks and 24 weeks. Another independent observer was asked to evaluate the clinical findings at the above mentioned intervals. The following parameters were evaluated:

- Duration of surgery
- Fracture segment mobility/mal-union
- Paresthesia
- Occlusion
- Wound dehiscence
- Time taken to return to normal function and diet

Results

A total of 30 (24 males, 6 females) patients with a mean age of 32 years were selected for this study. The most common etiology was motor vehicle accidents (67 %) followed by falls (17 %). There were four cases of assault and one case of farm accident (borewell recoil injury). Mean duration of surgery in Group A patients was 27 min

and in Group B patients was 39 min (Fig. 9). Immediate post-operative reduction and stability achieved was comparable in both group of patients. Occlusion was deemed satisfactory in all but one patient (Group A) by both the evaluators. Post-operative malocclusion in that patient was corrected using elastics for a period of 2 weeks. This finding was statistically insignificant ($P > 0.05$). In all patients, there was no fracture segment mobility noted post-operatively. Upper border or lower border splaying was not seen in either group. Five patients (1 in Group A, 4 in Group B) reported of post-operative paresthesia which resolved on its own after a mean period of 3 weeks. Four patients (all belonging to Group B) showed post operative wound dehiscence and gaping (Fig. 10) which was statistically significant.

Radiographically, no discrepancies were noted with respect to reduction of fracture fragments achieved (Figs. 5, 6, 7, 8). However, observer two noted that in three cases (20 % of patients in Group B) the plate fixed at the superior end was close to the apices of the canine and the pre-molar which was not the ideal positioning desired.

Fig. 5 Group A post-op OPG

Fig. 6 Group A post-op occlusal view

Fig. 7 Group B post-op OPG

Fig. 8 Group B post OP occlusal view

Discussion

Fractures of symphysis and parasymphysis of the mandible are extremely common injuries [1]. The key to successful management of these fractures is to understand the principles of accurate fracture reduction, reestablishment of occlusion, and stable internal fixation. The basic requirement of rigid fixation is to provide adequate stability to prevent interfragmentary motion even with active mandibular movements. This can be achieved by accurate close approximation of fracture fragments and ensuring larger contact areas in regions that are under compressive forces [5]. Many modalities like bone reconstruction plates, lag screws, geometric bone plates and miniplates are available to achieve internal fixation of body/symphysis fractures.

Primary bone healing promotes direct extension of osteocytes across the minimal gap present between fractured bone fragments. This type of bone healing occurs without external callus formation, thereby shortening the time period required for remodelling and consolidation [6, 7].

Spiessl [3] and Prein and Kellman [8] stressed on the two fundamental principles required to obtain adequate rigid

Fig. 9 Comparison of mean duration of surgery

Fig. 10 Comparison of wound dehiscence observed in two groups

internal fixation. First, the fixation needs to support full functional loads (load bearing osteosynthesis). Second, absolute stability of the fracture construct must be achieved which is the prerequisite for sound healing and a low rate of infection.

Ellis and Walker [9] found a high rate (28 %) of complications after fracture fixation using two non-compression miniplates. This suggests that there could be several factors contributing towards development of complications rather than just biomechanical considerations.

The disruption of the blood supply to the lateral mandible by stripping off the periosteum for fixation of miniplates at the inferior border may be one reason for the less favourable clinical results of two plate fixation techniques. Two plate fixations take more time and longer operation time exposes the bone to a higher bacterial contamination. Successful bone healing is a delicate balance between sufficiently rigid internal fixation and the preservation of the bony and soft tissue environments required for fracture consolidation [10].

In this study the application of a single 2.5 mm bone plate in the neutral zone required comparatively less time, minimal periosteal stripping and provided good anatomical reduction.

Champy et al. did not advocate the usage of such IMF procedures pre-operatively, intraoperatively or postoperatively [4, 11]. Some authors however believe that performing inter-maxillary fixation (IMF) with arch bars and wires will always be the best way to guarantee occlusal integrity during fracture plating. So most surgeons prefer to employ some kind of intermaxillary fixation prior to open reduction of mandibular fractures and the most commonly used technique is through placement of arch bars.

Arch bars or dental splints can also serve as the tension band for the anterior region [12]. We believe that placement of a sturdy stable lower arch bar could eliminate the need for two miniplates in the parasymphysis region. Circumferential loop wiring or usage of dental splints do prove effective and can compensate for the use of split arch bars. Placing two miniplates potentially increases the chances of mental nerve injury, injury to teeth roots, chances of infection and exposure of osteosynthesis implants.

Rix et al. [11] followed Champy's principle, but used a modification for parasymphysis fractures in close proximity to the mental nerve. Instead of two miniplates, only one was placed above the foramen and supplemented with loop wiring which included two or more teeth on either side of the fracture line with satisfactory results.

Tams et al. [13] in their in vitro three-dimensional study of loads across the fracture site observed high torsional moments and 'negative bending' moments. Their findings further validate usage of single and stable mini-plate in Group A patients to counteract the forces generally seen in symphyseal and parasymphyseal fractures.

Summary and Conclusion

This study attempts to compare the long term and short term outcomes of fixing mandibular symphysis and parasymphysis fractures with one single mini plate and conventional fixation using two mini plates. We observed that a single 2.5 mm (4 holes with gap) mini-plate provides adequate stability in symphyseal and parasymphyseal fractures with relatively shorter operating time when compared to conventional two plate fixation technique. Though miniplates are most commonly placed according to Champy's principle, symphysis/parasymphysis fractures can also be managed by placing a single stronger miniplate in Champy's neutral zone along with arch bars or dental splints, which act as effective tension bands to counter the forces resulting in fewer potential complications like

wound dehiscence and iatrogenic injury to the tooth roots. A study with a larger sample size would probably be helpful to establish the effectiveness of a single miniplate in symphysis and parasymphysis fracture cases.

Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Human and Animals Rights No animals were used in this study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Approval to conduct the study was obtained by the ethical committee of the institutional review board.

Informed Consent Informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this article. Appropriate permission was also obtained to use clinical photographs for the purpose of further academic research and publication in academic journals.

References

1. Subhashraj K, Nandakumar N, Ravindran C (2007) Review of maxillofacial injuries in Chennai, India: a study of 2748 cases. *Br J Oral Maxillofac Surg* 45:637–639
2. Brook IM, Wood N (1983) Aetiology and incidence of facial fractures in adults. *Int J Oral Surg* 12(5):293–298
3. Spiessl B (1989) Internal fixation of the mandible. Springer, New York
4. Champy M, Lodde JP, Schmitt R et al (1978) Mandibular osteosynthesis by miniature screwed plates via a buccal approach. *J Maxillofac Surg* 6:14–21
5. Parren SM (1969) A dynamic compression plate. *Acta Orthop Scand Suppl* 125:29
6. Perren SM, Huggler A, Russenberger M, Allgöwer M, Mathys R, Schenk R et al (1969) The reaction of cortical bone to compression. *Acta Orthop Scand Suppl* 125:19–29
7. Reitzik MB, Schoorl W (1983) Bone repair in the mandible. *J Oral Maxillofac Surg* 41:215
8. Prein J, Kellman RM (1987) Rigid internal fixation of mandibular fractures—basics of AO technique. *Otolaryngol Clin North Am* 20(3):441–456
9. Ellis E, Walker L (1994) Treatment of mandibular angle fractures using two non-compression miniplates. *J Oral Maxillofac Surg* 52:1032–1036
10. Schierle HP et al (1997) One or two plate fixation of mandibular angle fractures? *J Craniomaxillofac Surg* 25(3):162–168
11. Rix L, Stevenson ARL, Punnia-Moorthy A (1991) An analysis of 80 cases of mandibular fractures treated with miniplates osteosynthesis. *Int J Oral Maxillofac Surg* 20:337–341
12. Koshy JC, Feldman EM, Chike-Obi CJ, Bullocks JM (2010) Pearls of mandibular trauma management. *Semin Plastic Surg* 24(4):357–374. doi:10.1055/s-0030-1269765
13. Tams J, Van Loon JP, Rozema FR, Otten E, Bos RRM (1997) A three dimensional study of bending and torsion movements for different fracture sites in the mandible: an in vitro study. *Int J Oral Maxillofac Surg* 26:383–388