A Comparative Prospective Study of Three Different Bone Plating Methods for Treatment of Mandibular Symphysis and Parasymphysis Fractures

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ABSTRACT

Background: Recently, various modifications in placing miniplates for direct fixation of the mandibular fracture are gaining popularity. The modifications have various advantages like more rigidity, less foreign material, less time in application, etc. Thus the purpose of this prospective study was to evaluate outcomes for three bone plating techniques used in the treatment of mandibular symphysis/ parasymphysis fractures.

Material and Methods: A prospective study was conducted on 45 patients with mandibular symphysis/parasymphysis fractures and the patients were divided into 3 groups (A, B and C). Patients were followed for 3 months. Outcome parameters like occlusion, distraction of lower border radiologically, parasthesia, infection, failure of bone plate (plate fracture) and screw loosening, postoperative segmental stability and radiological evaluation of fixation were recorded.

Results: Distraction of lower border was seen in all the groups which were noticed radiographically at all follow ups. There was no occlusal discrepancy present in all the groups after three months post operatively. The fracture segments were stable in all groups at all times. Parasthesia was noticed in all the groups, which gradually decreased in one month and resolved completely by third month follow up. The degree of parasthesia, distraction of lower border, occlusal discrepancy was not statistically significant between the three groups. Hardware failure was not found in all the groups.

Conclusion: It can be concluded that conventional miniplate system is a better and easier method than the 3D miniplate system for fixation of mandibular fractures. In comparison, the 3D miniplate system is unfavorable for use in cases of oblique fractures and those involving the mental nerve, and is also difficult to adapt.

Keywords: Champy's Principle, Mandible Fracture, Symphysis/parasymphysis fracture, Miniplate, Tension Band, 3D Plates.

Introduction

The mandibular symphysis and parasymphysis are one of the most frequently fractured sites after the angle and the condyle, making up 18-20% of the mandibular fractures in adults¹. The aim of mandibular fracture treatment is the restoration of anatomical form and function with particular care to establish the occlusion. Traditionally, this has been achieved by immobilizing the jaws using various wiring techniques. In the past few decades, interest has increased in the different methods of open reduction and internal fixation (ORIF)² which includes trans-osseous wiring, dynamic compression plates, eccentric dynamic compression plates, lag screws, Champy's miniplates, bio-resorbable miniplates and 3-D miniplates. Rigid internal fixation was initially used in the Oral and Maxillofacial region in the late 1970s since the work of Michelet et al and later Champy et al, miniplate osteosynthesis has become an important fixation method in maxillofacial and craniofacial surgery^{3,4,5}.

When open reduction and internal fixation is chosen as treatment, many internal fixation schemes can be employed.

Perhaps the most common is the application of two small (mini-) plates or one larger plate, with or without an arch bar. The purpose of this study was to evaluate outcomes for three bone plating techniques used in the treatment of mandibular symphysis/parasymphysis fractures.

Materials and Methods

The study was based on 45 patients of mandibular fractures in symphysis and parasymphysis area, divided into 3 equal groups 'A', 'B' and 'C'. These cases were selected randomly from Department of Oral and Maxillofacial Surgery, MPCD &RC, Gwalior in between November 2015 to October 2016. All patients were explained in detail about the surgical procedure and due consent was taken from them. Patients of both genders within the age of more than 18 years with Mandibular symphysis and parasymphysis fracture with any other non-communited fracture in the mandible were included.

15 patients of group "A" were treated by open reduction and single plate fixation arch bar acting as tension band.

15 patients of group “B” were treated by open reduction and fixation of two plates on the bone having two screws on either side of the fracture line separated by 5mm gap at least with arch bar and arch bar removed postoperatively as per Champy’s principle. 15 patients of group “C” were treated by open reduction using 2.0-mm 3D miniplates.

Surgical Procedure: In group A, Erich’s arch bars were placed and IMF was performed under LA/GA. A curvilinear (vestibular) incision 5 mm apical to the muco-gingival junction was given. The mentalis muscle was exposed and incised perpendicular and deep to the bone, leaving a flap of muscle attached to bone for closure. A full thickness muco-periosteal flap was raised carefully keeping the mental neurovascular bundle intact. After obtaining adequate exposure of the fractured segments, the segments were manipulated with reduction forceps and were satisfactorily reduced. After reduction of the fractured segments, fixation of the fractured segment was achieved by using single 2.5mm (4 hole with gap) conventional miniplate with 2.5mm X 10mm screws. Adequacy of fixation and occlusion were rechecked after placement of the conventional miniplate.

In group B, after reduction of the fractured segments, fixation of the fractured segment was achieved by using two 2.5mm (one 4 hole with gap and one two hole with gap) conventional miniplate with 2.5mm X 8mm screws with removal of arch bar postoperatively.

In group C, fractures were fixed with a 2.0-mm titanium 3D miniplate and were placed in such a way that horizontal bars were perpendicular to the fracture line and vertical parallel to it.

After the fixation was done the area was thoroughly irrigated with Betadine® and saline and adequate hemostasis was achieved. The deeper layers of the wound were closed using 3-0 Vicryl® and mucosal layer was closed with 3- 0 silk. Intermaxillary fixation was released and an adhesive pressure bandage was given extra orally. Postoperatively, no MMF was done for 24 hours. After that, the status of the occlusion was checked. In occlusal

discrepancy cases, MMF was done with guiding elastics for seven days in all the groups. All patients were prescribed prophylactic antibiotic Cefotaxime 2 gm intravenously 0.5 hour before the procedure, followed by 1 gm 2 times per day for 2 days followed by five days oral administration. Assessment of the patients postoperatively was done using the following parameters: postoperative occlusion, distraction of lower border radiologically, significant period of postoperative complications (parasthesia, infection, failure of bone plate (plate fracture) and screw loosening), postoperative segmental stability and evaluation of fixation. All the patients were followed for three month postoperatively. The evaluation was done in the immediate postoperative period, one month postoperatively, three months postoperatively. Each complication was recorded according to plates used.

Result

Average age of the patients in all the groups was 29 in which the minimum age was 18years and the maximum age was 65years. This shows that younger age group is more susceptible to trauma mainly in the second and third decade of life. Out of the 45 patients taken for the study 38 patients were male and 7 patients were female as males are more prone to fractures than female. The etiology was 66.7% was of road traffic accident and 33.3% were injured by physical assault. Patients were divided into two groups (i) One suffering from isolated symphysis or parasymphysis fracture. (ii) Suffering from symphysis and parasymphysis associated with other fractures. 20 patients (44.4%) were having isolated symphysis/parasymphysis fracture and 25 patients (55.6%) associated fracture also.

Post Operative Occlusion Discrepancy: The occlusion was seen in all the 45 patients and it was seen that only in the immediate post op there was occlusion discrepancy present in all the groups which was statistically not significant. None of the patients in all the groups showed any movement of the fracture segment at all follows up. Postoperative complication that is parasthesia, infection, hardware failure (plate fracture) and screw loosening were also evaluated.

Table 1: Demographic Data of Study Patients.

S.No			Group A (N-15)	Group B (N-15)	Group C (N-15)
1.	Gender	Male	11	14	13
		Female	4	1	2
2.	Age (years) Mean Range	Average age -29yrs	22-65yrs (30yrs)	18-50 yrs (28 yrs)	18-58 yrs (29.3 yrs)
3.	Causes	RTA (66.7%)	8	10	12
		Physical assault/Interpersonal violence (33.3%)	4	8	3

S.No			Group A (N-15)	Group B (N-15)	Group C (N-15)
4.	Incidence of fracture site	Isolated	7	3	10
		With angle	6	10	3
		With condyle	2	2	2

Table 2: Evaluation of Parasthesia and Infection.

PARASTHESIA	GROUP A	GROUP B	GROUP C	P-VALUE
Immediate post op	2	2	1	1.6
1 st month follow up	2	1	2	1.6
3 rd month follow up	2	2	1	1.6
INFECTION				
Immediate post op	0	0	0	0
1st month follow up	1	2	1	1.6
3rd month follow up	0	0	0	0

Fig. 1: Intra operative pictures of patients treated with (a) Single plate (b) Two plates (c) 3D plate.

Fig. 2: Post-operative radiographs of patients treated with (d) Single plate (e) Two plates (f) 3D plate.

Discussion

Mandibular fractures are the commonest fracture of the face usually caused by accidents and other possible etiologies which may be interpersonal violence, fall, and sports injuries etc⁷. The purpose of surgical fixation for mandibular fractures is to secure the reduced fragments during osteogenesis to permit sound healing. Inevitable frequent masticatory loads can cause motion at the fracture site and interfere with the healing process. The objective in the treatment of mandibular fracture is to re-establish normal occlusion and masticatory function. Conservative treatment to achieve this is performed by immobilizing the mandible for the healing period by dental wiring, arch bars, cap splints, and gunning splints⁸⁻⁹. Operative treatment of mandibular fractures involves intraoral or extraoral opening of the fracture site and direct osteosynthesis with trans osseous wires, lag screws, or bone plates¹⁰⁻¹¹. A study

done by Sami et al¹² for non-comminuted symphyseal and parasymphyseal mandible fractures showed that the application of 2 miniplates with monocortical screws offers good surgical outcomes in most patients with minimal complications following Champy's principle. Though miniplates are best used following Champy's principle. The use of 3D miniplates in mandibular fracture has not yet become established. In recently published survey¹³ of 104 North America and European AO/ASIF surgeons only 6% stated that they use this type of plate. Moreover, only a few follow-up series are presented in the literature, with few studies¹⁴⁻¹⁷. The newly introduced 3-D plating system provides definite advantages over the conventional miniplates as it uses fewer plates and screws to stabilize the bone fragments. Thus lesser foreign material, and reduces the operation time and overall cost of the treatment as described by Zix et al². Arch bars placed for intermaxillary

fixation can be used as a tension band, which eliminates the need for plate at the upper border^{12,19}. With this concept in mind we planned our study to compare and analyze the results between three groups using either single plate at the lower border with an arch bar, two plates according to Champy's principle or 3D plates in 45 patients presenting with symphysis / parasymphysis fractures.

In our study 15 patients were treated with 2.5 mm single conventional miniplate with Erich's arch bar placed for 4 weeks, 15 patients were treated with 2.5mm two conventional miniplates placed according to Champy's principle and 15 patients were treated with 3-D plates. The study showed higher frequency of mandibular fracture in males compared to females and the ratio was 5:1 respectively. Road Traffic accident due to motor cycle's collisions is the commonest cause of these fractures²⁰. Our study showed that symphysis/parasymphysis fractures exist in conjunction with angle or condyle fractures (60%). This is in accordance with various studies like as Ellis¹⁹. In our study, post operatively 2 patients (13.33%) in group A, 3 patients (20%) in group B and, 4 (26.66%) patients in group C had occlusal discrepancy which was corrected by giving guiding elastic for 5-7 days. In 1st month and 3rd month visit, no occlusal discrepancy was found in the 3 groups. This was also seen by Alpert et al²¹ who inferred that miniplate should be perfectly adapted to the underlying bone to prevent alteration in the alignment of the segments and changes in the occlusal relationship. Occlusal discrepancy comparison of all the groups in our study was statistically not significant ($P = 0.1$).

Paraesthesia of mental nerve was seen in 2 patients (13.33%) in our study in each group at all follow ups which was present preoperatively and remained same in postoperative follow up periods. However in a similar study by Zix et al², it was considerably high, i.e. 60% and 25%. When our results were compared to those of Feller et al²² on miniplate fixation using Champy's principle, it was found that parasthesia rate was 6%. Preoperatively the parasthesia can be attributed to the nerve entrapment in the fractured segment. However, postoperatively the incidence of low parasthesia in our study is due to the use of monocortical plate as compared to other types of plating system in which chances of mental nerve injury are more due to bicortical screws.

In our study, 1 patient (6.6%) belonging to Group A, 2 patients (13.3%) belonging to Group B and one patient (6.6%) belonging to Group C showed incidence of postoperative infection at 1 month. Infection in both groups was resolved with the help of normal saline irrigations and antibiotics prescribed for 7 days which lead to satisfactory

healing. The incidence of infection after comparison of all the groups in our study was not significant. Infection in all the groups can be attributed to the fact that few patients did not maintain a good oral hygiene. Preoperatively all patients of A, B and C groups had mobility of the fracture segment. Postoperative segmental mobility was not evident in any of our cases in all the three groups, whereas segmental mobility was reported in 10% cases in a study series of 20 patients by Jain et al²⁴. In a biomechanical comparison study by Alkan et al²⁵, it was concluded that stability is better with single miniplate with Erich arch bar system. However on the contrary all biomechanical tests in which a second miniplate had been fixed to the mandibular margin revealed less mobility according to Ellis¹⁹. By the end of 1st and 3rd month postoperatively none of the patients in both groups showed any mobility in the fracture segment.

There was no such complication present in our study like plate fracture (Hardware failure) and screw loosening in the groups whereas Rehman AU et al²⁶ in his study performed plate removal of 33.3% plates from the body region and 18.5% in parasymphyseal region owing to the above mentioned reasons. One has to keep in mind that results depends much more on the characteristics of the fracture, behavior of the patient, absence of systemic disease, postoperative care, and adherence to partial postoperative functional restrictions.

As per the principle of a 3D plate to treat fractures near the mental foramen, the plate should be placed above the nerve, and, to avoid injury to the dental roots, holes should be drilled monocortically, directing them into space between the roots. A rectangular plate and short screws are preferred²⁷.

Conclusion

It can be concluded that fixation in isolated mandibular parasymphysis/parasymphysis fracture can be managed either by a single miniplate at the inferior border and utilizing the arch bar as a tension band for 4 weeks or by placing 2 miniplates (one at inferior border of mandible and another at approx. Conventional miniplate system is a better and easier method than the 3D miniplate system for fixation of mandibular fractures. In comparison, the 3D miniplate system is unfavorable for use in cases of oblique fractures and those involving the mental nerve, and is also difficult to adapt.

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