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Original Article

Comparison of therapeutic results of closed and open repair of mandibular condylar fractures

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Abstract: Background: Mandibular condylar fractures mostly result from traumatic accidents or strife. There is still dispute on the effectiveness of various therapeutic methods. Here we aimed to evaluate and compare the open or closed repair methods for mandibular condylar fractures. Methods: This is a clinical trial that was performed in 2015-2021 in Iran on all patients that referred to our medical centers with mandibular fractures due to traumatic events. Those cases with severe lateral dislocation of the mandibular condyles or severe dislocations of the fractured parts were assigned to the open surgical treatment group. The other patients were treated using Arch bar + intermaxillary fixation (IMF). The patient's abilities of mouth opening were assessed in centimeters within 1 month, 3 months, 6 months, 1 year and 2 years after the operations. Results: 726 mandibular fractures were evaluated. Our data showed that 302 fractures (41.6%) were in the mandibular condyles. Of the 302 condylar fractures, 172 fractures (57.1%) occurred due to automobile accidents and 82 fractures (27.5%) occurred due to direct trauma. 203 patients (67.2%) underwent the close surgical procedures using maxillary and mandibular fixation using arch bar + IMF. 99 patients (32.8%) underwent open mandibular fixation operation and internal fixation (ORIF). Assessments of mouth opening showed significant improvements in this ability within the follow-up period in both groups ($P<0.001$ for both). Furthermore, we observed that patients treated by the open mandibular fixation procedure had significantly better results within the 6 months and 1 year after the procedures but after 2 years, no significant differences could be observed between groups. Conclusion: Both open and closed surgical approaches for condylar fractures are associated with significant improvements, however, patients that were treated with ORIF had better clinical results in the first year after the surgical procedures.

Keywords: Condyle, fracture, ORIF

Introduction

The mandible is the second most common facial bone to fracture due to trauma [1]. The condylar and subcondylar region is the most common site of fracture of the mandibular bone in people with trauma and accounts for about 2% of cases of mandibular fractures [2, 3]. The mandibular condyle consists of three areas: the shaft, the neck, and the subcondyle.

Fractures at the junction of the head and neck, especially intracapsular fractures, are termed head fractures, and border fractures between the sigmoid or above it (below the head area) are referred to as condylar neck fracture [4]. A fracture below the sigmoid region is called a subcondylar fracture. Although most condylar fractures are in the subcondylar region, fractures in all three areas are generally referred to as condylar fractures [5].

Diagnosis and treatment of condyle fractures are very important and if left untreated, can lead to malocclusion, mandibular and facial asymmetry, temporomandibular joint (TMJ) joint ankylosis, chewing disorders and reduced

range of motion of the mandible and orthognathic disorders [6, 7].

Two different treatments namely closed treatment (without surgery) and open surgery, is common in the treatment of condylar fractures. In most cases where the condyle remains in the joint surface area and there is no severe displacement, non-surgical treatment and physiotherapy are recommended [8]. Surgical treatment is recommended in cases of severe condylar displacement or severe dislocation of fractures that can lead to a reduction in the height of the mandibular ramus [9].

Also, in case of condylar displacement to the middle cranial fossa cavity or the presence of a foreign body at the fracture site and failure to achieve proper interaction of the teeth with the closed method, surgery is recommended [10]. The surgical procedure requires a surgical incision in the sensitive area, which can be associated with damage to the branches of the facial nerve, damage to the parotid gland, bleeding, hematoma, infection, and surgical incision scar [11].

However, these complications are considered as rare based on previous studies. And the open surgery method by fixing the broken parts with screws and plates reduces the complications caused by the closed method, such as incorrect confrontation of the teeth or asymmetry of the face (due to the short length of the ramus) on the fractured side [10, 12].

Studies have also shown that there is not much difference between closed and open methods in this regard, and due to the potential complications of open surgery, this method was recommended only in cases of severe condyle displacement [13].

The mentioned studies and evidence show that there is still disagreement about how to treat condylar fractures. In the present study, we aimed to evaluate the mandibular condylar fractures and the efficacy and complications of open and closed surgical approaches among patients.

Methods and material

Study design

This study was performed in 2015-2021 in Imam Reza and Taleqani hospitals affiliated to Kermanshah University of Medical Sciences. The current study was conducted on all patients that referred to our medical centers with mandibular fractures due to traumatic events. The study protocol was approved by the Research Committee and the Ethics committee has confirmed it (Ethics code: IR.KUM.MED.REC.1390.366).

Inclusion and exclusion criteria

The inclusion criteria were diagnosis of mandibular fracture by radiologic imaging, unilateral or bilateral mandibular fractures due to traumatic events, confirmation of mandibular fractures by plastic surgeons, having no history of facial fractures, referring to our medical centers in 2015-2021, and signing the written informed consent to participate in this study. The exclusion criteria were previous mandibular surgery, poor bone quality resulting from conditions such as cancer, metabolic bone diseases, osteoporosis, osteomyelitis, active or chronic infection of the upper limb, presence of tumors or local bone cysts, consumption of corticosteroids, and death of the patient.

Assessments and grouping

The severity of cases was assessed by two expert plastic surgeons and one Maxillofacial surgeon based on radiologic and clinical data, cases that met the mentioned criteria entered the study. Patients were divided into two groups based on the clinical conditions and radiologic assessments.

Division of patients was conducted by the means of clinical and diagnostic results based on skull X-rays. Those cases with severe lateral dislocation of the mandibular condyles or severe dislocations of the fractured parts were assigned to the open surgical treatment group. The other patients were treated using Arch bar + intermaxillary fixation (IMF).

In this study, 302 patients with mandibular condylar fractures entered the study and divided into two groups. 203 patients (67.2%) underwent the close surgical procedures using maxillary and mandibular fixation using arch bar + IMF and 99 patients (32.8%) underwent open mandibular fixation operation and internal fixation.

Treatments

Patients in the first group underwent open mandibular fixation operation and internal fixa-

Figure 1. Open mandibular fixation operation and internal fixation.

tion of the parts (**Figure 1**). The operations were performed under general anesthesia. Risdon incision was used in all patients. We used rigid maxillomandibular fixation (MMF) and arch bars and wires to hold and fix the fractured parts together during the open surgical procedures. Other patients in the close surgical group underwent maxillary and mandibular fixation using arch bar + IMF (**Figure 2**) for 2 weeks followed by elastic bands for 3 to 6 months after the procedures.

Post-operative follow-ups

All patients received a soft diet for 1 month and received prophylactic antibiotics and analgesics after the procedures. Neurotonics were prescribed for the cases of numbness of the chin, and the patients were discharged from the hospital the second day after procedures. Physiotherapy of the mandible was initiated in both groups almost 2 weeks after fixations.

Assessments

We evaluated the functions of the mandible in all patients by the means of the range of motion. During this process, the patient's abilities of mouth opening were assessed in centimeters within 1 month, 3 months, 6 months, 1 year and 2 years after the operations. The primary variable of the current study was the patient's abilities of mouth opening. These variables along with the complications of the surgical approaches were compared between groups of patients. Complications of the treatments including injuries to the facial nerve, injuries to parathyroid glands, bleeding, hematoma

Figure 2. maxillary and mandibular fixation using arch bar + IMF.

and post-operation infection were also assessed. All patients were followed for at least 2 years and the frequencies of possible complications were also evaluated during the follow-ups.

Data analysis

The obtained data were entered into the Statistical Package for Social Sciences (SPSS) version 24. We used Independent t-test and repeated measure tests to compare data between different time lines and also different groups. *P*-value <0.05 was considered as the significance threshold.

Results

Study population

A total number of 510 cases with mandibular fractures entered this study. Based on the initial analysis, 510 cases had 726 fractures in the mandible and 302 condylar fractures were found in 262 cases. The mean age of the patients was 24.59 ± 6.87 years ranging from 10-47 years, 215 patients (82.06%) were males and 47 cases (17.94%) were females (**Table 1**).

Fracture sites

726 mandibular fractures were evaluated. Our data showed that 302 fractures (41.6%) were in the mandibular condyles, 160 fractures (22%) were associated with mandibular shaft fractures, 160 fractures (22%) in parasymphysis, 48 fractures in mandibular angle (6.6%), and 21 fractures in symphysis (2.9%). These data are indicated in **Table 2**.

Table 1. Primary clinical and demographic data of patients

Variable		Amount
Age (years) (mean ± SD)		24.59 ± 6.87
Gender (n (%))	Male	215 (82.06%)
	Female	47 (17.94%)
Clinical findings (n (%))	disorders in the opposition of the teeth	235 (89.7%)
	pain in the temporomandibular joint	185 (70.6%)
	lack of condylar movements	178 (71.3%)
	edema or ecchymosis	157 (59.9%)

Table 2. Distribution of sites of mandibular fractures

Fracture site	Number	Percent
Mandibular condyles	302	41.6%
Mandibular shaft	160	22%
Mandibular parasymphysis	160	22%
Mandibular angle	48	6.6%
Mandibular symphysis	21	2.9%
Dentoalveolar	17	2.3%
Mandibular ramus	9	1.3%
Mandibular coronoid	9	1.3%
Total	726	100%

Evaluation of the patients with condylar fractures showed that 258 fractures (85.4%) were unilateral and 44 fractures (14.6%) were bilateral.

Fracture cause and clinical manifestations

Of the 302 condylar fractures, 172 fractures (57.1%) occurred due to automobile accidents and 82 fractures (27.5%) occurred due to direct trauma, and 48 fractures (15.4%) occurred due to falling. Our data also demonstrated that the most common clinical finding was disorders in the opposition of the teeth (89.7%), pain in the TMJ (70.6%), lack of condylar movements (71.3%) and edema or ecchymosis (59.9%).

Therapeutic strategies

Based on our data, 203 patients (67.2%) underwent the close surgical procedures using maxillary and mandibular fixation using arch bar + IMF. 99 patients (32.8%) underwent open mandibular fixation operation and internal fixation based on the mentioned criteria. Patients were followed for 2 years after the operations and assessments were performed.

Post-operative assessments

Assessments of mouth opening showed significant improvements in this ability within the follow-up period in both groups (P<0.001 for both). Furthermore, we observed that patients treated by the open mandibular fixation procedure had significantly better results within the 6 months and 1 year after the procedures but after 2 years, no significant differences could be observed between groups. These data are summarized in **Table 3**.

Further assessments showed that 3 patients in the close surgical procedure and 2 patients in the open mandibular fixation group had paresthesia in the marginal mandibular branch of the facial nerve that ameliorated within 6 months. 2 cases of surgical wound abscess were also observed that required abscess drainage and antibiotic treatment. No significant differences were observed between the two groups of patients regarding surgical complications (P = 0.83).

Discussion

Management of traumatic mandibular condylar fracture is an important facial surgery issue. Studies have mentioned various criteria for open or close surgical approaches and have reported different results. In the current study, we performed a 6-year study with 2 years follow-up period on 302 mandibular condylar fractures.

Based on the results of our study, the condylar fracture was the most common fracture type in mandibular fractures. Automobile accidents were the most common cause of mandibular condylar fracture, opposition of the teeth and pain were also the most common symptoms. Assessments of patients indicated that both open and closed surgical approaches resulted in significant improvements in mouth opening. Furthermore, we observed that patients treated by the open mandibular fixation procedure had significantly better results within the 6 months and 1 year after the procedures but

Table 3. Assessments of mouth opening within the study period

Variable		1 month	3 months	6 months	1 year	2 years	*P*-value
Mouth opening (cm) (mean ± SD)	ORIF group	21.56 ± 3.68	24.20 ± 4.12	35.71 ± 5.28	38.58 ± 5.64	40.39 ± 5.94	P<0.001
	Closed group	22.12 ± 4.29	23.45 ± 3.77	28.63 ± 4.20	31.47 ± 4.34	39.88 ± 4.82	P<0.001
P-value		0.12	0.18	0.02	0.03	0.36	

after 2 years, no significant differences could be observed between groups.

In the present study, we operated on patients with severe lateral dislocation of the mandibular condyles or severe dislocations of the fractured parts using open surgical treatment procedure and other cases were treated by closed surgical procedure. Based on our findings, these cases had better improvements within the first year after treatments but within the follow-ups, both groups had similar results. A review article by Brandt and colleagues evaluated the open vs. closed reduction of adult mandibular condyle fractures. They mentioned that conventional closed reduction of these fractures is an effective therapeutic method but open surgical approaches might be associated with more promising results that require further research [14]. Another study by Assael and colleagues showed that accidents and falling were the most common causes of mandibular condyle fractures and ORIF is a preferred surgical approach in patients with the same conditions. They also reported that open surgical approaches might be associated with the least surgical complications [15]. The results of our study were in line with the findings of these studies. However, we used ORIF only for patients with severe lateral dislocation of the mandibular condyles or severe dislocations of the fractured parts. We believe that these criteria could be useful in clinical practice.

Another study was conducted by Sawazaki and others in 2010, evaluating the incidence and patterns of mandibular condyle fractures. They reported that the most common cause of condylar fractures was road traffic accidents (57.8%) and subcondylar displaced fractures were significantly associated with surgical treatment [16]. Vesnaver and others also reported that ORIF treatments of condylar fractures in patients should be used for patients with severe fractures and these patients will have improvements more quickly than closed approaches [17]. It was also shown that patients treated with ORIF could have a higher quality of life compared to cases treated with closed surgical approaches due to better clinical improvements [18]. Based on the results of our study, the patients that were treated with ORIF had better clinical results compared to closed treatments but after 1 year, both groups of patients had similar results.

These data are suggestive of the superiority of ORIF treatments in mandibular condylar fractures but only in short-term results. On the other hand, we used the mouth opening test as the main indicative item for the patients of our study. Previous studies have also confirmed that this test is indicative of patient's improvements [19, 20].

The limitations of our study were not performing this study as a case-control study between similar cases and also not evaluating other variables among patients but we believe that these results could be reliable. As indicated, to date, very few studies have compared open and closed surgical treatments in patients with condylar fractures and this study could support the use of ORIF especially in cases with severe fractures.

Conclusion

Both open and closed surgical approaches for condylar fractures are associated with significant improvements, however, patients that were treated with ORIF had better clinical results in the first year after the surgical procedures. We recommend that ORIF should be performed in cases with severe condylar fractures with dislocations.

Disclosure of conflict of interest

None.

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References

[1] Vasil'ev Y, Paulsen F and Dydykin S. Anatomical and radiological features of the bone organization of the anterior part of the mandible. Ann Anat 2020; 231: 151512.

[2] Algan S, Kara M, Cakmak MA, Tan O, Cinal H, Barin EZ and Inaloz A. Experiences with a modified preauricular mini incision with subdermally dissection in condylar and subcondylar fractures of the mandible. J Craniomaxillofac Surg 2018; 46: 588-593.

[3] Bayat M, Parvin M and Meybodi AA. Mandibular subcondylar fractures: a review on treatment strategies. Electron Physician 2016; 8: 3144.

[4] Boffano P, Corre P and Righi S. The role of intra-articular surgery in the management of mandibular condylar head fractures. Atlas Oral Maxillofac Surg Clin North Am 2017; 25: 25-34.

[5] Steed MB and Schadel CM. Management of pediatric and adolescent condylar fractures. Atlas Oral Maxillofac Surg Clin N Am 2017; 25: 75-83.

[6] Vincent AG, Ducic Y and Kellman R. Fractures of the mandibular condyle. Facial Plast Surg 2019; 35: 623-626.

[7] Rozeboom A, Dubois L, Bos R, Spijker R and de Lange J. Open treatment of condylar fractures via extraoral approaches: a review of complications. J Craniomaxillofac Surg 2018; 46: 1232-1240.

[8] Li J, Yang H and Han L. Open versus closed treatment for unilateral mandibular extra-capsular condylar fractures: a meta-analysis. J Craniomaxillofac Surg 2019; 47: 1110-1119.

[9] Skroch L, Fischer I, Meisgeier A, Kozolka F, Apitzsch J and Neff A. Condylar remodeling after osteosynthesis of fractures of the condylar head or close to the temporomandibular joint. J Craniomaxillofac Surg 2020; 48: 413-420.

[10] García-Guerrero I, Ramirez JM, de Diego RG, Martínez-González JM, Poblador MS and Lancho JL. Complications in the treatment of mandibular condylar fractures: surgical versus conservative treatment. Ann Anat 2018; 216: 60-68.

[11] Shakya S, Zhang X and Liu L. Key points in surgical management of mandibular condylar fractures. Chin J Traumatol 2020; 23: 63-70.

[12] Monnazzi MS, Gabrielli MA, Gabrielli MF and Trivellato AE. Treatment of mandibular condyle fractures. A 20-year review. Dent Traumatol 2017; 33: 175-180.

[13] Theologie-Lygidakis N, Chatzidimitriou K, Tzerbos F, Gouzioti A and Iatrou I. Nonsurgical management of condylar fractures in children: a 15-year clinical retrospective study. J Craniomaxillofac Surg 2016; 44: 85-93.

[14] Brandt MT and Haug RH. Open versus closed reduction of adult mandibular condyle fractures: a review of the literature regarding the evolution of current thoughts on management1. J Oral Maxillofac Surg 2003; 61: 1324-1332.

[15] Assael LA. Open versus closed reduction of adult mandibular condyle fractures: an alternative interpretation of the evidence. J Oral Maxillofac Surg 2003; 61: 1333-1339.

[16] Sawazaki R, Lima Júnior SM, Asprino L, Moreira RW and de Moraes M. Incidence and patterns of mandibular condyle fractures. J Oral Maxillofac Surg 2010; 68: 1252-1259.

[17] Vesnaver A, Ahčan U and Rozman J. Evaluation of surgical treatment in mandibular condyle fractures. J Craniomaxillofac Surg 2012; 40: 647-653.

[18] Kommers SC, van den Bergh B and Forouzanfar T. Quality of life after open versus closed treatment for mandibular condyle fractures: a review of literature. J Craniomaxillofac Surg 2013; 41: e221-e225.

[19] Nitzan DW and Palla S. "Closed reduction" principles can manage diverse conditions of temporomandibular joint vertical height loss: from displaced condylar fractures to idiopathic condylar resorption. J Oral Maxillofac Surg 2017; 75: 1163.e1-1163.e20.

[20] Lekven N, Neppelberg E and Tornes K. Long-term follow-up of mandibular condylar fractures in children. J Oral Maxillofac Surg 2011; 69: 2853-9.