External Oblique Ridge Fixation: An Effective Technique of Treating Mandibular Angle Fractures

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ABSTRACT

Introduction: Management of the mandibular angle fractures represent a clinical challenge as it is traditionally been plagued with a high postoperative complication rate. In spite of much controversy, in recent years 'miniplate fixation' has become the standard treatment of providing semirigid fixation, eliminating the need of postoperative MMF. The continuing quest for a simple, but effective technique is on. The present study is intended to evaluate the patients for postsurgical results and complications following the use of one non-compression miniplate in the management of mandibular angle fracture.

Material and Methods: The study included 30 patients with mandibular angle fractures, with or without associated fractures. All the thirty patients were treated with intraoral open reduction and internal fixation using one non-compression titanium miniplate along the external oblique ridge. Postoperatively, all patients were evaluated upto 6 weeks.

Results: The results showed that open reduction and one miniplate fixation intraorally, brought about excellent stability of the fractured segments and re-establishment of occlusion with minimal postoperative complications.

Conclusion: In a follow up period of 6 weeks, intraoral single plate for mandibular angle fixation was far superior treatment modality with minimal postoperative complications specially in cases with linear fractures of the mandibular angle. However, a larger number of cases should be studied over a longer period of time for better postoperative analysis of different types of angle fracture.

Keywords: Mandibular Angle Fracture, External Oblique Ridge, Miniplate, Champy's lines, Maxillomandibular Fixation, Open Reduction and Internal Fixation.

INTRODUCTION

Mandible is a bow shaped facial bone, strongest at its center and weakest at the ends (i.e., angle and condyle) where it breaks more often than any other bone of the facial skeleton. According to Killey and Rowe, the incidence of mandibular fractures range between 40 – 65% of all facial fractures and are twice as common as fractures of the mid-facial bones.[1] Road traffic accidents, assaults, falls, sports events and pathological fracture are amongst the major causes.

Amongst all, fractures of the mandibular angle comprises approximately 23% - 42% cases.[2] There are several factors which makes mandibular angle region vulnerable to fracture, like presence of third molars, thinner cross – sectional area at the angle region; curvature of trajectories; lingual surface of the angle region being one site of maximum tensile strain resulting from anterolateral application of muscle forces and finally weakness of the angle produced by the abrupt change in direction between the body and ascending ramus in two planes, almost 20° in the vertical plane and about 70° in the horizontal plane at the upper border. Only solace in this is the insertion of the masseter and medial pterygoid muscles just behind the third molar which comprises a great source of strength to the ascending ramus.

Management of the mandibular angle fractures represent a clinical challenge as it is traditionally been plagued with a high postoperative complication rate, the incidence ranging from 0 to 32%. Physiologic, anatomic and social factors may contribute to these complications.[3,4] Not all mandibular angle fractures (MAF) require operative treatment, but all successful treatment of mandible fractures depends on undisturbed healing in the correct anatomic position under stable conditions. Failure to achieve these conditions results in infection, malocclusion, non-union or malunion.

Over the past 30 years, open reduction and internal fixation of mandibular angle fractures using plate and screw has been instituted with the advantage of not requiring maxillomandibular fixation (MMF) in the postsurgical period. Two philosophies exist. One group viz. AO/ASIF (Arbeitsgemeinschaft fur Osteosynthesefragen / Swiss Association for the Study of Internal Fixation) surgeons and Luhr, believes that plate and screw fixation should provide sufficient rigidity to the fragments to prevent interfragmentary mobility during active mandibular movements for which they used large bone plates fastened with bicortical bone screws. On the other side, Michelet et al[5] proposed fixation using small, easily bendable, noncompression bone plates placed transorally and attached with monocortical screws as they believed that that rigidity of the fracture fragments is important to resist infection in mandibular angle fracture but is not considered mandatory for healing of the same. Champy et al[5] developed the technique and described the ideal sites for bone plate placement, and reported a low incidence of postoperative complications.

The present study was intended to determine the efficacy of

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external oblique ridge fixation by evaluating the patients for the results and postsurgical complications following the use of single non compression miniplate for the management of mandibular angle fracture.

MATERIAL AND METHODS

This study was conducted from 2008 to 2011 (40 months) and included 30 cases of mandibular angle fracture (keeping in mind the follow up period in the stipulated time of the study) with or without fracture elsewhere in the mandible or midface that reported to the Department of Oral and Maxillofacial Surgery in our centre which were treated by open reduction and internal fixation using one noncompression miniplate intraorally along the external oblique ridge.

A well informed and written consent was obtained from all the patients. Individuals above 12 years of age, dentate and with noncomminuted fractures of the mandibular angle were selected and those multiple facial fractures requiring MMF postoperatively, were excluded. In all the cases a thorough clinical history was recorded along with patient's health history to rule out any significant systemic conditions that might have had a bearing on patients treatment protocol. Detailed clinical examination was carried out as per the protocol. Radiographic examination included the posteroanterior view of mandible, occlusal view of the mandible and the Orthopantomogram (OPG). Additional radiographic projections were obtained when indicated. The radiographs were assessed for the degree of displacement of the fracture fragments.

Surgical Technique

After placement of Erich's arch bars or Ivy eyelets, patient was shifted to the operating room and was taken under local or general anaesthesia followed by part preparation. An 'S' shaped incision was marked in the third molar area. A mucoperiosteal flap was raised along the superior and lateral aspect of the mandible. This incision, as opposed to one more buccally placed, allows access to the ridge area with minimal retraction of the lingual flap. If teeth in the fracture were to be extracted, the intraoral incision included the attached gingival around the involved tooth.

Once the fracture was exposed, evaluated and reduced, the jaws were placed into maxillomandibular fixation and a four-hole with gap non-compression titanium miniplate (Mondeal, Germany) was adapted along the medial side of the external oblique ridge and screwed to the bone using 2.0 x 7 mm self-threading screws (Figure-1). No transbuccal trochar was necessary for instrumentation. The three most anterior screws were inserted with the patient in MMF. The most posterior screw on the medial surface of the mandibular ramus was inserted after removing the MMF, allowing instrumentation between the upper and lower teeth from the opposite side. After the plate was placed, MMF wires were removed, and the occlusion was reevaluated. Postsurgical MMF was not used in any of the patient. Closure was done using resorbable suture (Vicryl 3-0), and no drains were placed. Postsurgical recommendation for soft diet was prescribed for atleast 6 to 8 weeks.

STATISTICAL ANALYSIS

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 15.0 statistical Analysis Software. The values were represented in percentages and Mean ± SD.

RESULTS

After fixation of the fractured fragments with bone plate, all fractures appeared to be well reduced and stable. Postoperative radiographs were taken within the first 2 days when compaired with the preoperative radiographs, showed excellent reduction in all cases (Figure-2). All the patients were recalled at 1 week, 3 weeks and 6 weeks postoperatively. Assessment of pain, swelling, derangement in occlusion, change in mouth opening, mobility status and complications were recorded during follow up intervals and, extent of change from pre-operative (baseline) status was made.

Majority of subjects, 53.3% were in the age range 21-30 years, followed by 33.3% $\leq$ 20 years and rest 13.3% subjects were between 41-50 years. Thus we saw that most of the subjects were in their active phase of life. Males dominated the study subjects with 86.7% with only 13.3% females. Road traffic accident (60%) was the most common cause of mandibular fracture in our study fall (20%), interpersonal violence (13.3%) and occupational accident (6.7%) were the other causes. In majority of subjects only one side was involved (93.3%). There were only 2 subjects in whom bilateral involvement was seen. Post-operative assessment of the patients was done by comparing the changes in pain, swelling, mouth opening, mobility status, occlusion and complications involved.

At baseline the mean pain score was 4.00±0.38, with increase in time the pain scores continued to decrease. Statistically significant change in swelling was seen from 1 week

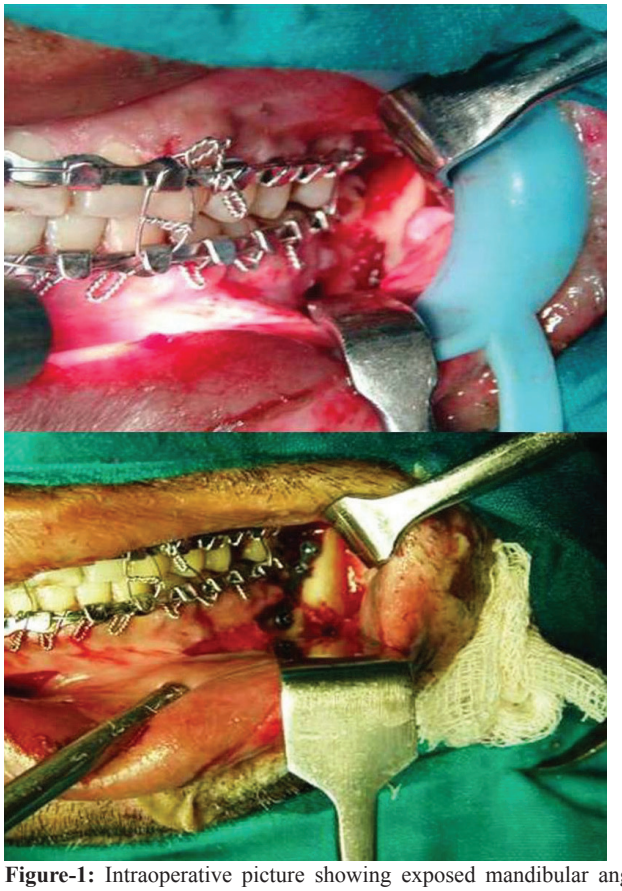

Figure-1: Intraoperative picture showing exposed mandibular angle fracture reduced and fixed with 2mm, 4 Hole with gap, Titanium Miniplate.

postoperatively, which remained maintained till the last follow up. At baseline all the subjects had deranged occlusion. Immediate postoperative occlusal relationships were judged as normal in all the cases but at 1 week, 6 (20%) showed slight ipsilateral open bite. This resolved with the use of light training elastics for 10 - 14 days. At the end of 3 weeks and 6 weeks interval, only 2 patients were judged to still have an ipsilateral open bite that was attributed to malunion at a fracture site (Table-1). All other occlusal relationships were judged normal.

At baseline the mean mouth opening was 16.80±4.77 mm. With the passage of time the mean mouth opening continued to increase reaching to peak level at 6 weeks (37.67±3.37) thus showing a total mean increment of 20.87±4.09 mm which was significant statistically ($p<0.001$). All the fracture were found to be stable from first week onwards showing a statistically significant change from baseline ($p<0.001$).

Complication in the form of infection was observed at 1 week and 6 weeks time interval in 2 cases only (Table-2). No other complication was noticed.

DISCUSSION

Management of mandibular angle fracture, generate highest frequency of complications relative to all other mandible fractures, with reported rates from 0% to 32%. Infection was the biggest culprit recorded in non rigid fixation. Physiologic, and anatomic factors, increased prevalence of drug and alcohol abuse, poor oral hygiene and nutritional status, and reduced compliance with treatment contributes to an increased incidence of these complications.[6,7] Thus the varying treatment methods and the surgeon's experience with a particular technique may influence the postoperative results and complications in patients with MAF.

Ellis III & Walker[7] treated 81 patients with mandibular angle fracture using a single miniplate without postoperative MMF. They found this treatment modality to be associated with minimal postoperative complications and patients were able to open their mouth & regain mandibular mobility immediately after surgery. Their results confirmed that the single miniplate for treating non-comminuted fracture of the mandibular angle was ideal.

In the present study all the patients were treated using a single non-compression miniplate without the use of postoperative maxillomandibular fixation (MMF), minimal postoperative complications were noticed and thereby the use of single miniplate for mandibular angle fracture fixation was found to be highly attractive.

The question of removal of tooth in the line of fracture is greatly debated. The high infection rate in mandibular angle fractures were usually attributed to the presence of lower third molar. Ellis[9] showed an increased rate of infection when a tooth was present irrespective of whether the tooth was extracted. He also showed that the presence of the lower third molar tooth at the fracture line increases the risk of postoperative complication but the increase is not statistically significant. The removal of third molars in management of angle fractures should be dealt on case to case basis weighing the risk against benefit. Fractured or damaged roots, pericoronal/periodontal infection, gross caries, tooth mobility and inability to reduce the fracture without tooth removal should be considered as criteria in removing the tooth.

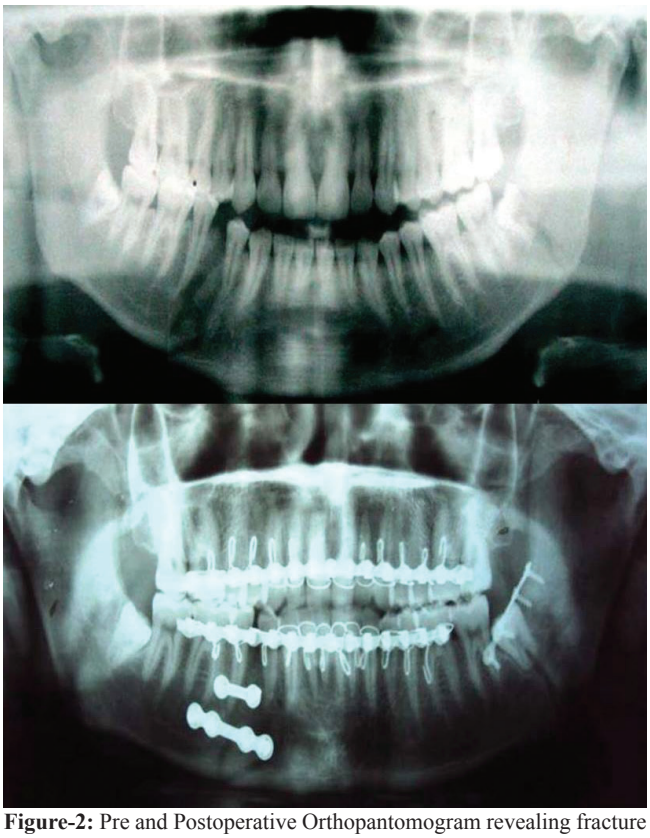

Figure-2: Pre and Postoperative Orthopantomogram revealing fracture left angle & right mandibular body fixed using miniplates

S. No.	Interval	No.	%	Statistical significance of change from baseline	
				χ^2	P
1.	Baseline	15	100	–	–
2.	1 week	3	20	20.000	<0.001
3.	3 week	1	6.7	26.250	<0.001
4.	6 week	1	6.7	26.250	<0.001

Table-1: Change in Derangement of occlusion at different time intervals

S. No.	Interval	No.	%
1.	1 week	1	6.7
2.	3 week	0	0
3.	6 week	1	6.7

Table-2: Postoperative Complications at different time intervals

In the present study all mandibular angle fractures were associated with a lower third molar none of which was extracted at the time of surgery. But postoperatively only 2 patients had infection of the surgical site which was managed conservatively with antibiotics.

Cawood[10] compared 48 patients of mandibular angle fracture of which 27 were treated with miniplate fixation and 21 patients with wire fixation along with 6 weeks of MMF. At 4 weeks, the miniplate group achieved an average of 42 mm interincisal opening, whereas in the wire fixation group it was only 34 mm 15 weeks postoperatively.

In the present study, all the patients were treated with miniplate fixation and most of the subjects 18 (60%) at baseline had mouth opening between 15-20 mm, 8 (26.7%) cases had a mouth opening <15 mm while in rest 4 (13.3%) mouth opening

was between 20-25 mm. Postoperatively at 6 weeks an average of 37.67 mm mouth opening was achieved.

Ellis and Walker[8], 1996, noted that the use of a single 2-mm monocortical plate was associated with a low complication rate (16%), most frequently local infection that was treated without patient incision and drainage and later removal of the miniplate under local anesthesia.

Levy and coworkers[11] found a very low complication rate of 3% in fractures treated with 2 miniplates compared with a 26% complication rate in fractures fixed with a single miniplate.

This was in contrast to our study and various other studies conducted by Ellis, Walker etc. where in single miniplate for the treatment of mandibular angle fracture had minimal complications.

Siddiqui's[12] study compared two treatment modalities, one mini-plate versus two mini-plate. The study took into account the minor and major complications which showed no significant difference in these groups. Placement of a second plate via extraoral approach showed no added advantage in treating mandibular angle fracture but on the other hand increases the cost and adds up to the operative time. Intraoral open reduction and internal fixation using one malleable non compression mini-plate presented with 14% complication of which 9% required surgical intervention. All these complications were considered minor and consisted of plate fracture, local infection or both.

The intraoral technique[13-17] followed in the present study showed association with fewest postsurgical complications. Most complications in this study were minor and easily managed. 6 out of 30 patients showed postoperative ipsilateral posterior open bite which responded well to light elastics. 2 patients reported with infection of the surgical site which was managed conservatively using antibiotics.

Ellis and Walker reported soft tissue infection occurring 2 weeks after surgery in 2 patients who were treated with oral antibiotics and fracture healing progressed as normal.[8] In the present study only 1 (6.7%) patient developed minor complication of soft tissue infection 1 week postoperatively which responded well to oral antibiotics and fracture healing was good. There was no major complication requiring hospitalization or further intervention. In the present study, long term occlusal discrepancy in the form of ipsilateral posterior open bite was seen in 2 (6.7%) patients.

Kuriakose[18] in his study regarded miniplates as semi-rigid fixation system allowing the use of elastic traction to correct small occlusal discrepancies, this flexibility was lacking in a rigid fixation.

Similarly in the present study minor occlusal discrepancies at the first postoperative appointment were corrected by light guiding elastics for 10 days in 4 cases.

In some cases there was a gap along the inferior border of the mandible in the immediate postoperative radiograph. However after follow up of 6 weeks the gap was found completely healed in all the cases.

According to Saito & Murr[19], application of MMF creates several well known and significant problems for both patient and surgeon. The patient's inability to open the mouth leads to nutritional deficits, suboptimal wound healing, and weight loss. The MMF hardware often creates painful abrasions and ulcers in the oral mucosa. Also, prolonged immobilization of the temporomandibular joint leads to ankylosis and bone resorption. MMF can even lead to life-threatening complications, as when patients with nausea and/or substance abuse aspirate gastric contents during episodes of emesis. Because of such problems, the use of rigid fixation is appealing as it allows early recovery of mandible function with limited or no need for postoperative maxillomandibular fixation.

In the present study all mandibular angle fractures were fixed using single monocortical miniplate along the superior border of external oblique ridge intraorally without the use of postoperative MMF in any of the patients.

There are a number of treatment options available for the management of mandibular angle fracture. Diverse studies show that a controversy exists as regards the ideal means of treating the angle fracture. We sought to develop a protocol to treat mandibular angle fractures intraorally, using the principles developed by Champy[20] and colleagues that would minimize morbidity and allow early return of masticatory function.

CONCLUSION

As evaluated in the present study we conclude that intraoral single plate for mandibular angle fixation is a superior treatment modality with minimal postoperative complications specially in cases with linear / noncomminuted fractures of the mandibular angle but it may seem incongruous with the principles of rigid internal fixation, according to which a single miniplate does not satisfy the requirements of a truly rigid system. As believed by the proponents of the rigid internal fixation, prevention of interfragmentary mobility is the key to success and should be sought when treating fractures.[20] However, a larger number of cases should be studied over a longer period of time for better postoperative analysis of different types of angle fracture.

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