



RESEARCH ARTICLE

COMPARATIVE EVALUATION OF 3-DIMENSIONAL NON LOCKING VERSUS 2-DIMENSIONAL LOCKING MATRIX MINIPLATE OSTEOSYNTHESIS IN MANDIBULAR FRACTURE TREATMENT : A PROSPECTIVE STUDY AND CLINICAL OUTCOMES

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ABSTRACT

Aim: The aim of this study is to compare the feasibility, advantages, disadvantages and complications in mandibular fractures treatment using 3-D non locking miniplate and 2-D non locking miniplates.

Materials and Methods: This study involves of 40 patients divided into two groups I & II (20 each) treated with ORIF using 2mm locking miniplates and 3-D plate respectively.

Results: Mean duration of surgery (minutes) was 22.4±2.75 for group I and 13.8±1.93 for group II. One patient in group I showed slight wound dehiscence. Two patients in group I and one patient in Group II had slight occlusal discrepancy which was corrected by coronoplasty and elastic traction. One patient in group I and two in group II, showed lip paraesthesia. Other clinical parameters like pain, swelling, trismus, wound healing, infection, malunion were statistically insignificant.

Conclusion: 3D miniplate system is a better and easier method for fixation of mandibular fractures, compared with the locking miniplate. The 3D miniplate system provides good stability in most cases and operative time is shorter. But it cannot be used in fractures involving mental nerve and oblique fractures. Short sample size and short term follow were our limitations.

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INTRODUCTION

Maxillofacial surgeon treats various facial injuries but mandibular fractures top that list. Fractures of the mandible occur more frequently than any other fracture of the facial skeleton. The management of trauma has evolved greatly over the past many years from supportive bandages, splints, circummandibular wiring, extraoral pins, and semi-rigid fixation with transosseous wiring to rigid fixation with compression plates, lag screws and more lately back to semi-rigid fixation with miniplates. Currently, modifications in miniplates, like 3 dimensional and locking plate/screw system, have been developed. This paper reviews Comparison of

efficacy of 3-D miniplate versus locking miniplate osteosynthesis for mandibular fractures. There are two methodology for the treatment of mandible fracture using plates and screws. Spiessl introduced technique of Rigid fixation by compression plates fixing along the lower border of fractured mandible using bicortical screws. The use of compression plates securely fix the fractured bone segments in a rigid manner and thus prevents the movement between the fractured segments and this leads to healing by primary intention. Difficulty in adaptation, bulk of the plates, scar formation due to extraoral approach, and increased chances of nerve injury were their disadvantages (Spiessl, 1972). Champy et al. (1986) introduced Semi-rigid fixation technique and defined the "ideal lines of osteosynthesis" based on experiments of Group of Research in Bones and Joint Biomechanics of Strasbourg and proposed intraoral fixation by

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modifying the Michelet *et al.*'s (1973) technique of osteosynthesis. It comprised of mono-cortical, juxta alveolar, and subapical osteosynthesis and the concept of compression was not used here. Intermaxillary fixation was done using diminished flexible plates. The monocortical plating system in maxillofacial surgery gained popularity due to diminished size of plates, ease of placement, good adaptability due to its flexible nature and use of intraoral approach. (Cawood, 1985) However, Luhr and AO/ASIF (Luhr, 1987) observed that miniplates did not offer adequate stabilization of the fractures, thereby necessitating the need of further inter-maxillary fixation. Farmand and Dupoirieux (Farmand and Dupoirieux, 1992) presented 3-D plates with quadrangular shape formed by joining two mini-plates with interconnecting crossbars. Accessible nature of plates, greater resistance against torque forces and stability due to its quadrangular shape, and condensed form were some of positive aspects of these plates.

MATERIALS AND METHODS

This study was aimed to compare titanium 3D miniplates versus conventional locking miniplate in fixation of anterior mandibular fractures. Forty patients (24 Males and 16 Females) with anterior mandibular fractures were included in this study. The patient age ranged from 15-50 years with mean of 32.5 years. Road-Traffic accidents were the cause of fractures in 26 patients, 8 from fall and 6 resulted from physical assault. The patients were divided into two equal groups of 20 each according to plate used for fracture fixation. Group I patients fixed with two (2.0 mm) titanium Locking mini-plates (Figure 1 & 2). Group II: patients fixed with one 3 Dimensional rectangular mini-plate (Figur 3& 4). All the surgical procedures were done by same surgeon under G.A. Arch bars were placed in maxillary and mandibular arch. The fracture was approached through a vestibular incision. Once the fracture has been reduced to the anatomic position, intraoperative maxillomandibular fixation was done and occlusion was achieved by physical manipulation. After the routine clinical and radiological examination, the fracture site was exposed by intraoral / Extraoral approach. In symphysis and parasymphysis region, two miniplates were used. A number were taken into consideration to appraise the patients like the location, type and number of fractures, presence of tooth in fracture line, time elapsed between the presentation of the patient after trauma, complications during surgery, pre and post surgical occlusal relationship, adequacy of reduction on postoperative radiograph and any post surgical complications requiring a secondary surgical intervention.

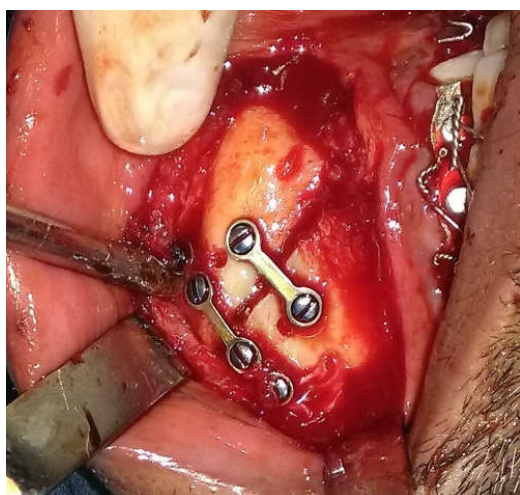


Figure 1 & 2. ORIF with 2.0 mm titanium 2D (straight) Locking mini-plates

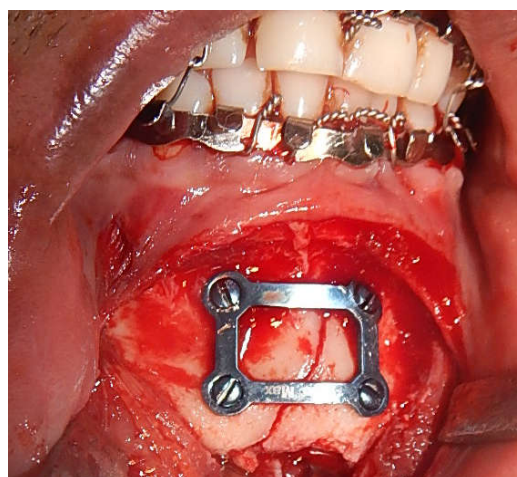


Figure 3 & 4. ORIF with 2.0 mm titanium Non Locking 3-D rectangular mini-plates

Antibiotics and analgesics were prescribed for 7 days following surgery. Initially the patients were kept on follow up for 6 weeks, for every week and thereafter every 6 months to evaluate radiographic evidence of healing.

RESULTS

All the patients in the study were evaluated for parameters like time taken for surgery, post operative healing (clinically and radiographically), malunion/non-union, implant failure/rejection, infection at surgical site, neurosensory complications, occlusal derangement and mouth opening. In this study, the mean duration of plate adaptation and fixation (minutes) was 22.4 ± 2.75 for group I and 13.8 ± 1.93 for group II. The difference was found to be statistically significant (p

value 0.001). Wound healing was satisfactory. No abnormal swelling, pus discharge or any sign of infection were seen during follow-up period. In group I, wound dehiscence was observed in one patient with exposure of superior plate at starting of second week post operatively which was treated conservatively by irrigation and dressing, antiseptic mouthwash, good oral hygiene maintenance. Postoperatively, mild occlusal disturbance was observed in two patients in group I and one patient in Group II had which was treated by applying traction elastics in neutral occlusion position along with selective coronoplasty. There was no significant clinical evidence of neurosensory deficits due to surgery in all cases. Preoperative Neuropraxia of the lower lip was noted in three patients one in group I and two in group II, which was resolved spontaneously following surgery after four weeks. Normal inter-incisor mouth opening was achieved at 4 week post operatively in group I and group II. Results shows no statistically significant differences between maximal mouth opening in both groups. No patients in both the groups presented with nonunion or malunion post operatively. Post-operative radiographs shows that the fracture line almost healed after 6 months in (65%) patients in group I and (85%) patients in group II. Result shows statistically insignificant differences in bone density at the fracture site between both the groups. All patients were followed up for 6 months postoperatively clinically and radiographically.

DISCUSSION

The goals in the treatment of mandibular fractures are to resettle normal occlusion and masticatory function with least impairment and complications. This can be achieved by immobilizing the mandible for healing period using conservative approach like dental wiring, arch bars, gunning splints and cap splints. Operative treatment of mandibular fractures involves intra or extraoral opening of the fracture site and direct osteosynthesis with transosseous wires, lag screws, or bone plates. A number of fixation methods have been advocated for the treatment of mandibular fractures. In present scenario, open reduction with internal fixation using small titanium plates is the main stay to immobilize fractured fragments of the jaw. Morbidity of the procedure is low with the advantage that the patient returns to normal function within days of treatment. The intraoral approach is preferred unless indicated otherwise as it is time saving and less traumatic (Raveh *et al.*, 1987). The tension zone of mandible is secured by using miniplates in that area. No injury is done to the dentition and inferior alveolar nerve due to the monocortical nature of the plate. The 3D plating system has a solid condensed design and is relatively easy to use. The 1.0 mm thick 3D plate and much thicker 2-0 mm miniplate has comparable stability. This offers better bending stability and more resistance to out of plane movement or torque (Zix *et al.*, 2007). Adjustments is easy because of the thin connecting arms of the plate even in case of 1 mm standard plate. There is no tension to the bone as the screws adapt every part of the plate separately. There is no need for the exact adaption of the plate as is necessary with thicker plates (Farmand, 1995). The recently introduced 3D plating system has definite cutting edge over conventional miniplates. The number of plates and screws required to stabilize the bone fragments are lesser in 3D plating system when compared to conventional miniplates. Thus it uses lesser foreign material, reduces the operation time and overall cost of the treatment (Alkan *et al.*, 2007). The 3D miniplates is actually pseudo name as it is not three dimensional in

geometrical term but it secure the fracture segments by resisting the forces in three dimensions i.e shearing, bending and torsional forces. The technique of 3D fixation was popularised by Farmand that it is a closed quadrangular plating system fixed with bone screws promotes the stability in three dimensions. The stability is gained over a defined surface area and is achieved by its shape and not by thickness or length. A good blood supply to the bone is achieved due to smaller dissection and greater free areas between the plate arms.

The 3-D plating system has advantages over conventional 2-D locking miniplates. 3-D stability of fracture site is assured by Quadrangular shape of the plates as it provides greater resistance against torque forces, and thus there is no need for inter-maxillary fixation, resulting fairly early restoration of mandibular function, and diminished rate of infection at fracture site postoperatively. Simplicity, malleability, low profile, ease of application, and reduced infection rate are its advantages over conventional 2-D locking miniplates. "The locking plate/screw system", was initially developed by Raveh *et al.* In the mid 1980s, the principles of external fixation device were incorporated into a bone plate. These plates achieve stability by locking the screw into the plate and have been shown to enhance fixation stability. A unique advantage to the locking plate/screw system is that it becomes unnecessary for the plate to have intimate contact with the underlying bone, making plate adaptation easier leading to lesser alterations in the alignment of the segments and changes in the occlusal relationship upon screw tightening (Collins *et al.*, 2004; Mukerji *et al.*, 2006; Feller *et al.*, 2003; Ardekian *et al.*, 1998) Second advantage in the locking plate is that the do not interfere with cortical bone blood supply like as the conventional miniplates which gives pressure and compress the surface of the bone plate to the cortical level (Sikes *et al.*, 1998; Villarreal *et al.*, 2000). A third advantage of the locking plate/screw system is that the screws are unlikely to loosen from the plate. This states that the screw will not loosen up even if it is inserted in to the fracture line. The possible advantage to this property of the locking plate/screw system is decreased incidence of inflammatory complications from loosening of hardware (Schmidt *et al.*, 2000). It is also proposed that this system provides greater stability that provided by the standard conventional miniplate. It is observed that the degree of plate adaptation affected the mechanical behavior of nonlocking plates but did not affect the locking plate/screw system. The only exclusion is that for correct locking of the screw to the plate, one should use a drill guide to "center" the drill hole within the center of bone plate.

Conclusion

We can conclude that 3D titanium miniplates are effective in the treatment of mandibular fractures and overall complication rates are lesser as compared to locking miniplates. Post fracture fixation both the systems have sufficient stability. It is the shape of the 3D plate and not its thickness or length that is responsible for stability. Good blood supply to the bone is achieved by smaller dissection and greater free areas between the plate arms. The 3D system is easy to use and cheaper. Moreover it utilise lesser hardware when compared to conventional miniplates. Thus 3D plate can be used as a replacement for conventional miniplates. The system is dependable and effective treatment method for treating mandibular fractures. The small sample size and limited follow-up could be considered as the limitations of this study.

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