

EFFICACY OF OPEN REDUCTION INTERNAL FIXATION IN UNILATERAL MANDIBULAR ANTERIOR FRACTURE BY USING SINGLE MINIPLATE WITH ARCH BAR: A CLINICAL STUDY

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Abstract

Background: The aim of this study was to evaluate the efficacy of Open Reduction Internal Fixation in the management of unilateral mandibular anterior fracture by using single miniplate fixation along with erich arch bar as tension band.

Materials & Method: The study was conducted on 10 patients reported to department of Oral and Maxillofacial Surgery. The patients were treated with single miniplate fixation along with arch bar as tension band for the management of unilateral mandibular anterior fracture. All the patients were evaluated for infection, malocclusion, stability, paraesthesia, and radiographic evaluation for anatomical Reduction post operatively at different intervals (1st week, 1st month, 3rd month).

Results: In this study the mean age of Patient was 30.7 years. Road traffic accident was the main etiological factor followed by interpersonal violence and fall from height. Infection was seen in 1 patient which was successfully managed by antibiotics and wound debridement. Malocclusion was seen in 2 patient which was successfully managed by guiding elastics for 4-7 days and molar grinding on one side. Mobility of segment was seen in 1 patients which was managed by Intermaxillary fixation for 2 weeks post operatively.

Conclusion: The use of miniplate for the treatment of mandibular anterior fracture varies from surgeon to surgeon and centre to centre. Though miniplate are best used following Champy's Principle, still many surgeons use single miniplate with arch bar placed for intermaxillary fixation can be used as tension band, eliminating the need of upper plate with minimum morbidity and complications. In our study the fixation of unilateral mandibular anterior fracture with single plate along with arch bar was found to be as effective as champy's recommendation of using two plate fixation as mentioned in previous scientific literature.

Keywords: Mandibular fracture, Erich arch bar, Miniplates, Parasymphysis fracture, Tension band.

Introduction

Oral and Maxillofacial injuries are most commonly associated with road traffic accidents, sports, falls and interpersonal violence. The injuries can vary in severity from simple crack to major fractures of the entire facial skeleton. The Anatomical structure of the facial skeleton is divided into three areas i.e upper third, middle third and lower third. The lower third i.e mandible (60%) is more prone to fracture due to its prominent position as compared to other bone (40%) of the facial skeleton.^{1,2} It has been noticed that fracture of mandible occur with a lower frontal impact force of 425lb (190kg) for the mandibular condylar fracture and a force of 800-900 (350-400kg) is sufficient for mandibular symphysis and parasymphysis fracture. The factors that causes mandible more prone to fracture are presence of foramina, long root of canine, presence of impacted third molar and sudden changes in the direction of trajectory at mandibular angle region.^{3,4} Open reduction of fractures of mandible has evolved significantly from wire osteosynthesis with intermaxillary fixation to rigid internal fixation.^{5,6}

Now a days, different methods of open reduction and internal fixation (ORIF) are present which include: Transosseous wiring, Dynamic compression plates (DCP), Eccentric dynamic compression plates (EDCP), Lag screws, Champy's mini-plates, Bio-resorbable miniplates & 3-D miniplates.

The treatment of mandible fracture is done by the fixation of miniplate that was popularized by champy's. All study modes present till date have suggested fixation at two points i.e two plates and suggested that it provide better stability than a single plate. Champy suggested that when the plates are placed along the ideal line of osteosynthesis they give maximum stability and proper osteosynthesis. ORIF with stainless steel miniplates and screws has proven to be the most effective method, associated with minimal morbidity, early mobilization and return to work.^{5,6,7} Champy and colleagues advocated the use of 2 mini plates anterior to the mentalforamina.⁶ In the symphysis and parasymphysis regions but it leads to many postoperative complications like damage to the tooth roots, plate exposure and dehiscence of the surgical wound.⁸ To counter the disadvantage of conventional bone plate / screw system there must be accurate adaptation of the plate to the bone. This will prevent any changes in the alignment of fracture segment and occlusion.⁹ The use of (intermaxillary fixation) IMF for a period of 3-4 weeks causes great patient discomfort, speech difficulties, weight loss, local effects such as gingivitis, and the rate of recovery to normal masticatory function is generally slower.^{6,8}

Recent studies by different authors have shown that fractures of the symphysis and parasymphysis can be

treated trans-orally using a single miniplate with arch bar with minor postoperative complications.^{6,10}

Objective

The objective of the study was to evaluate:

- a) Infection
- b) Malocclusion
- c) Stability
- d) Paraesthesia or Numbness
- e) Radiographic evaluation for anatomic reduction.

Materials and Method

This prospective study was conducted on 10 trauma patients having unilateral mandibular anterior fracture without any systemic diseases reported in the Department of Oral and Maxillofacial Surgery for the management of unilateral mandibular anterior fracture.

Proper case history was taken and all clinical and radiological examination was done to achieve the diagnosis of mandibular symphysis or Parasymphysis fracture (Figure1). Patient was advised for all haematological investigation, all patients were explained in detail about the surgical procedure and informed consent was taken before surgical procedure. Preoperatively all patients underwent intermaxillary fixation under local anaesthesia (Figure 2).

In this study the patient were treated with one stainless steel 2.0 mm 4 hole with gap mini-plate and post operative radiograph were taken (Figure 3).



Figure 3: Post operative PA mandible

Observation and Results

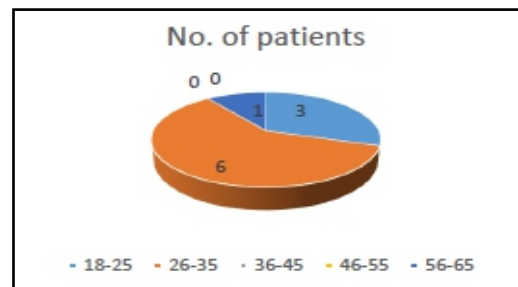
The study was conducted on 10 patients of unilateral mandibular anterior fracture who had undergone open reduction internal fixation under local/general anaesthesia. The patients were treated with single stainless steel miniplate of 2.0 mm 4 hole with gap for fixation with monocortical screws and arch bar (as tension band) for fixation in treatment of unilateral mandibular anterior fractures. Various preoperative and postoperative parameters were used to evaluate the outcome. (Graph 1,2,3 & Table 1)



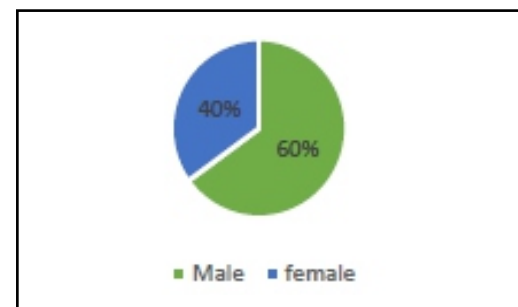
Figure 1: Pre operative PA mandible



Figure 2: Surgical exposure & fixation with single mini plate



Graph 1: Pie Chart Showing the Maxillofacial Trauma in Different Age Group



Graph 2: Pie Chart Showing the Maxillofacial Surgery in Different Gender

In this study out of 10 patients patients shows infection which was successfully managed by normal saline irrigation and on antibiotic prophylaxis and two patients are suffering from postoperative malocclusion which was successfully managed by guiding elastics for 5-7 days and selective grinding on one side. None of the patients shows paraesthesia in this study. One of the patients shows instability in the fracture which was successfully managed by intermaxillary fixation for two weeks.

Infection	
Infection	Patients
Present	1
Absent	9
Malocclusion	
Malocclusion	Patients
Present	2
Absent	8
Paraesthesia	
Paraesthesia	Patients
Present	0
Absent	10
Instability	
Instability	Patients
Present	1
Absent	9
Radiographic evaluation for anatomic reduction	
Radiographic evaluation for anatomic reduction	Patients
Present	2
Absent	8

Table1: Postoperative Evaluation of different Parameters

Discussion

Mandibular fractures are the commonest fracture on the face usually caused by accidents and other possible etiologies may be interpersonal violence, falls, sports injuries etc.¹¹ The need of osteosynthesis for mandibular fracture is to minimize the movement between the two fractured segments to promote the sound healing. This healing process can be deterred by the masticatory loads which can cause movements in between the fractured segments. The purpose of treatment of mandibular fracture is to regain proper occlusion and masticatory function, this can be achieved conservatively by immobilizing the fractured fragments by arch bar, dental wiring cap splints, and gunning splints.¹² Open reduction of mandibular fracture can be done by intraoral and extraoral approach. This is followed by direct osteosynthesis with transosseous wires which was described by Schwentzer in 1982, lag screws which was popularized by Niederdellmann in 1982 and bone plates which was given by Schilli and Spiessel in 1975 and 1976.¹³ Champy *et al*¹⁴ describe the ideal line of osteosynthesis in which the system of semirigid fixation with screws and miniplates were introduced by Champy's and his associates. According to his technique if the miniplate are placed along the ideal osteosynthesis they tend to provide good stability and osteosynthesis. It consisted of mono-cortical, inferior border plate and a plate below the roots of anterior teeth using miniaturized malleable plates.⁸ If the fracture distal to mental foramen the technique suggested use of a single miniplate in the

subapical region or against the external oblique ridge. However if the fracture are proximal to foramina two miniplate should be used to counter the torsional forces. This intermaxillary fixation will act as second line of resistance to counter load anterior to the fracture line. Sami SM *et al*¹⁶ did a study using Champy's principle on non-communitedsymphyseal / parasymphyseal fracture they suggested that good surgical outcome can be achieved with the application of two miniplate with monocortical screws. In order to eliminate the use of other plate at superior border^{16,17}, arch bar that is used for IMF can be used as tension band. By this concept a clinical study was done to get the efficacy in unilateral mandibular anterior fracture by using single miniplate with arch bar on 10 patients. In our study mean age of patients was 30.7 years. Similarly, mean age of the patients in other studies were in the same range like 28.6 years in the study of Guimondet *et al*¹⁷, 26 years in Bui *et al* study, 28 years in the study of Ellis E III¹⁸ and 29 years in the study of Edward AL *et al*.¹⁹

In our study showed higher frequency of mandibular fracture in males compared to females and the ratio was 6:4 respectively. This variation in frequency was attributed to the fact that males are involved more in outdoor activities and automobiles driving, the commonest cause of fracture. According to Champy M *et al*¹¹, Ellis E III¹⁸, Hussain S *et al*²¹, Thapliyar GK *et al*, Devadiga A *et al*, Subhashraj K *et al*¹¹, Okoturo EM *et al* and Ellis E *et al*.²² Our study is in accordance to various studies which also shows higher frequency of mandibular fractures in males.^{11,18,21} Different etiologies which account for mandibular fractures are road traffic accidents (39%), followed by fall (32%), 11% by interpersonal violence and (18%) others.³ In our study, only single miniplate was used in patients on the lower border of mandible and Erich arch bar as tension band. Al-Belasy *et al*²³ conducted a study and advocated a short period of MMF followed by an arch bar placed on lower dentition is a suitable option to conventional IMF for management of undisplaced mandibular fractures.

In our study postoperatively (10%) patients had occlusal discrepancy which was corrected by giving guiding elastic for 5-7 days. In second (1st month) & third (3rd month) visit, there were no occlusal discrepancy in both groups. Our study similar to the study conducted by Alpert B *et al*.²⁴ To prevent disharmony in occlusion and to maintain structural alignment of fracture segment, the miniplates should be well adapted to the underlying bone. Malocclusion recorded was 6% in a study by Sauerbier S *et al*²⁵ in which 2-mm locking plating system was used, 4.4% in a study by Moreno *et al*²⁶, which was based on Champy's principle. None of the patients in this study reported paraesthesia which is similar in accordance with the study conducted by Samira A *et al*⁶ postoperatively the paraesthesia in our study was low due to the fact that monocortical screws were used and also attributed to the use of single plate. In our study, (10%) of the patients are suffering from infection which was resolved with the help of normal saline irrigations &

antibiotics prescribed for 7 days which lead to satisfactory healing. Hussain S.²⁷ Favours the assumption that reduction of implanted material has minimized procedural errors and has facilitated easy adaptation of one plate at selected mandibular fracture. In previous studies the infection rate attributed with the use of metal plates and screws for the treatment of fractured mandible, reported between 3% to 27%.²⁹⁻³⁰ Hussain S.²¹ stated the mobility of fractured segments have been the most common technical cause of infection. Technical errors, like inadvertent placement of screws in the line of fracture, poor plate adaptation or contouring, inadequate cooling during preparation of holes for insertion of screws, increase the risk of post-operative infection. Champy M et al.¹⁴ and Orringer JS et al stated the technique failure was proved to be a frequent event in the application of rigid internal fixation devices to mandible fractures.¹⁴ Lack of antibiotics used is considered as a predisposing factor for infection, so the use of antibiotics, as prophylaxis as well as after surgery has been advocated in routine.²⁸ In our study, we routinely prescribed Intravenous followed by oral antibiotics to all our patients. Manor Y et al and Orringer JS et al have accepted tooth in the line of fracture as a major risk factor for infection.

Preoperatively mobility of fracture segments was seen in all 10 patients. Postoperative (10%) segmental mobility was evident. In a biomechanical comparison study by Alkanet al, it was concluded that stability is better with single miniplate with Erich arch bar system. Ellis and Walker conducted biomechanical test on mandible to evaluate stability by using two plate and their result was in favour of Champy's principle for the application of miniplates. In the present study radiographic follow-up was maintained until 3 months to evaluate anatomic reduction. The radiographic evaluation of fracture at different times showed in 20% of the patients. Our study was similar to Saluja H et al.¹⁷, which demonstrated radiographically that almost equal number of patients had inferior border discrepancy/distraction. The results of our study are in accordance with this study. In a study by Renton TF et al.²⁹, comparing the technique of mandibular osteosynthesis following and ignoring Champy's principle, it was concluded that the use of single stainless steel mini-plates was an effective method of treatment for mandibular fracture especially following Champy's principle.²⁹ Rix et al.^{29,30} followed Champy's principle with a modification that a loop or intramandibular wiring was used along with single miniplate in parasymphyseal fracture close to mental foramen in order to prevent any trauma to mental nerve that would lead to postop paraesthesia. Similar results were obtained in our study however complete lower arch bar was placed instead of loop wiring. Adaptation and placement of single miniplate on a limited bone surface is easier, safe, least palpable and less likely to be removed even after healing of bone. There was no complication like infection related to plate, plate exposure or plate

palpability as no plate was removed during this study. Postoperative removal of arch bar after four weeks had increased the stresses going to the bone hence had reduced the stress shielding to minimum when compared with double plate fixation system. Utilization of an Arch bar as a tension band has reduced chances of complications related to technical errors during fixation of second plate and screws. It has decreased possibilities of potential complications like stress shielding, Palpability, thermal sensitivity, and others. Also it provided two fold benefit by a second surgery for removal of plate. This technique not only used half of the recommended implanted material but also made it more reliable, cost effective and produced fewer complications. Thus, the outcome of the present study suggested that use of single miniplate along with an Erich arch bar for 4 weeks which acts as a tension band provides several advantages in terms of low morbidity, low infection & low cost. This also reduces the intra-operative time. It is economical for the patient as one miniplate is used instead of two. The use of single miniplate causes minimum injury to the mental nerve in the case of a fracture line running close to the mental foramen.

Conclusion

There are various combinations for rigid internal fixation are available for mandibular symphysis/parasymphysis fractures like fixation with 2 miniplates, 3D plate, single miniplate with continuous arch bar, lag screw and others. So, evaluation of the different fixation methods is important to provide a direction for the stability and predictability of each option. The aim of our study was to evaluate effectiveness of single plate in the management of mandibular anterior fracture. On analyzing the observation and results following conclusions were obtained. Infection was noticed in, 10% of patients which was treated with antibiotics and wound debridement.

1. There was occlusal discrepancy present in 20% of patients in immediate post-operative period which was successfully managed with guiding elastics and selective cuspal grinding on one side, respectively.
2. The instability of fracture segments were seen in 10% of patients which was successfully managed by intermaxillary fixation for 2 weeks.
3. Paraesthesia was completely absent in this study
4. Distraction of lower border was noticed radiographically in 20% of patients on their follow-up. However functionality of the occlusion was not altered.

Osteosynthesis provided optimal stability for healing of the fractures and allowed immediate function of mastication. Rigid fixation by this technique proved to be faster, cost effective, requires less amount of implanted material. Results were improved by this modality due to easy and better adaptability of single plate and less number of screws. Arch bar fixation provided better

control on occlusal stability and made minor occlusal corrections possible post operatively without attempting second surgery. It can be concluded that fixation in isolated mandibular symphysis / 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. The small sample size and limited follow-up could be considered as the limitations of this study. Further study with larger sample size and long term follow up period is required for establishment of this result.

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