

ORIGINAL ARTICLE

FUNCTIONAL OUTCOMES OF OPEN VERSUS CLOSED TREATMENT OF UNILATERAL MANDIBULAR CONDYLAR FRACTURES

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Background: Although mandibular condylar fractures are among the most common fractures of maxillofacial region, the ideal method for treatment of these fractures is still a controversy. The objective of this study was to compare functional outcomes of open vs closed treatment of unilateral mandibular condylar fractures. **Methods:** This study was carried out at Department of Oral and Maxillofacial Surgery, Armed Forces Institute of Dentistry, Rawalpindi. All patients, included in our study, were randomly put in open and closed treatment groups. Patients were assessed for maximal mouth opening, deviation of mandible on opening and occlusal status six months postoperatively. Maximal mouth opening was assessed by maximal interincisal distance, deviation of mandible on opening by calculating the midline discrepancy during mouth opening and occlusion was assessed by clinical examination according the modified criteria described by Singh V *et al.* Independent samples *t*-test was used to compare means of variables in open and closed treatment groups. **Results:** After six months of follow up the mean mouth opening was 36.39±4.72 mm in open treatment group while it was 33.74±4.72 mm in closed treatment group and difference was statistically significant. While deviation of mandible on opening was found to be 0.48±0.99 mm in open treatment group and 1.09±1.60 mm in closed treatment group. The mean occlusal disturbance was found to be 1.17±0.38 in closed treatment group while it was 1.10±0.30 in open treatment group. **Conclusion:** Open treatment of unilateral mandibular condylar fractures results in better functional outcomes particularly in terms of mobility of mandible (mouth opening).

Keywords: Mandibular condyle; Temporomandibular joint; Maxillomandibular fixation; Open reduction; Internal fixation

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INTRODUCTION

Mandibular condylar process is frequently involved in maxillofacial trauma. Fractures of mandibular condyle account for almost 25–35% of all mandibular fractures.^{1,2} Depending on anatomical location, the condylar fractures can be classified into condylar head fractures, condylar neck fractures and condylar base or subcondylar fractures.

Clinicians are generally agreed regarding the treatment of fractures in most regions of mandible; however, there is considerable controversy as far as the management of mandibular condylar fractures is concerned.³ It is indispensable for surgeon to clearly define the goals of treatment and choose the simplest and most efficient surgical method to achieve them. Goals of surgical therapy are to, obtain stable occlusion, restore interincisal opening and mandibular excursive movements, minimize deviation of mandible, produce pain free articular apparatus during rest and function, avoid internal joint derangement of TMJ, and avoid the future growth disturbance.

Various treatment modalities⁴ have been proposed for treatment of mandibular condyle fractures

including functional or observation only treatment, closed treatment and open treatment. Functional treatment is indicated for patients with undisplaced fractures and optimal occlusion, and it includes observation by frequent follow up and soft diet for initial period of healing. Although open reduction and internal fixation of condylar fractures results in better outcomes closed reduction has traditionally been the preferred treatment for the condylar fractures and it employs variable periods of maxillomandibular fixation (MMF), followed by aggressive physiotherapy.⁵

In case of mandibular neck and subcondylar fractures there is general consensus that fractures with mild displacement, i.e., ramal height shortening less than 2 mm or deviation less than 10 degrees should be treated by closed means while severely displaced fractures, i.e., ramal height shortening more than 15mm or more than 45 degrees of deviation should be treated by open method.^{6,7} But the controversy still exists regarding the management of moderately displaced fractures, i.e., fractures that fall in between above two categories. Although some latest studies have shown open method of treatment results in better functional

outcomes, consensus regarding the preferred mode of treatment of mandibular condylar fractures is lacking among clinicians.

In recent years open treatment of condylar fractures with rigid internal fixation is being increasingly acknowledged as the treatment of choice for displaced mandibular condylar neck and subcondylar fractures because of modified surgical access to the joint, development of special surgical instruments for repositioning and fixation of condyle, and introduction of functionally stable osteosynthesis techniques. The rationale of this study is to explore the procedure with better functional outcomes in treatment of unilateral mandibular condylar neck and subcondylar fractures.

MATERIAL AND METHODS

This randomized control trial was carried out at Oral and Maxillofacial Surgery Department, Armed Forces Institute of Dentistry Rawalpindi Pakistan from June 2011 to Dec 2015. The sample size was calculated by taking level of significance 95%, study power of 80%, pooled standard deviation = 2.055¹, test value of population mean = 33.54¹ and anticipated population mean = 39.61¹. After taking the informed consent patients with moderately displaced (≥ 2 mm but < 15 mm calculated on orthopantomogram) and or deviated ($\geq 10^\circ$ but $< 45^\circ$ calculated on reverse townes or PA mandible radiograph) condylar neck or subcondylar fractures were included in our study. Exclusion criteria was young patients (less than 18 years of age), patients with condylar head fractures and patients with severe pre-traumatic skeletal malocclusion. Selection of patients for either open or closed treatment group was done randomly by lottery method. Patients were assessed for maximal mouth opening, deviation of mandible on opening and occlusion six months postoperatively. Maximal mouth opening was assessed by maximal interincisal distance, deviation of mandible on opening by calculating the midline discrepancy during mouth opening and occlusion was evaluated according to the modified scoring method described by Singh V and colleagues¹, i.e., 1: Pre-trauma occlusion. 2: Mild malocclusion that required occlusal adjustment by spot grinding of teeth, 3: Gross malocclusion, that required reoperation.

Data was analyzed using SPSS version 17. Descriptive statistics, i.e., Mean \pm SD was calculated for variables which were quantitative in nature like age, maximal mouth opening and deviation on opening and occlusion score. Frequency and percentage were calculated for gender.

Independent samples *t*-test was used to determine the difference in means between open treatment and closed treatment groups with regards to

maximal mouth opening, deviation of mandible on opening and occlusion. *p*-value $< .05$ was considered significant.

RESULTS

A total of 80 patients (n=80) who met the inclusion criteria were included in the study with 40 patients in open treatment and closed treatment groups each. Nine patients in open treatment while 5 patients in closed treatment group were dropped out from the study because they were unable to maintain the follow up for 6 months post operatively. Out of remaining 66 patients that were studied in our research 59 (89.4%) patients were male and 7 (10.6%) were female. In open treatment group 28 (90.3%) patients were male while 3 (9.7%) were female while in closed treatment group 31 patients (88.6%) were male and 4 (11.4%) were female. Mean age of the patients was 31.15 \pm 11.84 years (range=18–65 years). Mean age of the patients in open treatment group was 31.5 \pm 11.71 years (range =18–58 years), while mean age of the patients in closed treatment group was 30.80 \pm 12.12 years (range =18–65 years). Road traffic accident was the major cause of mandibular condylar fractures while sports injury was the least common etiology of condylar fractures in our study group. Figure-1

After six months of follow up the mean mouth opening of all patients (n=66) was 34.98 \pm 4.87 mm (range= 20–45 mm) while deviation of mandible on opening was 0.80 \pm 1.37mm (range= 0–5mm). In open treatment group the mean mouth opening was 36.39 \pm 4.72mm while it was 33.74 \pm 4.72mm in closed treatment group. Independent samples *t* test was applied to compare means and the *p*-value was 0.027 which shows statistically significant difference between open and closed treatment groups. After six months of treatment deviation of mandible on opening was found to be 0.48 \pm 0.99 mm in open treatment group and 1.09 \pm 1.60 mm in closed treatment group. Independent samples *t*-test showed *p*-value of 0.068 which is statistically not significant.

In closed treatment group 6 out of 35 patients (mean value 1.17 \pm 0.38) reported with occlusal disturbances while in open treatment group just 3 patients from the total of 31 patients (mean value 1.10 \pm 0.30) had occlusal disturbances 6 months post operatively. All these patients had mild occlusal disturbances that were managed by chairside occlusal adjustment. None of the patients needed reoperation for correction of occlusal adjustment. Independent samples *t*-test was applied, and *p*-value was found to be 0.386 which is statistically not significant. The comparison of means of all variables is shown in table-1.

Table-1: Comparison of means of open and closed treatment groups

Treatment	n	Minimum	Maximum	Mean	Std. Deviation	p-value
Opening						
Open	31	28 mm	45 mm	36.39 mm	±4.72 mm	0.027
Closed	35	20 mm	41 mm	33.74 mm	±4.72 mm	
Deviation						
Open	31	0	3 mm	0.48 mm	±0.99 mm	0.068
Closed	35	0	5 mm	1.09 mm	±1.60 mm	
Occlusion						
Open	31	1	2	1.10	±0.30	0.386
Closed	35	1	2	1.17	±0.38	

DISCUSSION

Treatment of mandibular condylar fractures is one the most controversial subjects of maxillofacial trauma management. Although closed treatment has long been the method of choice for mandibular condylar fractures various other treatment modalities have been used to improve the functional outcomes, decrease the period of maxillomandibular fixation and early return to function. The conservative management of condylar fractures may be as simple as observation and soft diet or may include a period of immobilization followed by physiotherapy (closed treatment).^{8,9} Observation only treatment is indicated only in case of undisplaced fractures with normal occlusion. However, in our study only closed treatment with maxillomandibular fixation and open treatment employing open reduction and internal fixation with miniplates were compared as undisplaced fractures were excluded.

In our study closed treatment was done by immobilization with maxillomandibular fixation for a period of three to five weeks while open treatment was done by either extraoral or intraoral approach. Since the introduction of open reduction and internal fixation as a treatment option for mandibular condylar fractures, many techniques have evolved. Intraoral approach was used in only 6 cases while preauricular, submandibular and retromandibular approaches were utilized in other cases. In our study it was seen that mean mouth opening, measured by calculating the interincisal distance, was 33.74±4.72mm in closed treatment group while it was 36.39±4.72mm in open treatment group. Although the difference in mouth opening was approximately 3mm, it was statistically significant as shown by p-value of 0.027. Santler and colleagues¹⁰ in their study in 1999 compared outcomes of surgical and nonsurgical treatment of condylar fracture. They found similar results in both groups despite the fact that 97% of fractures treated surgically and 36% of fractures treated non-surgically were dislocated preoperatively. Haug RH¹¹ conducted a similar study to compare outcomes of open and closed treatment of mandibular subcondylar fractures groups and found similar results in both groups. Recently a

similar study conducted by Shiju M *et al*¹² showed that the patients in both open and closed treatment groups had similar range of mouth opening when examined 6 months post-operatively. While Yang and colleagues¹³ in their study showed better mobility of mandible in closed treatment group. This can be because of the inclusion of patients in both open and closed treatment groups was done according to a predefined criterion, i.e., more displaced and dislocated fractures were treated by open means while the minimally displaced fractures were treated by closed treatment. The author ascribed this limited mouth opening after open treatment to excessive muscle stripping, scar formation and incisional pain. Furthermore, Niezen and colleagues¹⁴ have described that patients with closed treatment recover to the pre-traumatic normal mouth opening after one year of treatment.

However, few well-known studies have shown that operative treatment results in better mobility of mandible than closed treatment. A prospective randomized multicenter study by Ecklet *et al*¹⁵ has shown better mobility of mandible in open treatment group. A similar study by Schneider *et al*.⁵ has shown better mandibular mobility in open treatment group not only in case of subcondylar fractures but also in condylar neck and condylar head fractures. Another randomized control trial of moderately displaced subcondylar fractures (ramal shortening ≥ 2 mm or deviation 10–45 degrees) has shown both treatments resulted in acceptable results, but open treatment was superior to closed treatment in all functional variables studied including maximal interincisal opening.¹ A meta-analysis of randomized control trials having similar inclusion criteria as our study was conducted by Liu and colleagues⁷ in china. They found that although there was no significant difference in results of open and close treatment groups in terms of maximal mouth opening, the difference in other parameters, i.e., protrusive and excursive movements was statistically significant in favor of open treatment. The authors also suggested that protrusion is a better indicator of temporomandibular joint mobility than passive opening because it requires active movement of condyle during functional activity.

After six months of treatment, deviation of mandible on opening was found to be 0.48 ± 0.99 mm in open treatment group and 1.09 ± 1.60 mm in closed treatment group. This slight difference between the two groups was statistically insignificant. A study by Singh *et al*¹ demonstrated that degree of lateral shift and deflection of mandible on opening was more in case of closed treatment and there was statistically significant difference between open and closed treatment groups. It is said that this deviation or lateral shift of mandible on opening is due to compensatory movement of contralateral joint because of decrease in height of ascending ramus of mandible on the injured side. Ellis and Throckmorton¹⁶ studied the difference in facial asymmetry after closed and open treatment of mandibular condylar fractures and found significant asymmetry after closed treatment. They followed patients up for two to three years and postulated that the major factor for loss of posterior facial height was the pull of elevator muscles and contraction of scar tissue within the fracture gap. As the follow up period in our study was six months, this could explain the insignificant difference between open and closed treatment groups in our findings. On the other hand, increased stripping of lateral pterygoid muscle during open treatment can also contribute to deviation of mandible on opening in open treatment group. In a recent study Shiju and colleagues¹² have shown that seventy percent of patients treated by closed method resulted in deviation of mandible on opening. They accredited it to the diminished activity of lateral pterygoid muscle and malposition of condyle on the side of fracture.

As far as postoperative occlusal status is concerned, we did not find any significant difference between two groups. Our results were quite similar to the earlier studies by Haug and Assael¹¹ and Singh V *et al*¹. While in few other studies Worsaae and Thorn¹⁷ and Ellis *et al*¹⁶ described that significantly high number of patients in closed treatment group reported with malocclusion as compared to patients who were treated with open reduction and internal fixation despite the fact that patients included in open treatment group had more displaced fractures. Although in our study it was shown that open treatment group had better occlusal status six months postoperatively, the difference between open and close treatment groups was statistically not significant. In another contemporary study¹² it was found that in early post-operative period there were significantly more patients with malocclusion in closed treatment group but after six months of follow up the difference in occlusal status among open and closed treatment group was statistically insignificant. The authors suggested that this improvement in

occlusal status in closed treatment group was due to attrition of dentition and muscular adaptation.

A recent meta-analysis by Al-Moraissi and Ellis¹⁸ has shown that the open treatment of mandibular condylar fractures results in better clinical outcome in terms of mandibular mobility (opening, protrusion and lateral excursion), pain and deviation on opening. Abdel-Galil¹⁹ in his review of literature also found better results with open reduction and internal fixation of mandibular condylar fractures. Recently Gurrero *et al*²⁰ performed a retrospective study on 2458 patients and found that closed treatment results in more complication rates in terms of facial asymmetry and development of malocclusion. Another meta-analysis²¹ of comparison of open and closed treatment groups has shown that open treatment results in better outcomes in terms of mouth opening and occlusal harmony but similar results in terms of deviation on opening. While a meta-analysis performed by Berner T *et al*²² found significantly better outcomes in terms of protrusion and lateral excursion but could not report significant difference between open and closed treatment groups in terms of maximal mouth opening. They also suggested further randomized control trials for assessment of occlusal status and other clinical outcomes. Khelemsky R *et al*⁴ in their review of literature suggested that in case of moderately displaced condylar fractures open treatment leads to better functional and subjective outcomes while closed treatment has higher risk of functional disturbances and condylar resorption.

As functional muscular adaptation is an ongoing process²³ we recommend future studies with larger sample size, broader variable base and longer follow up period to better elucidate and compare the functional outcomes of open and closed treatment modalities. Tabrezi R *et al*²⁴ and Lee JS *et al*²⁵ in their studies found that the pattern of condylar and concomitant maxillofacial fractures has an association with functional outcomes of treatment of condylar fractures. Therefore, the effect of both presence and type of treatment of concurrent maxillofacial fractures on the final functional outcomes like mobility of mandible and occlusal status should also be taken into account.

CONCLUSION

Open treatment of unilateral mandibular condylar fractures results in better functional outcomes particularly in terms of maximal mouth opening. From present study it can deduced that mandibular condylar fractures with moderate displacement should be treated by open method to obtain better functional results and early return to function, studies

with longer follow up period and a wider variable base can give a better understanding of the functional outcomes of open and closed treatment of mandibular condylar fractures.

AUTHORS' CONTRIBUTION

MAA: Data collection, data analysis and interpretation, literature search and drafting. MWI: Selection of study, data collection, supervision and proof reading. MUJ: Design and concept of study, data analysis. RZ: Literature search and drafting of work. MUQ: Literature search and drafting.

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