

Comparison of Intraoral External Oblique Ridge Fixation and Transbuccal Lateral Cortical Plate Fixation for Mandibular Angle Fracture – A Randomized Control Trial

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Abstract

Background/objectives: Mandibular fractures account for almost half of all the fractures occurring in the maxillofacial region. Among mandibular fractures, angle fracture has a highest rate of post-operative complications (0-32%). This study compared the fixation of mandibular angle fracture with intra-oral external oblique ridge fixation versus transbuccal lateral cortical plate fixation using a single miniplate. Post-operative complications especially infection was noted and compared.

Methods: A randomized controlled trial was done to compare the outcome of the two procedures. A total of 120 mandibular angle fracture patients were randomly allocated into Group A and Group B, 60 in each group. Group A underwent ORIF with intraoral approach and Group B underwent open reduction Internal fixation (ORIF) with transbuccal lateral cortical plate fixation for mandibular angle fractures. Patients of both groups were reviewed on 1st week, 1st month and third month for clinical signs of infection.

Results: In group A, 10 (16.66%) patients suffered from infection and in group B, 4 (6.66%) of patients reported with infection at the last follow up visit that is at the end 3 months. No statistically significant p value after application of 'Chi square test' was noted for infection at the end of the third month review.

Conclusion: Mandibular angle fractures can be effectively treated with transbuccal lateral cortical plate fixation as ease of plate adaptation, placement of plate in mid neutral area and less chance of infection.

Keywords: External oblique ridge fixation; Lateral cortical plate fixation; Mandibular angle fracture; Miniplates; ORIF

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Introduction

Mandible plays the central part in function and esthetics in oral and maxillofacial region [1]. The mandible is present in very pronounced position on face and the projected chin is favorite target of trauma. Mandibular fractures account for almost half of all the fractures occurring in the maxillofacial region [2,3]. The mandible fractures are more common in young adults and in males as compared to female [4]. The most common cause of mandibular fracture includes road traffic accidents, other causes may be fights, falls, sports accidents and pathological fractures. Most frequently fractured area in the mandible is the condyle

followed by symphyseal and parasymphyseal and angle fractures [5]. Mandibular angle fractures are one of the most common (25%) facial fractures [6,7].

The magnitude and direction of the trauma intensity and anatomy of site effect the location of fracture [8,9]. The frequent involvement of mandibular angle in facial fractures can be attributed to i) thinner cross-sectional area ii) presence of third molar iii) angle is subjected to muscle forces. There is also an abrupt change in shape from horizontal to vertical rami [10].

Mandibular displaced fracture results in loss of function and facial disfigurement [11]. Angle fractures are generally posterior

to the molar dentition, which prevents optimal stabilization by maxillomandibular fixation. Also, the presence of a third molar has been linked to an increased risk of angle fractures, and may hinder fracture reduction, decrease bony surface contact area, disrupt the vascularity to the fracture site, and be a source of pathogenic organisms. The angle fracture can be further complicated by distraction and rotation by opposing forces of the muscles (masseter, medial and lateral pterygoids, temporalis) and the depressor muscles (geniohyoid, genioglossus, mylohyoid, digastric) Angle fracture has a highest rate of complications postoperatively compared with all other mandibular fractures encountered (0-32%) [12].

The accurate treatment of mandibular angle fracture is essential in order to restore the function and esthetics [11]. In the literature different techniques for the management of mandibular angle fracture have been reported including close reduction with intermaxillary fixation, open reduction with transosseous wires, lag screws and plate osteosynthesis [13]. As a result of early research in long bones, AO (Association of Osteosynthesis) initially stressed the need for absolute stability to prevent fragment mobility and generate primary bone healing. Open reduction and internal fixation (ORIF) of the mandible with bone plates was first described by Schede in 1888, who used steel plates and screws [14]. Currently internal fixation with miniplates has become the standard treatment for mandibular angle fractures [10]. The advantages of open reduction and internal fixation include early restoration of occlusal functions and proper repositioning of fracture [15].

Researchers had documented lines of osteosynthesis for the fractures of mandibular angle depending on its ease and function which consists of fixation with one miniplate at superior boarder of mandible ventral to external oblique ridge [16]. Treatment of angle fracture with single miniplate according to Champy's technique can lead to the opening of fracture line at the lower border, lateral displacement of the fragment at the inferior mandibular border, posterior open bite on the fracture site, wound dehiscence and infection [16,17].

The ideal treatment for these fractures remains controversial [12]. The surgeons have shown a strong preference in using combined transbuccal/oral approach using one miniplate flat against the outer surface of mandible. This approach has many advantages over the intra oral approach alone, the given reasons were, ease of use, minimal requirement to bend the plate and facilitation of placement of plate in mid neutral area of mandible. This combined procedure is associated with less complication like infection (5%), as compared to intraoral approach alone i.e. infection (20%) [17,18]. In literature we could not find any study previously conducted in Pakistan that intraoral external oblique ridge fixation compared with transbuccal lateral cortical plate fixation for mandibular angle fracture. The objective of this study is to compare the two treatment modalities for mandibular angle fractures thereby emphasizing the selection of best technique in terms of postoperative complications and contributing in developing better management of patients.

Materials and Methods

This study was conducted at Oral and Maxillofacial Surgery Department, Pakistan Institute of Medical Sciences (PIMS), Islamabad from 2014 to 2015. Ethical approval was taken from the PIMS Ethical Review Committee. A randomized controlled trial was done to compare the outcome of the two procedures. All the patients presented with mandibular angle fracture requiring fixation and age between 16 and 75 were considered in this study. Patients with comminuted, pathological, infected, pan facial or previously treated fractures and immunocompromised were excluded from the study. Informed consent was taken before randomization. Closed lots with envelopes were used to achieve the randomization.

Surgical technique

The patients in group A were treated with intra-oral external oblique ridge fixation with a single miniplate. This technique involved the application of eyelets in both upper and lower jaws and an intra-oral incision for exposing the fracture line. Third molars in the fracture lines were removed, fractures were reduced and patients were placed on intraoperative MMF. Fixation was done with five holes miniplate placed on the external oblique ridge, two mini screws were placed on each side of fracture line. The MMF was released to verify the proper occlusion. The surgical sites were closed with resorbable 3/0 sutures.

The patients in group B were treated with transbuccal lateral cortical plate fixation using a single 5 holes miniplate. This technique also involved the application of eyelets in both jaws and exposure of fracture line using intra oral incision. Third molars in the line of fracture were removed, fractures were reduced and patients were placed on intraoperative MMF. Fixation was done using five holes miniplate on lateral cortical plate using trocar, two mini screws were placed on each side of fracture line. The MMF was released to verify the proper occlusion. The surgical sites were closed with resorbable 3/0 sutures.

The same plating equipment was used for all the patients. All the patients remained admitted in the hospital for three days and were prescribed broad spectrum antibiotic injection Amoxill 500 mg TDS or injection clindamycin 300 mg BD in patients allergic to penicillin. Follow up visits were done on first week, first month, and third month. All the data was analyzed by SPSS 21.

Results

A total of 120 patients with mandibular angle fractures fulfilling the inclusion criteria were included in the study. The patients were randomly allocated into group A and group B comprising of 60 patients each. The mean age of these patients was 31.55 years (SD \pm 13.01) with an age range from 16- 66 years. In group A, mean age was 30.83 (\pm 12.86) with an age range from 16-66 years whereas in group B, mean age was 32.27 (\pm 13.23) with an age range from 16-65. Males formed the predominant gender 78% (n=94) involvement whereas females constituted 21% (n=26). In Group A, males formed the predominant gender 81.66% (n=49) whereas there were 18.33% females (n=11). In group B, male gender was predominant 75% (n=45) whereas females comprised

the remainder 25% (n=15) (Table 1). Peak incidence was noted from 16-30 year age group.

Overall the left side was more often fractured with 72 (60%) patients presenting with mandibular angle fractures as compared to the right side with 48 (40%) patients presenting with mandibular angle fractures (Table 1). In group A, 21 (40%) fractures were seen on the right side out of which 16 were males and 05 were females whereas 48 (60%) fractures were seen on the left side, 33 males and 06 females. In group B, 25 (41%) fractures were seen on the right side out of which 20 males and 05 females whereas 34 (56%) fractures were seen on the left side out of which 25 males and 09 females (Table 1).

In group A, 10 (16.66%) patients suffered from infection and in group B, 4 (6.66%) patients reported with infection at the last follow up visit (at the end of 3 months). The overall infection rate taking both groups into account was 14 patients with overall percentage of 11.67%. The left side was infected more often with 08 (57%) patients reported with infection whereas on the right side 6 (43%) patients reported with infection. In group A, according to site 05 (50%) patients had infection on right side and 05 (50%) patients had infection of the left side. In group B, 1 (25%) patient suffered from infection on the right side and 3 (75%) patients had infection on the left side (Table 2).

In group A, 05 patients presented with infection on first week follow up visit. On one month's review, infection of the 05 previous patients responded to medical therapy. Whereas 03 cases presented with infection on first month follow up. The first month infection cases were treated with medical therapy and on three month's review two cases presented with infection, who had no clinical signs of infection at the end of medical therapy.

In group B, 02 patients were found to have infection on first week follow up visit. On one month's recall, 02 of the previous patients were infection free after antibiotic treatment. One patient presented with infection on first month follow up and one patient

Table 1 Demographic data of patients in the study (n=120).

Study group	Gender	Age	Fracture site
Intra oral external oblique ridge fixation	Male=49 (81.66%) Female=11 (18.33%) n=60	Mean=30.83 Range=16-66	Left=39 Right= 21
Transbuccal lateral cortical plate fixation	Male=45 (75%) Female=15 (25%) n=60	Mean=32.27 Range=16-65	Left=34 Right=26

Table 2 Summary of infection in both groups.

Study group	Infection rate (1 st week review)	Infection rate (1 st month review)	Infection rate (3 rd month review)
Intra oral external oblique ridge fixation	5 (8.33 %)	3 (5%)	2 (3.33%)
Transbuccal lateral cortical plate fixation	2 (3.33%)	01 (1.66%)	1 (1.66%)
	P=0.349	P=0.260	P=0.222

presented with infection on third month follow up. On three months review, one patient who had infection on previous review was free of infection as a result of medical therapy. On first week review, 5 patients in group A and 2 patients in group B presented with infection. On application of Chi square for association between both groups a 'p' value of 0.349 was obtained which is statistically insignificant. On one month's review, 03 patients in group A and 01 patients in group B suffered from infection, with the help of Chi square for association between both groups a p value of 0.120 was obtained which is statistically insignificant. On three months review, two patients in group A and one patient in group B had infection using Chi square for association between both groups a p value of 0.222 was obtained which is statistically insignificant.

Discussion

In this study a total of 120 patients were treated with mandibular angle fractures with single miniplate. The mean age of the patients involved in this study was 31.55 years (SD ± 13.01) with an age range from 16- 66 years with peak incidence of fractures occurring in 16-30 years age groups. Edward Ellis in his comprehensive prospective study found mean age to be 27.9 with an age range of 13-54. Males formed the predominant gender group in our study with 78% (n=94) males involvement whereas females constituted 22% (n=26) of the total sample. Patil in his study recorded that 80% (n=60) of his patients were males and 20% (n=15) were females [19].

Males bearing the main workload in our society necessitate them to work and travel around quite a lot more than the females. Also males being more aggressive in nature indulge in interpersonal violence a lot more than females and results in sustaining more mandibular fractures than females. Mandibular angle fractures are prone to highest complication rates, ranging from 0% to 32% [7]. The most common complication of mandibular fractures is infection which is reported to develop in 0.4-32% of all cases. Infection may develop from delay in treatment, lack of prophylactic antibiotic administration, teeth located in the line of fracture, devitalized intervening hard or soft tissue and persistent fracture instability [20]. Among all the mandibular fractures, angle has highest rate of postoperative infection [21]. Infection is considered one of the major predisposing factors for nonunion and for some is the main reason for plate removal in the postoperative period [22].

The main enigma faced by researchers in assessing the infection rates is that the tools, to measure infection rate and its prevalence, are hard to comparable from one study to the other. Moreno et al. described infection as presence of inflammatory signs or presence of suppuration from the fracture site on clinical examination [23]. Sugar *et al.* deems a patients fracture to be infected if there is presence of pus [14]. Seemann et al. also classified infection as pooled abscess and local phlegmon but he intermingled infection and wound-healing disturbances in the same group for ease of statistical analysis. Wound healing disturbances includes cellulitis, purulence, dehiscence of incision, granulation tissue at incision site and plate exposure which makes it difficult to compare results of his study for research work [23].

In current study, overall infection rate was 11.67% (n=14) out of which 8.33% (n=10) developed infection in group A and 3.34% (n=4) presented with infection in group B. Sugar et al conducted first study comparing intraoral and intraoral with transbuccal approach using single miniplate for fixation of mandibular angle fracture. He reported an overall infection rate of 14.28% which is slightly higher than our result [14]. Laverick et al in his study recorded an infection rate of 13%. Although this percentage is consistent with literature, Laverick considered this slight high percentage to be a consequence of the population they treated from a large inner city with many socially deprived areas [21]. Wan et al in his study recorded an infection rate of 12.1% in a total sample of 597 patients [24]. Levy et al. recorded an infection rate of 15.8% while treating angular fractures [25]. Seeman et al recorded an infection rate of 20% in his study [26]. High rate of infection observed in different studies might be due to difficulty faced by authors while classifying infection, wound dehiscence and osteomyelitis separately.

In our study 16.66% (n=10) patients developed infection in group A (intraoral alone) and 6.66% (n=4) presented with infection in group B (transbuccal lateral cortical plate fixation). Sugar et al recorded infection rate in intraoral alone and intraoral with transbuccal approach as 21% and 9% respectively. Infection rate in intraoral with transbuccal approach is comparable to our study whereas infection rate in intraoral approach alone in our study is 5% less than that of Sugar's study. This high rate of infection in Sugar's study can be attributed to the fact that Sugar carried out his study in multiple centers from various countries in which multiple teams of surgeons participated. Direct comparison of studies from different units and countries could have posed difficulty as the etiology of fractures, socio-economic status of patients, compliance of patients, quality of post-surgical care and definition of complications might have varied among different centers [14].

Laverick et al recorded infection rate of 5% and 20% in intraoral and transbuccal approach and intraoral approach respectively [12]. Infection rate in combined intraoral and transbuccal approach was significantly less (1.66%) than our study whereas infection rate in intraoral approach alone was significantly higher (4%) than our study, reasons for these significant differences were explained by Laverick himself as having some flaws in the randomization of patients which biased the study. Multiple teams of surgeons participated in Laverick's study causing some inaccuracy of results whereas our study was conducted by a single team of surgeons. Laverick reviewed patients at one week and one month postoperatively and lost some data during follow up visits whereas we reviewed patients at one week, one month and three months.

We evaluated patients for infection on one week, one month and three months post surgically in both groups. The incidence of infection in intraoral approach was 8.75%, 17.5% and 15% respectively. Similarly in group B, observations on one week, one month and three months were 5%, 11.25% and 8.75% respectively. There are only three studies in published literature that have compared the transbuccal with intraoral technique. The

first study which compared both techniques was conducted by Sugar et al. in 2009 and recorded observation in a similar manner. They reported 7%, 23% and 20% infection rate in intraoral technique and 4%, 15% and 9% infection in transbuccal technique on first week, first month and three month review respectively [14]. Their study shows that infection peaks at four week mark and then gradually starts to decline which is consistent with our results. The other two studies conducted by Laverick et al and wan et al reviewed patients not more than 06 weeks making direct comparison of results difficult.

Although, this was a prospective randomized study and randomization was done by lottery method, there were certain short comings including failure to exclude multiple mandibular fractures. Although patients with multiple mandibular fractures were included in the study but data was collected for only angle fractures. Additional fractures may act as confounder variable and affect outcome of the study. They may contribute to instability at the mandibular angle fracture site thus potentially impair bone healing and predispose them to infection. Age of the patient was recorded in number of years as told by patient himself, instead of calculating from patient's date of birth, it may lead to discrepancies in data collection and misleading results regarding mean age and the age range as most of the female patients in our society are reluctant to mention their exact age. Other confounders which might have affected the results include presence of (Teeth with apical periodontitis, deep caries, fractured, mobile or displaced and extracted or not extracted per-operatively) may affect the outcome as they may increase the risk of complications. Habits of patient (smoking and drinking) which may affect soft tissue and bony healing, predisposing the fracture site to development of infection [27]. There is need for further research in this regard to have clear guidelines for the management of mandibular angle fractures.

Conclusion

The key findings of this study suggest that the use of the transbuccal-lateral cortical plate fixation produces fewer postoperative complications compared with external oblique ridge fixation. Although the results of the study are statistically insignificant but considering the potential decrease in complications (infection), transbuccal lateral cortical plate fixation proved to be superior as compared to intraoral approach.

Conflict of Interest

"The authors declare(s) that there is no conflict of interest regarding the publication of this paper".

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Data availability statement

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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