Effectiveness of 2.0 mm Standard and 2.0 mm Locking Miniplates in Management of Mandibular Fractures: A Clinical Comparative Study

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Abstract To compare and evaluate the effectiveness of 2.0 mm locking miniplates versus 2.0 mm standard miniplates in treatment of mandible fractures. Sixty randomly selected patients who sustained mandibular fractures were selected for this study. The fractured fragments were stabilized using 2.0 mm locking miniplates in 30 cases and in the remaining 30 cases the fractured fragments were fixed with conventional 2.0 mm miniplates. Post-operative stability was assessed with radiographs at 7th day, 1st, and 3rd months. The stability of the reduced fracture was assessed clinically and both the types of plates were assessed with an OPG or conventional radiographs. This study shows favorable results on use of locking miniplates in mandibular fractures. The results show that there were no significant differences in the post-operative complications between the conventional and the locking plate/screw mandibular systems. The locking plate/screw system was more rigid than conventional plate/screw system, thereby reducing the need and duration of intermaxillary fixation (IMF).

Keywords Mandibular fractures · Occlusion · Intermaxillary fixation · Locking miniplate

Introduction

With the development of osteosynthesis in maxillofacial surgery different systems have been designed which have become smaller, simpler to handle and avoided extra oral procedures.

Miniplate fixation of mandibular fractures has become a standard treatment which along the “Ideal lines of osteosynthesis” has become the most widely used technique. Champy laid the scientific foundation for the use of a technique of semi rigid fixation in mandibular fractures described by Michelet. Studies continue to cite high complication rates using these traditional methods [1].

The stability of conventional bone plating systems is achieved when the head of the screw compresses the fixation plate to the bone as the screw is tightened. Invariably over a period of time, the cortex of bone adjacent to the plate will resorb. If the plate is not contoured precisely and is not in intimate contact with the bone or if the host is compromised (medically or nutritionally), the “race” between fracture healing and cortex resorption will be lost and will result in unstable fixation [2].

This problem has been overcome by the development of a screw which locks not only to the bone but to the bone plate i.e. locking plate/screw system. This is accomplished by having a screw with a double thread. One thread will engage the bone; another will engage a threaded area of the bone plate. The result is a locking plate system which in effect provides a mini-internal fixation. Since the plate locks to the screw rather than gaining its rigidity by being compressed against the bone, it also avoids the cortical

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necrosis which is sometimes seen under a plate which is compressed against the bone. The locking design in the plate prevents screw migration out of bone by maintaining screw plate integrity, creating a more rigid system and potentially improved plate performance. The locking screw plate system reduces compressive forces between the undersurface of the plate and lateral bony cortex compared with a conventional mandibular plate [3].

This study was conducted in the department of oral and maxillofacial surgery at St. Joseph Dental College and Hospital at Duggirala, Eluru to compare and evaluate the efficacy of 2.0 mm locking miniplates versus 2.0 mm standard miniplates in treatment of mandible fractures.

Patients and Methods

Sixty randomly selected patients who sustained mandibular fractures were selected for this study. The fractured fragments were stabilized using 2.0 mm locking miniplates in 30 cases and in the remaining 30 cases the fractured fragments were fixed with conventional 2.0 mm miniplates. Patients who required open reduction and internal fixation for mandibular fractures with or without middle 1/3rd fractures were selected for the study.

Inclusion criteria were patients ranging in age from 15 to 60 years with non-comminuted mandible fractures, and dentition complete enough to apply stable Erich arch bars and non-infected fracture site.

Exclusion criteria were patients with comminuted fractures, bilateral fractures, mandibular fractures associated with intracapsular and coronoid fractures, patients in whom IMF is medically contraindicated (epilepsy, severe asthma, psychiatric condition, and alcohol or drug abuse, etc.) and patients with systemic diseases.

In all 60 patients Erich's arch bar fixation or eyelet fixation was done as a means for intermaxillary fixation intraoperatively. As per the surgical principles all the 60 patients underwent a thorough pre-operative evaluation comprising of a detailed case history, clinical examination, radiographic examination, all necessary haematological investigations and preanesthetic evaluation.

In 30 patients mandibular fractures were fixed with 2.0 mm locking stainless steel miniplates and 2.0 mm $\times$ 8 mm screws, and in 30 selected patients mandibular fractures were fixed with 2.0 mm standard stainless steel miniplates and 2.0 mm $\times$ 8 mm screws using Champy's principle. Closure was done with 3-0 vicryl or 3-0 catgut.

Chlorhexidine mouthwashes and antibiotic cover (Inj. cefotaxime 1 gm 12th hourly and Inj. metronidazole 500 mg 8th hourly) were given pre-operatively from the time of admission till 3rd post-operative day. Following this, oral antibiotics were prescribed for a minimum period

of 3 days. Post-operative assessment of the cases was done using the following parameters; need for intermaxillary fixation and its duration, anatomic reduction of the fractured fragment with post-operative OPG, stability of fixed fractured fragments by means of bimanual palpation, any infection at the fractured site and need for removal of plates and screws, any other post-operative complications such as paresthesia/neurosensory changes, occlusal discrepancies. All cases have been followed-up for a minimum period of 3 months.

A lower vestibular incision was made in the labiobuccal sulcus and a mucoperiosteal flap was raised to expose the fracture site till the lower border of the mandible. Open reduction was done and fracture segments were reduced. Occlusion was established with maxillomandibular fixation. The surgical technique used to apply both plating systems was same, except that a locking drill was used with the locking plates. Occlusion was checked on 7th postoperative day, 1st, and 3rd months post-operatively and complications were recorded if any.

Results

Sixty patients were treated who had 17 angle (7 in group I, 10 in group II), 8 body (4 in group I, 4 in group II), 26 parasymphysis (14 in group I, 12 in group II), 9 symphysis (5 in group I, 4 in group II) (Graph 1). Post-operatively three patients in group I had mild derangement and one patient had gross derangement. In group II, six patients had mild derangement and eight patients had gross derangement. In these patients intermaxillary fixation was done using elastics for 1–2 weeks followed by guiding elastics if necessary for one week. After four weeks all patients had a

Graph 1 Fractures in group I and group II patients

functional occlusion. There was a significant difference between group I and group II patients.

After fixation of the fracture with locking miniplates and conventional miniplates, routine post-operative OPG was taken to evaluate the reduction of fracture at intervals of 7 days, 1st, and 3rd months.

Assessment was done for stability of plate clinically by bimanual palpation, need for IMF (Graph 2) and post-operative complications.

Post-operative complications were soft tissue infections in three patients in group I and two patients in group II which were not due to the plates but due to extra oral incisions and poor maintenance of the patients. These infections were treated by incision, drainage and by antibiotics. In none of the cases plate removal was needed.

Temporary paresthesia was noted in eight patients pre-operatively and three patients post-operatively. In group I, two patients had temporary paresthesia and in one patient post-operative paresthesia lasted for more than four weeks. In group II, three patients had temporary paresthesia and in two patients it lasted for more than four weeks (Graphs 3, 4).

None of the cases had either delayed healing or non-union. This study shows favorable results on use of locking miniplates in mandibular fractures as the anatomic reduction of fracture was good in post-operative OPG. Adequate stability was achieved with no mobility of fractured segments. No associated complications were noted in any of the patients.

Discussion

In our study 60 cases were taken up, of which 30 were considered as group I (locking mini plates) (Fig. 1) and the remaining cases were considered as group II (conventional mini plates) (Fig. 2). All the patients were males in the age

Graph 2 Need of IMF

Graph 3 Paresthesia

Graph 4 Soft tissue infection

group of 20 and 60 years. In our study both parasymphiseal fractures were the most common type of fractures followed by angle fractures. In a study of 191 patients of 280 mandibular fractures, frequent location was the angle region (28.21 %), parasymphiseal (21.07 %) in the order of frequency [4]. In our study in group I patients, four patients required IMF post-operatively and in group II, nine patients required IMF due to gross displacement. Chritah et al. [5] assessed 2.0 mm locking miniplate screw in the treatment of mandibular fractures with one week period of maxillomandibular fixation. They concluded that the procedure is a reliable and effective treatment modality for mandibular fractures [6]. Bolourian et al. [6] and others [7] proposed 2.0 mm conventional miniplates fixation and two weeks of IMF. Ellis and Graham [8] treated 80 fractures in 59 patients with 102 locking plate or screw system and without IMF. They concluded that the use of 2.0 mm locking plate/screw system was simple and provides sound fixation in all cases. Villarreal et al. [9] evaluated mandible fracture repair using computer assisted densitometric image analysis system and concluded that rigid internal fixation is useful for more rapid bone mineralization than the use of IMF. Post-operatively three patients in group I had mild derangement and one patient had gross derangement. In group II, six patients had mild derangement and eight patients had gross derangement. In these patients IMF

Fig. 1 Group I (locking mini plate)

was done using elastics for 1–2 weeks. After four weeks all the patients had functional occlusion. The first biomechanical comparison of locking plates to appear in surgical

literature was made by Gutwald in 1999. Investigation was performed using 16 cadaver mandibles. Strain gauges were applied to the mandibles which were then subjected to

Fig. 2 Group II (standard mini plate)

cranial, caudal and torsional forces. They concluded that a higher stability was achieved with locking plates [10]. Chiodo et al. [11] performed a laboratory study to determine any difference in performance and found no statistical difference between the locking and conventional 2 mm mandibular plate. Singh et al. [12] conducted a study in 50 patients with 76 fractures and concluded that locking miniplate gave the advantage of greater stability and early

restoration of function with almost similar results as seen in non-locking miniplate osteosynthesis. SaiKrishna et al. [13] assessed both systems on a clinical study and found the locking plate/screw system to be more rigid than conventional plate/screw system reducing the need and duration of IMF. In a prospective study by Cawood, 5.7 % of mandibular fractures excluding additional condylar neck fractures treated by miniplate osteosynthesis had

malocclusion detected on review [15] and other study reported a 4.8 % malocclusion rate in their group treated by miniplate osteosynthesis [4]. Seemann et al. [16] assessed both types of plating systems in condylar fractures and found that locking plates were more likely to break and non-locking plates showed screw loosening. Temporary paresthesia was present in eight patients preoperatively and three patients post-operatively. In group I, two patients had temporary paresthesia and in one patient post-operative paresthesia lasted for more than four weeks. In group II, three patients had temporary paresthesia and in two patients it lasted for more than four weeks. Halpern et al. [17] conducted a prospective study on perioperative neurosensory changes with treatment in 61 patients with 97 mandibular fracture sites. They found that inferior alveolar nerve (IAN) neurosensory disturbances were unchanged or improved immediately after treatment in most patients. Cawood showed mental paresthesia in 8 % cases of mandibular fractures treated by miniplate osteosynthesis [2].

In our series of cases in three patients in group I and two patients in group II soft tissue infections were noted which was managed conservatively with antibiotics. None of the patients developed infections associated with plating system. In group II no infections were noted and no plate removal was needed in our study. Ellis [10] conducted a study on locking plates and described the incidence of surgical infections were less and plate removal was minimal and other study on miniplates removal described the incidence was mainly due to infection and exposure [18, 19].

Conclusion

Our study showed that there were no significant differences in the post-operative complications between the conventional and the locking plate/screw mandibular systems. Locking plate/screw system was more rigid than conventional plate/screw system, thereby reducing the need and duration of IMF.

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