



Evaluation of mandibular fracture patterns and treatment methods: A single center retrospective study

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Abstract

ARTICLE INFO

Keywords:

Mandible fractures
Trauma
Treatment

Received: May 25, 2023

Accepted: Aug 01, 2023

Available Online: 25.08.2023

DOI:

[10.5455/annalsmedres.2023.05.120](https://doi.org/10.5455/annalsmedres.2023.05.120)

Aim: Mandible fractures are among the most common bone fractures in the maxillofacial region. Correct and early treatment is important in mandible fractures. The aim of this study is to retrospectively examine and analyze the patterns and treatment methods of mandibular fractures seen in patients admitted with trauma.

Materials and Methods: Patients treated for mandible fractures between 2006 and 2021 years were included in this retrospective study. The files and archive records of the patients were scanned retrospectively. Demographic, clinical and radiological data were recorded. The treatment methods of the patients included in the study were evaluated.

Results: 176 patients with a total of 246 fractures were included to the study. Simple fractures were found in 130 patients, green tree fractures in 12 patients, and comminuted fractures in 34 patients. There were 147 unfavorable and 29 favorable fractures in total. Fall was found to be the most common etiologic cause in all gender and age groups (n=55, 31.2%). Angle fracture was observed most frequently in single fracture cases, while condyle fracture was the most common accompanying fracture type in multiple fractures. 88 patients were treated with the open and, 56 with the closed approach, and 32 with both the open and closed approach.

Conclusion: Fracture type and etiologic cause are closely related with the type of the fracture. Mandible fractures should be carefully examined and the most appropriate treatment for the type of fracture should be applied as soon as possible.



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Introduction

Mandibular fractures are among the most common fractures in the maxillofacial region. They can lead to malocclusion, dentofacial asymmetry, limited jaw movements, and difficulties in functions such as speech, chewing, and swallowing, emphasizing the importance of early treatment [1]. Mandibular fractures can occur as a result of blunt or penetrating traumas, as well as weakness in the mandible caused by factors such as tooth extraction, tumors, or cysts [2]. The etiology of fractures is closely related to the type and cause of trauma, including traffic accidents, falls, physical assault, and sports injuries [3]. The type and etiology of trauma are closely associated with the localization of mandibular fractures. While angle or para symphyseal fractures are commonly observed in traumas caused by direct impact, fractures involving the

symphysis and para symphysis are more common in motor vehicle accidents, and condylar and sub-condylar fractures are frequently seen after falls. Age, tooth localization, direction of impact, and physical characteristics also directly influence the type of fracture [1-4].

Mandibular fractures are often accompanied by other facial bone fractures, and studies have shown that approximately 65% of mandibular fracture cases resulting from high-energy traumas such as traffic accidents are life-threatening injuries [5]. Therefore, mandibular fractures should not be considered as isolated fractures. The primary goals of mandibular fracture treatment are to restore the anatomical integrity of the mandible, achieve pre-fracture occlusion, and restore normal function [6]. Open reduction and internal fixation methods are commonly preferred in the treatment of mandibular fractures. In some cases, a combination of intermaxillary fixation and rigid fixation can be applied depending on the type of fracture. The choice of fixation method may vary depending

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on patient-related factors, fracture type, and the surgeon's experience. This retrospective single-center study aims to determine the types of mandibular fractures, treatment options, and complications that occur after treatment.

Materials and Methods

This study was conducted with the approval of the Erciyes University Clinical Research Ethics Committee (protocol no: 2022/189). Patients who presented with mandibular fracture complaints to the Department of Oral and Maxillofacial Surgery at Erciyes University Faculty of Dentistry, and who had diagnosis, treatment, and follow-up records, were retrospectively evaluated for eligibility. Patients with mandibular fractures due to traumatic history, those with pathological fractures associated with conditions such as tumors or cysts, and those who had previously undergone unsuccessful mandibular fracture surgery at another center and required reoperation were included in the study. Patients without mandibular fractures resulting from maxillofacial trauma and patients with only dental trauma history were excluded similar to the study of Bormann et al. [7].

Between 2006 and 2021, medical records and operation reports of patients who presented to the clinic with complaints of mandibular fracture and completed their treatments were retrospectively reviewed. Demographic data such as age and gender of the patients, etiology of the fracture, fracture localization, accompanying traumas, diagnostic and treatment methods, treatment duration, and complications after treatment were recorded. Mandibular fractures were classified into subgroups as condylar, sub condylar, symphysis, para symphysis, angle, coronoid, and body fractures from panoramic radiographs and cone beam computed tomography (CBCT) images. The relationship between the type of fracture, etiological factors, treatment methods, and complications were analyzed.

Statistical analysis

Turcosa statistical software (Turcosa Analitik Ltd. Şti., www.turcosa.com.tr) was used for statistical analysis of the data. The normality of the data distribution was tested using the Shapiro-Wilk test, and variance homogeneity was tested using the Levene test. The patients were divided into two main groups according to their gender, and independent two-sample t-tests were applied for quantitative data, while Fisher's exact chi-square test was used for qualitative data in intergroup comparisons. Furthermore, patients were grouped according to the type of fracture and the treatment methods applied, and the comparisons between groups were evaluated using one-way analysis of variance. The correlations between the data were assessed using Spearman's correlation test. Data were expressed as mean \pm standard deviation, median (1st and 3rd quartiles), or frequency (percentage). $P < 0.05$ was considered statistically significant.

Results

Demographic findings

When the data of a total of 176 patients included in the study were examined, a total of 246 fractures were detected. The ages of the patients ranged from 2 to 78. Of

Table 1. Findings of etiology.

Etiology	Number of Patients	%
Fall	55	31.2
Stroke	36	20.4
Fight	35	19.8
Accident	27	15.3
Pathological	23	13
Total	176	100

the cases, 35 were female (20%) and 141 (80%) were male. The mean age was determined as 26 (18-37.75). The distribution of fractures according to age groups revealed that there were 38 patients in the 0-18 age group, 114 patients in the 18-50 age group, and 24 patients in the over 50 age group.

Etiology

It was determined that the most common etiological cause in all gender and age groups was falls ($n=55$, 31.2%). Stroke was identified as the second most common etiological cause ($n=36$, 20.4%). Fractures resulting from forces directly applied to the mandible were included in this group. Additionally, it was found that 35 patients had mandibular fractures during fights, and 27 patients had fractures due to accidents. The accidents included intra-vehicle traffic accidents ($n=23$), work accidents ($n=3$), and motor vehicle accidents ($n=1$). In 23 patients, it was determined that mandibular fractures occurred due to pathological causes (Table 1).

When pathological fractures were examined, it was observed that fractures occurred after tooth extraction in 8 patients. In 6 patients, malunion, in 1 patient non-union, in 2 patients osteomyelitis, in 2 patients tumor, in 3 patients cyst, and in 1 patient mandibular fracture after ramus graft treatment were determined.

Gender distribution was compared according to etiology groups, and the percentage of male patients with mandibular fractures due to fights was significantly higher than the other groups ($p=0.002$) (Table 2).

Fracture localization

118 patients (67%) had fractures in a single location in the mandible, while 58 patients (33%) had multiple fractures. It was observed that angle fractures were the most common in cases with a single fracture ($n=46$, 26.1%). In addition, 12 patients (6.8%) had symphysis fractures, 22 (13%) had para symphyseal fractures, 19 (10.2%) had condylar fractures, 11 (6.2%) had body fractures, 4 (2.3%) had ramus fractures, 3 (1.7%) had alveolar fractures, and 1 (0.4%) had coronoid fracture. When the fractures were examined according to types, simple fractures were detected in 130 patients, green tree fractures in 12 patients, and comminuted fractures in 34 patients. There were 147 unfavorable fractures and 29 favorable fractures. On the other hand, 71 patients had fractures on the left side, 60 patients had fractures on the right side, and 35 patients had bilateral fractures.

Table 2. Comparison of gender distributions according to etiology.

Gender	Etiology					p
	Fall (n=55)	Stroke (n=37)	Fight (n=35)	Accident (n=26)	Pathologic (n=23)	
Male	36(65.5) ^a	29(78.4) ^a	35(100.0) ^b	22(84.6) ^a	19(82.6) ^a	0.002
Female	19(34.5) ^a	8(21.6) ^a	0(0.0) ^b	4(15.4) ^a	4(17.4) ^a	

Table 3. Comparison of gender distributions by treatment type.

Gender	Treatment type			p
	Open (n=85)	Closed (n=55)	Combined (n=34)	
Male	69(81.2)	42(76.4)	28(82.4)	0.726
Female	16(18.8)	13(23.6)	6(17.6)	

Table 4. Displacement status of the fracture and distribution of treatment options.

Fracture	Treatment type		
	Open (n=85)	Closed (n=55)	Combined (n=34)
Favorable	11(12.9) ^{ab}	14(25.5) ^a	2(5.9) ^b
Unfavorable	74(87.1) ^{ab}	41(74.5) ^a	32(94.1) ^b

Table 5. Comparison of the percentage of infection according to the presence of third molars.

Infection	Presence of third molars		Total	p
	No	Yes		
No	12	26	38	0.320
Yes	4	4	8	
Total	16	30	46	

Table 6. Relationship between fracture type and infection.

Fracture Type	Infection		p
	No (n=148)	Yes (n=28)	
Simple	110(74.3)	20(71.4)	0.578
Comminuted	27(18.2)	7(25.0)	
Green tree	11(7.4)	1(3.6)	

Diagnosis and treatment protocol

It was determined that 160 of the included patients (91%) were treated through intraoral approach, 4 (2.2%) through extraoral approach, and 10 (5.6%) through both intraoral and extraoral approaches. It was observed that two patients were regularly followed without any treatment. Among the treated patients, 88 were treated with an open approach, 56 were treated with a closed approach, and 32 were treated with a combination of open and closed approaches. When the differences in treatment options according to gender were evaluated, no statistically significant

difference was found between the groups (p=0.726) (Table 3). Among the 56 patients treated only with a closed method, the mean IMF (intermaxillary fixation) duration was found to be 6 weeks (4-6). When IMF duration was compared by gender, no statistically significant difference was observed (p=0.843). Among the patients who underwent IMF along with an open approach, it was determined that the total IMF duration was 4 weeks (3-5) on average in 32 patients. When the degree of displacement of the fracture and treatment options were examined, no statistically significant difference was found between patients with favorable fractures treated with open or closed methods. However, the majority of patients who received combined treatment had un-favorable fractures (Table 4).

Complications

Complications associated with trauma were observed in 126 patients (Table 8). Paresthesia was observed in 80 patients (45.4%) following the fracture. Infection was detected in 28 patients (16%) during the postoperative period. It was determined that plates and screws were removed in 14 patients (8%) for various reasons, and 4 patients (2.8%) underwent re-operation due to malocclusion. When patients with postoperative infections were examined, it was found that 18 of these patients had angle fractures (64.2%). Of these, only 8 were isolated angle fractures. This was followed by 4 body fractures, 2 symphysis fractures, 3 para symphyseal fractures, and 1 condylar fracture. 14 of the angle fracture cases with infection were treated with an open approach and 4 were treated with both open and closed approaches.

When the relationship between the presence of infection and the presence of third molar teeth was evaluated, no statistically significant difference was found (p=0.320) (Table 5).

When patients with infections were examined according to fracture type, it was observed that infections occurred in 20 patients with simple fractures, 7 patients with comminuted fractures, and 1 patient with a green tree fracture. When compared based on the presence of infection, no statistically significant difference was found in the distribution of fracture types (p=0.578) (Table 6).

Discussion

The mandible is the largest and strongest bone among the facial bones. Due to its position in the lower part of the face, its mobility, and its nature as a single bone, mandibular fractures occur twice as often as midface fractures [8]. It has been reported that mandibular fractures account for 36% to 54% of all facial fractures [9].

Sakr et al. reported a female-to-male ratio of 1:3.6 in a study involving 509 patients diagnosed with mandibular

fractures [10]. In another study by Oruç et al., the female-to-male ratio was found to be 1:4 among 419 patients diagnosed with mandibular fractures [11]. The difference in gender ratio is attributed to a higher incidence of daily physical activity, assault incidents, and traffic accidents among males compared to females [12,13]. Similar to the literature, our study observed that mandibular fractures occurred in 141 male patients and 35 female patients, resulting in a female-to-male ratio of 1:4.

Mandibular fractures can occur following blunt or penetrating trauma. Additionally, weakness in the mandible due to pathologies such as tooth extraction, tumor, cyst, or infection in the area can lead to fractures. When the etiology of mandibular fractures is examined, falls, accidents, fights, firearm injuries, and sports accidents are identified as contributing factors. Unlike the literature, our study found that "falls" were the most common etiological factor in all gender and age groups. The etiology of trauma is closely related to the localization of mandibular fractures. Fractures of the para symphysis and angle are often the result of assault, while condylar fractures frequently occur following falls [4]. In our study, falls were the most common etiological factor, with a higher incidence of angle fractures.

Various publications in the literature report different anatomical localizations of mandibular fractures. Different studies have reported condylar, angle, and body fractures as the most common fractures [10]. In our study, angle fractures were observed in 31.2% of cases, followed by condylar fractures (23.4%), para symphysis fractures (20.8%), and symphyseal fractures (10.2%).

Treatment options for mandibular fractures can be divided into open and closed methods [14]. There are different opinions regarding the timing of initiating fracture treatment. Stacey et al. found that initiating treatment for mandibular fractures within the first 72 hours was more effective [15]. In another study by Olson et al., no change in complication rates was observed based on the timing of treatment initiation in 580 mandibular fractures [16]. Some studies have reported that prolonged treatment periods are more painful and may hinder reduction due to the accumulation of fibrin tissue between fracture lines [15]. There are also studies that report no difference in complication development between treatment initiation within or after 72 hours [13-16]. In this study, out of the 176 patients included, 56 were treated with a closed approach, 88 were treated with an open approach, and 32 received combined treatment. Intervention was performed within the first 72 hours in 150 patients. It was observed that 19 patients were treated within 3-7 days and 7 patients were treated within 7-14 days. It was noted that delayed treatment was performed in patients with additional trauma and after improvement in general condition.

Surgical treatment options for mandibular fractures depend on various factors such as the type and etiology of the trauma, patient age, presence of additional injuries, and the condition of teeth and occlusion. Open reduction and closed reduction techniques are used in treatment, although there is no definitive consensus in the literature regarding the ideal treatment method [17,18]. Many authors also suggest the combined use of open and closed

techniques. Ellis et al. applied closed reduction to 77 out of 135 patients and determined that the average IMF (intermaxillary fixation) duration was 4-6 weeks [19]. Qureshi et al. reported that the IMF duration for mandibular fractures treated with a closed approach ranged from 4 to 6 weeks [20]. In this study, the average IMF duration for patients treated with a closed approach was found to be 4-6 weeks, similar to the literature.

Among mandibular fractures, angle fractures have been reported as the most commonly encountered fractures, and the presence of third molars has a significant impact on angle fractures [21]. Meisami et al. reported in a study that angle fractures occurred three times more frequently in patients with third molars compared to those without [22]. In this study, the presence of impacted third molars in the fracture site was determined in 50 out of 71 patients (70.4%) with angle fractures.

Complication rates of 7-30% are reported in the literature for mandibular fracture treatment. The most common complications encountered after mandibular fractures are infection and bleeding [23,24]. Lamphier et al. reported in their study that complications were more likely to occur in weak patients with low quality of life and nutritional disorders [25]. According to Lamphier's study, the most common complication was wound dehiscence and infection. Therefore, it is emphasized that nutritional support is crucial in promoting wound healing and reducing infection. In this study, when examining the patients who developed infection, it was observed that infection occurred in 24 patients who underwent open reduction, but it was controlled with antibiotic treatment. When evaluating the relationship between infection and teeth along the fracture line, no statistical difference was detected. It is believed that the development of infection may be attributed to limited oral hygiene due to restricted mouth movements and post-operative swelling.

Conclusion

In conclusion, the main goal in the treatment of common mandibular fractures is to restore function and aesthetic integrity. The etiology of the fracture is the most important determining factor for fracture type. Therefore, mandibular fractures should be thoroughly evaluated considering the etiological factors, and the most appropriate treatment option should be applied as soon as possible according to the type of fracture.

Ethical approval

This study was conducted with the approval of Erciyes University Clinical Research Ethics Committee (protocol no: 2022/189).

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