

Original research article

Outcome of eccentric dynamic compression plates fixation of mandibular fractures: a retrospective study**Dr. Shazia Khatoon^{1*}, Dr. Samir Jain²****¹Senior Resident, Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.****²Professor and HOD, Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India****Corresponding Author: Dr. Shazia Khatoon****Abstract**

Aim: to evaluate the treatment outcome of fixation of mandibular fractures with eccentric dynamic compression plates.

Material and methods: A Retrospective study was conducted in the Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India from feb 2019 to July 2019. All the 50 patients underwent open reduction with internal fixation of the fractured segments using 2.5 mm, 4 holes with gap Titanium Eccentric Dynamic Compression Plates and 2.5x8 mm titanium screws under general anesthesia or local anesthesia. Fractures of the associated condyle were treated with rigid fixation which was placed for 2-3 weeks. The patients were evaluated preoperatively, intra-operatively and postoperatively for various parameters. Postoperative clinical evaluation was done at the 1st week, 3rd week, 6th week & 3rd month. Evaluation was done for the operative time, ease of fixation of plate (access, reduction and fixation of fractured segments, stability (hardware failure), postoperative occlusion, neurosensory deficits (paraesthesia of the area involved), radiographic evaluation of fracture site at 1 week, 3 weeks, 6 weeks and 3 months and postoperative complications (infection, non-union, mal-union, delayed union).

Results: Among the study population, majority of the population were in the age group of 20-30 years. There were 40 (80%) male and 10 (20%) female patients. With road traffic accident (RTA) 45 patients (90%) being the most common aetiology followed by 5 patients with (10%) work related or self-falls. The Fracture distribution consisted of the following, mid- symphysis fracture of mandible 12 (24%) patients, left parasymphysis fracture of mandible 16 (32%) patients, right parasymphysis fracture of mandible 22 (44%) patients, along with associated fracture of the condyle accounting for 26(52%) of patients. The infection rate in our study was found to be 12%. We found the incidence of malocclusion to be 12 % in our study which was due to intra-capsular condylar fracture supposed to be treated with IMF but the patient was non-compliant for the same.

Conclusion: All the patients present in the study appreciated early recovery of normal jaw function, primary healing and good union at the fracture site with minimal weight loss due to early functional rehabilitation.

Introduction

Mandibular angle fractures (MAFs) account for 23% to 42% of all mandibular fractures.¹ The frequent involvement of the angle in mandibular fractures can be attributed to its thin cross-sectional bone area and the presence of a third molar.² The treatment of these mandibular fractures has changed dramatically in recent years. Traditional 6-week treatment of closed reduction with Maxillomandibular fixation (MMF) or open reduction with wire osteosynthesis and MMF has given way to Open Reduction and internal fixation (ORIF)

osteosynthesis techniques with early mobilization and restoration of jaw function, improved airway control, nutrition, patient comfort and hygiene, and an early return to work.³ In treatment planning for a mandibular fracture, there are two schools of plate osteosynthesis, one advocating compression osteosynthesis and the other favouring the miniplate osteosynthesis.⁴ in Europe in the 1970s. It showed primary bone healing under conditions of absolute stability.⁵ It has been shown that two segments of cortical bone brought into direct contact and fixed with absolute stability will heal without the formation of an external callus. Primary bone healing is rarely achieved with rigid fixation due to incomplete reduction of the fracture. The (AO) Swiss Association for internal fixation (ASIF) introduced the idea of axial compression into the limb fractures. As applied to the mandible, the idea of compression osteosynthesis was fortified with dynamic compression miniplates (DCP)^{4,6} During function the balanced side of the mandible is subject to bending, which exerts tensile forces on alveolar part of the mandible.⁷ Rigid internal fixation must neutralize all forces (tension, compression, torsion and shearing) developed during function. Multiple fixation techniques were developed to achieve this goal including lag screw, and miniplate osteosynthesis.⁸ The reduced size of miniplate system offers several advantages over the larger mandibular compression plate. Small incisions and minimal soft tissue dissection are necessary for their placement. Miniplates can be easily contoured in three dimensions. Special plate-bending pliers are used to achieve passive adaptation of the plate to the bone. Due to their small size, they will not be palpable extraorally and hence will not require a second operation for plate removal. Mini DCPs are a smaller version of the standard mandibular compression plates. The use of mini DCPs merges the principles of miniplate osteosynthesis and compression osteosynthesis.⁹ Several studies have been done using conventional miniplates for fixation of the fracture of the angle of the mandible by extra oral approach.^{4,10} Biologically, compression means undisturbed healing because it guarantees absolute stability even under the conditions of function. Mechanically it allows load sharing between bone and implant. Based on these findings the dynamic compression plate was developed which further led to the development of the eccentric dynamic compression plate. The aim of the presents study was to evaluate the treatment outcome of fixation of mandibular fractures with eccentric dynamic compression plates.

Material and methods

A Retrospective study was conducted in the Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India from feb 2019 to July 2019, after taking the approval of the protocol review committee and institutional ethics committee. 50 patients with mandibular fractures that require open reduction and internal fixation were included in this study.

Methodology

All the 50 patients underwent open reduction with internal fixation of the fractured segments using 2.5 mm, 4 holes with gap Titanium Eccentric Dynamic Compression Plates and 2.5x8 mm titanium screws under general anesthesia or local anesthesia. Fractures of the associated condyle were treated with rigid fixation which was placed for 2-3 weeks. The patients were evaluated preoperatively, intra-operatively and postoperatively for various parameters. Postoperative clinical evaluation was done at the 1st week, 3rd week, 6th week & 3rd month. Evaluation was done for the operative time, ease of fixation of plate (access, reduction and fixation of fractured segments, stability (hardware failure), postoperative occlusion, neurosensory deficits (paraesthesia of the area involved), radiographic evaluation of fracture site at 1 week, 3 weeks, 6 weeks and 3 months and postoperative complications (infection, non-union, mal-union, delayed union).

Surgical method

A 2.5mm 4 hole with gap titanium EDC plate for mandible fracture was custom made and used in this study, the plates were so designed that they had 2.5mm screw hole diameter, the plates had holes whose geometry was based on the “Spherical Gliding Principle” which transforms a vertical force into a horizontal one. The gliding hole had a bend of 135°, this is where the force changed. The length of the plate was 3.1cms. The distance between two central dynamic compression holes was 8.6mm and the distance between the dynamic and the outer eccentric holes was 7.5mm on either side; the eccentric holes being at 45°. The width of the plate was 8.0 mm. Increase in stability was achieved by the thickness of the plate which was approximately 1.0 mm.

When the mandible was in function the primary forces of concern on the plate included bending, vertical displacement and shear. In the EDCP since the two horizontally placed holes bring the inferior border into anatomic position with compression and the eccentric holes i.e. the vertical set rotates each alveolus into position around the axis of the first screw resulting in production of rigidity. The plates were carefully adapted. Rigidity also increased because of the thickness and the design of the plate.

Titanium screws, 2.5mm (thickness) x 8mm (length) were used the screws were so designed so as to glide on the hole of the plating system. The diameter of head of screw was 2.5mm. ORIF was done under local anaesthesia or general anaesthesia, either through extraoral approach by pre-existing laceration or intraoral approach by degloving incision to the fracture site. The EDC plates were adapted parallel to the lower border of the mandible. The drilling was performed with a 2.0mm drill bit, at an angulations which was maintained perpendicular to the surface of bone. The holes in the vertical set were drilled near the inferior border of the mandible, creating rotational forces in the superior direction that brings the alveolus into dynamic compression; whilst the inner holes were drilled laterally so that the screws glide and compress the fracture fragments against each other horizontally. The eccentric screws after drilling were tightened by slightly loosening the horizontally directed screws so as to produce dynamic compression at the alveolus. A force of 150 N was applied to the plates. The patient was instructed for a semi solid diet for one week. Subsequent follow up was done at 6 weeks and 3 months, during every follow up the patient was evaluated for occlusion, infection and plate stability radio graphically.

Results

Among the study population, majority of the population were in the age group of 20-30 years. There were 40 (80%) male and 10 (20%) female patients. With road traffic accident (RTA) 45 patients (90%) being the most common aetiology followed by 5 patients with (10%) work related or self-falls.

The Fracture distribution consisted of the following, mid- symphysis fracture of mandible 12 (24%) patients, left parasymphysis fracture of mandible 16 (32%) patients, right parasymphysis fracture of mandible 22 (44%) patients, along with associated fracture of the condyle accounting for 26(52%) of patients

Table 1: Demographic Profile of patients

Gender	Number of patients	Percentage
Male	40	80
Female	10	20
Age		
Below 20 years	3	6
20-30	30	60
30-40	10	20
Above 40	7	14
RTA	45	90

Table 2: Fracture distribution

Fracture distribution	Number of patients	Percentage
Mid- symphysis fracture of mandible	12	24
Left parasymphysis fracture of mandible	16	32
Right parasymphysis fracture of mandible	22	44

Table 3: Distribution of patients by using compression plate

Parameter	Number of patients	Percentage
ORIF under GA through extra approach using compression plate	12	24
ORIF under GA through intra oral approach using compression plate	16	32
ORIF under LA through intra oral approach using compression plate	22	44

Table 4: Operative time wise distribution

Operative time	Percentage	P value
<80 minutes	50%	1.0
>80 minutes	50%	

Table 4: Post op occlusion wise distribution

Post op occlusion	Number of patients	Percentage
Mal occlusion	6	12

Table 5: Post- operative complications wise distribution

Post- operative complications	Number of patients	Percentage
Extra oral scar	6	12
infection	6	12

Discussion

Open reduction and internal fixation (ORIF) of the mandible with bone plates was first described by Schede (1888). General acceptance of open osteosynthesis did not appear in maxillofacial literature until an organised research by AO in 1950. Luhr, Spiessl, and others derived inspiration from orthopaedic biomechanical studies performed by Schenk. Who suggested accelerated bone healing through compression, Rigid fixation using dynamic compression plate which has its own disadvantages such as requirement of a wide incision,

bulky nature of the plates and the procedure which are technique sensitive according to findings given by Iizuka et al. (1991).¹¹ The EDCP permits application of compression by taking advantage of a specially designed screw hole. This hole has an inclined surface, which means that the plate compresses the fracture when the screws are inserted in a somewhat eccentric position. Furthermore the spherical geometry of the EDCP permits insertion of the plate screws at an angle in order to avoid fracture lines and improve their function as lag screws.¹² Bouloux et al. reported slightly higher operating time of 150 minutes for mandibular fractures treated using dynamic compression plates using AO principles.¹³ In our study we reported an operative time of 82 min (mean) with a standard deviation of 10.08. The maximum operative time noted was 92 minutes. No significant time difference was noted between extra-oral and intra-oral approaches probably due to the fact that in our study, the only case in which we used an extra-oral approach, was done through a pre-existing cut lacerated wound. One of the disadvantages of EDCP is the bulk of the plate, which might lead to pain in the region of plate fixation due to cold sensitivity in patients who live in severe winter temperatures.¹⁴ The infection rate in our study was found to be 12%, which was less as compared to the 16% infection rate found by Lindquist et al. in 1986.¹⁵ 6% had a wound infection by 10th day which can be due to communication of the extra and intra-oral lacerated wounds or due to his tobacco chewing habit. The patient was put on antibiotic coverage, the infection subsided and plate removal was not deemed necessary. In a study done by Renton et al. in 1996 the incidence of malocclusion was noted to be around 17% which was treated with occlusal adjustment and the remainder resolved at a later review. We found the incidence of malocclusion to be 12% in our study which was due to intra-capsular condylar fracture supposed to be treated with IMF but the patient was non-compliant for the same. At later review dates the minor mal-occlusion was corrected with selective occlusal grinding. One of the advantages offered by EDCP is that there is no or lessened need to place IMF.^{16,17} Results in our study were concurrent with these findings in that the need to place the patient in IMF was obviated in 52% of patients and that the IMF which was done prior to ORIF was removed immediately after surgery and patient was put on a soft diet for a month. In the remainder of cases because of the involvement of the condyle patient was placed on MMF for a period of 2-3 weeks and the patients placed on liquid diet. The weight loss factor was eliminated in patients in whom IMF was not carried out. 12 Radiologic evaluations were carried out for 3 months postoperative and the bony union noted. It was found out that complete bony union was seen radiographically between 6 weeks and 3 months. In the study carried out by Mishra et al. in 1998 radiologic union was seen at 6-8 weeks.¹⁸

Conclusion

All the patients present in the study appreciated early recovery of normal jaw function, primary healing and good union at the fracture site with minimal weight loss due to early functional rehabilitation.

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