Correlating assessment between clinical features and morphologies on CT scan of mandibular condyle fracture

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Abstract

Background: Among mandibular fractures, condyle fractures are common injuries which directly affect the occlusal function and aesthetics of the patients. Accurate diagnosis based on clinical and radiographic features helps to choose the appropriate treatment. This study aims to evaluate clinical features, morphologies on CT Scan of mandibular condyle fractures and analyze the relationship between these characteristics. **Materials and methods:** A cross-sectional study on 30 patients with mandibular condyle fractures were conducted at Department of ENT - Ophthalmology - Odonto Stomatology in the Hospital of Hue University of Medicine and Pharmacy, from December 2021 to June 2023. **Results:** The male:female ratio was about 2:1, the main cause of fractures was traffic accidents (73.4%). The common clinical symptoms were malocclusion (96.7%) with occlusal interferences on posterior teeth and limited mouth opening (83.3%). On CT Scan, condylar neck fractures were the most common position (58.8%). There was a relationship between the side of deviated mouth opening and the affected sides ($p < 0.05$). In cases of unilateral condyle fractures, there was a relation between the side of premature contact on posterior teeth and the affected sides ($p < 0.05$). **Conclusions:** Fractures of condylar neck was the most common fractures in the mandibular condyle, which resulted in malocclusion, interferences on posterior teeth, limited and deviated mouth opening. There was a relationship between deviated mouth opening and premature contacts on posterior teeth with the fractured side.

Keywords: *Mandibular condyle fracture, clinical features, CT Scan.*

1. INTRODUCTION

The mandibular condyle is a component of the mandible that contributes to the temporomandibular joint. With its structure and position, the condyle plays an important role in the masticatory function and the growth of the mandible [1]. A fracture of the mandibular condyle is not life-threatening, however, it directly interferes the aesthetics and chewing of the affected patient. If left untreated, it can lead to complications such as joint dysfunction or stiffness, impaired mandibular movement, and facial growth disorders [2].

The incidence of condylar fractures varies among studies, ranging from 17.5% to 52% of mandibular fractures. In Vietnam, this rate is 14.03%, while in Hue, it is reported to be 8.57% [3], [4]. The classification systems of condylar fractures are relatively diverse. Criteria for grouping fractures involves in fracture location, the relation between the condyle and the glenoid fossa, affected side (unilateral or bilateral), degree of displacement and whether other positions of the mandible are fractured or not [5]. Clinical symptoms commonly observed in patients with condylar fractures of the mandible include tenderness in the prearticular area, limited mouth opening, deviated mouth opening, and malocclusion [6], [7], [8]. A study of Duc Nguyen Quang (2022) reported that limited mouth opening was present in all of the patients, followed by malocclusion (74.7%). CT Scan revealed that condylar neck fractures accounted for 65.2% of cases, and the percentage of combined condylar fractures with other mandibular locations was 77.9%. The ratio of unilateral to bilateral fractures was 3.5:1 [9].

Although making an early diagnosis of mandibular condylar fractures is not challenging, it also requires a combination of clinical and radiographic assessment to accurately determine the location of the fractures. In order to enhance the ability to diagnose early and precisely, we conducted this study to assess clinical features, morphologies on CT Scan, and analyze the relationship between clinical characteristics and morphologies on CT Scan of mandibular condyle fractures.

2. MATERIALS AND METHODS

2.1. Study design

We conducted a cross-sectional, descriptive study on 30 patients diagnosed with mandibular condyle fractures at the Department of ENT - Ophthalmology - Odonto Stomatology, Hue University of Medicine and Pharmacy Hospital from December 2021 to June

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2023. Patients had sufficient dentition to establish occlusion and agreed to participate in the study. All consent forms were collected.

2.2. Variables

2.2.1. General features

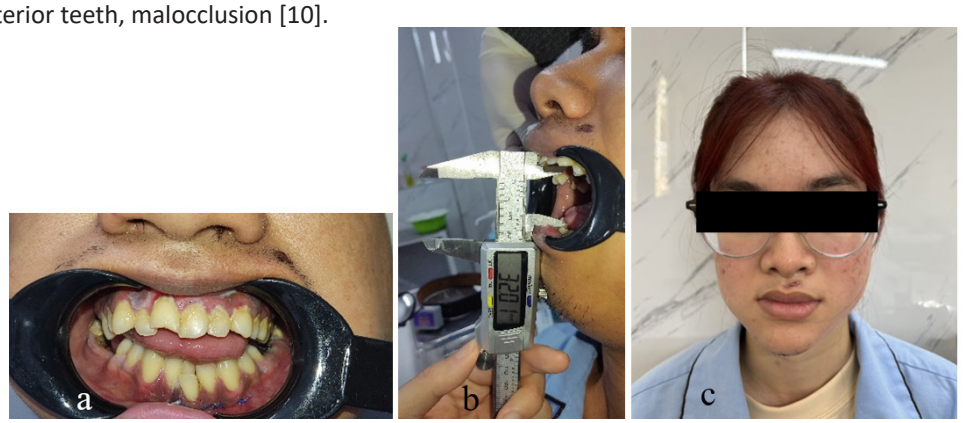
+ Age: ≤ 18 years old; 19 - 39 years old; 40 - 60 years old; > 60 years old.

+ Gender: Male/Female.

+ Cause of injury: traffic accidents; occupational accidents; domestic accidents; other accidents.accidents; other accidents.

2.1.2. Clinical symptoms

Clinical features were evaluated based on Fonseca's criteria, including: external auditory bleeding, tenderness in the preauticular region, limited mouth opening, deviated mouth opening, premature contacts on the posterior teeth, malocclusion [10].



a. malocclusion b. limited mouth opening c. tenderness in the preauticular region

Figure 1. Clinical features of mandibular condyle fracture

2.1.3. Radiographic features

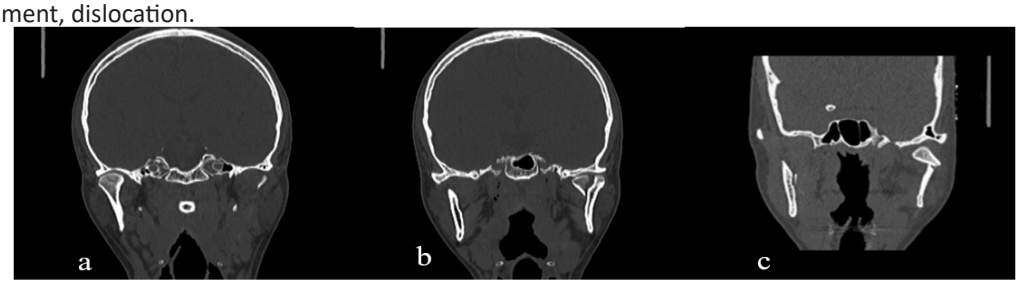
On CT Scan images, the following morphological features were recorded:

+ Location of the condyle fractures according to AOCMF (2014) [11]: condylar head, condylar neck, subcondylar area.

a. Subcondylar area fracture b. Condylar neck fracture c. Condylar head fracture

Figure 2. Location of the condyle fractures on CT Scan:

+ Relation between the condyle and the glenoid fossa according to AOCMF (2014) [11]: No displacement, displacement, dislocation.



a. No displacment b. displacement c. dislocation

Figure 3. Relation between the condyle and the glenoid fossa:

+ Number of affected sides: unilateral/bilateral.

+ Combinated fractures of the mandible: mental/ body/angle/coronoid/alveolar process.

2.3. Data analysis

The data were analyzed by using SPSS Statistics 2.0 software. The proportions were compared using the Chi-square test. In cases expected frequencies were less than 5, Fisher's exact text was used for testing. The level of significance was set at $p < 0.05$, and a confidence level of 95% was used for constructing confidence intervals.

3. RESULTS

3.1. Clinical features and the morphology of mandibular condylar fractures on CT Scan

3.1.1. Clinical features

3.1.1.1. Age

The average age was 25.43 ± 10.53. The youngest participant was 11 years old and the oldest one was 55 years old. The age group of 19 - 39 years old accounted for the highest proportion (73.3%), followed by the age group ≤ 18 years old (16.7%) and the age group of 40 - 60 years old (10.0%).

3.1.1.2. Gender and causes of injury

Table 1. Distribution of gender and causes of injury

Causes of injury	Gender					
	Female		Male		Total	
	N	(%)	n	(%)	n	(%)
Traffic accident	5	50.0	17	85.0	22	73.4
Occupational accident	0	0.0	1	5.0	1	3.3
Domestic accident	5	50.0	1	5.0	6	20.0
Other accident	0	0.0	1	5.0	1	3.3
Total	**10**	**100.0**	**20**	**100.0**	**30**	**100.0**

The male-to-female ratio was approximately 2 : 1.

Among the causes of injury, traffic accidents occupied the highest proportion, followed by domestic accidents. Specifically, in male patients, traffic accidents accounted for 85.0%.

3.1.1.3.Clinical symptoms

Table 2. Distribution of clinical symptoms

Clinical features		n	(%)
External auditory bleeding		3	10.0
Tenderness in the preauricular region		26	86.7
Limited mouth opening		25	83.3
Deviated mouth opening	Right	9	30.0
	Left	17	56.7
	Total	26	86.7
Malocclusion		29	96.7
Premature contacts on posterior teeth	Right	8	26.7
	Left	16	53.3
	Total	24	80.0

The percentages of cases with tenderness in the preauricular region was 86.7%. Almost cases presented malocclusion (96.7%). Limited mouth opening accounted for 83.3%. Interferences on posterior teeth appeard in 80.0% of cases.

3.1.2. Morphology of mandibular condylar fractures on CT Scan

3.1.2.1. Locations of condyle fracture

Table 3. Distribution of the location

Location of condyle fractures	n	(%)
Condyle head	8	23.5
Condyle neck	20	58.8
Subcondylar	6	17.7
Total	**34**	**100**

Condyle neck was the most common affected region, accounted for 58.8% of condyle fractures.

3.1.2.2. Relation between the condyle and the glenoid fossa

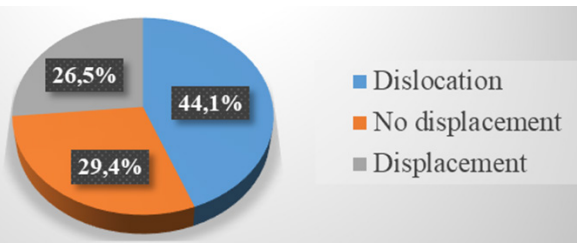


Figure 5. Distribution of relation between the condyle and the glenoid fossa (n = 34)

Condylar fractures with dislocation accounted for 44.1%.

3.1.2.3. Combinated location fractures and number of affected sides

Table 4. Relation between the combinated location fractures and number of affected sides

Combinated location fractures	Affected Sides				p(*)
	Unilateral		Bilateral		
	n	(%)	N	(%)	
Mental	7	26.9	4	100.0	**0.005**
Body	3	11.5	0	0,0	
Angle	1	3.8	0	0,0	
Alveolar process	1	3.8	0	0,0	

(*) Fisher's exact test.

Table 4 shows the relation between the combinated location fractures of the mandible and the number of affected sides. In particular, fractures in the mental are related to condylar fractures (p<0.05).

3.2. Relation between clinical features and the morphology of condyle fractures

Table 5. Relation between clinical features and the morphology of condyle fractures

The morphology of condyle fractures			Clinical features					p*
			Limited mouth opening (n)	Deviated mouth opening (n)		Premature contact on posterior teeth (n)		
				Right	Left	Right	Left	
Affected sides	Unilateral	Right	8	9	0	7	0	**0.001**
		Left	14	0	17	0	15	
	Bilateral		3	0	0	1	1	
p**			0.814	**0.001**		0.107		

Location of fractures	Condyle head	4	7	4
	Condyle neck	16	14	15
	Subcondylar	5	5	5
p**		**0.002**	0.498	**0.011**
Relationship between condyle and glenoid fossa	Dislocation	14	11	15
	Displacement	3	6	3
	No displacement	8	9	6
p**		0.07	0.157	**0.008**

(*) Chi-square test.
(**) Fisher's exact test.

Regarding the number of affected sides, there is a relationship between the side of deviated mouth opening and the affected sides ($p < 0.05$). In cases of unilateral fractures, there is a relationship between the side of premature contacton posterior teeth and the affected sides ($p < 0.05$).

Regarding the location of fractures, there is a relationship between the symptom of limited mouth opening and the location of condylar fractures ($p < 0.05$). There is also a relationship between the symptom of premature contact on posterior teeth and the location of condylar fractures ($p < 0.05$).

There is a relationship between the symptom of premature contact on posterior teeth and relationship between the condyle and the glenoid fossa ($p < 0.05$).

4. DISCUSSION

4.1. Clinical features and the morphology of mandibular condylar fractures on CT Scan

4.1.1. Clinical features

The average age of patients in this study was 25.43 ± 10.53. The age group of 19 - 39 years old occupied the highest proportion (73.3%). This is the working-age group, which involved in economic, social and transportation activities. This age group tends to engage in risky behaviors and high-speed activities, resulting in a higher incidence of injuries compared to other age groups, which is reasonable and consistent with the injury situation in Vietnam. The results of this study are also similar with the study by Thang Nguyen Hung (2019) and by Thanh Bui Van (2020), in which the age group of 19 - 39 accounted for the highest proportion (66.1% and 61.1% respectively) [7], [8].

In our study, the majority of cases are male patients, with a male-to-female ratio is approximately 2:1. This ratio is also in line with the study of Duc Nguyen Quang (2022), which reported a ratio of about 3.5:1 [9]. The reasonable explanation could be that males are predominantly involved in driving and transportation activitives, engaging in work with higher risk of injuries, sports and even altercations.

Traffic accidents are the most common cause of mandibular condyle fractures, accounting for 73,4% of cases. Among these, the proportion is higher in males than females. This could be attributed to the fact that males typically are the ones who operate vehicles and have a tendency to comsume alcohol while participating in traffic activities. Other causes have a relatively lower proportion, indicating that most fractures are associated with traffic incidents among the Vietnamese population. This proportion is also similar to the findings of studies conducted by Chon Ho Nguyen Thanh (2016) and Duc Nguyen Quang (2022) [6], [9].

The most commonly symptom is malocclusion, with a prevalence rate of 96.7%. This is a common symptom in most patients with mandibular condyle fractures. The condyle fracture alters the vertical dimension of the mandibular ramus, leading to premature contacts on the posterior teeth and malocclusion. Therefore, in this study, there is a relatively high proportion of patients with premature interferences on the posterior teeth (80.0%).

There was a relatively high proportion of patients with tenderness in the preauricular region (86.7%) and deviated mouth opening (83.3%). These are easily identifiable initial symptoms that can be used to point out the location of the injury, specifically the mandibular condylar region, allowing the physicians to prescribe appropriate X-ray to accurately assess the patient's condition. The preauricular region corresponds to the inner surface of the condyle, so tenderness in the area may be an indicative sign of

mandibular condyle fracture. The cause of deviated mouth opening may be an imbalance in the force exerted by the external pterygoid muscle on the condylar region.

The symptom of external auditory bleeding had the lowest proportion, which was at 7.7%. This may be due to the impact force pushing the condyle backward, causing laceration and affecting the external auditory canal, leading to bleeding.

The study conducted by Thang Nguyen Hung and Tu Nguyen Anh (2019) on 56 patients showed results regarding the proportion of clinical features in patients with condylar fractures that are similar to our study. Specifically, the symptoms of malocclusion and tenderness in the preauricular region accounted for 100%, the highest among the symptoms. The proportion of limited mouth opening was similar to our study, at 94.6%. External auditory bleeding had the lowest proportion at 14.3%. The authors concluded that the symptoms of tenderness in the preauricular region, malocclusion and limited mouth opening play an important role in the diagnosis of condylar fracture [7].

4.1.2. Morphology of mandibular condylar fractures on CT Scan

The ratio of unilateral to bilateral fractures was approximately 6:1. Depending on the placement and transmission of force, there may be an imbalance in the load-bearing capacity of the two condyles, causing the side bearing more load to fracture. This ratio is slightly higher, compared to the study of Duc Nguyen Quang [9]. The slightly smaller sample size in our study compared to the author's study could contribute to this difference.

The most common location of fractures was the condylar neck, accounting for 58.8%. This proportion is also relatively consistent with the study of Duc Nguyen Quang, which reported the highest proportion of condylar neck fractures at 65.2%. This is consistent with the structural weekness of the condylar neck in the mandibular condyle.

In this study, we observed that 44.1% of fractures had joint dislocation. This proportion is quite similar to a study performed by Thanh Bui Van [8]. Due to deviation of the condyle, external pterygoid muscle contraction could cause the dislocation.

The results from table 4 revealed a relation between the combinated site of jaw fractures and the number of affected sides ($p < 0.05$). Specificially, mental fractures were found in the majority of patients with fractures of the mandibular condyle. This can be explained by the fact that the mental protrudes the most, making it more susceptible to impacts. Direct forces apply to the jaw tend to transmit along the bone up to the condyle. If the force impact is excessive and directly, it can result in condylar fractures, whether it be unilateral or bilateral depending on the position.

These findings are also consistent with the studies conducted by Sawazaki (2010) and Tatsumi (2015) [12], [13].

4.2. The relation between clinical features and the morphology of mandibular condylar fractures on CT Scan

In this study, we found relations between clinical features and the morphology of mandibular condylar fractures on CT scan.

The symptom of deviated mouth opening showed a relation with the side of fractures. Patients with unilateral fractures tended to have more proportion of deviated mouth opening than those with bilateral fractures and the side of deviated mouth opening coincided with the injured side ($p < 0.05$). The limited movement of the injured condyle during mandibular movement js due to the contraction of external pterygoid muscle in the affected side, while the unaffected condyle still moves downward, forward and inward. Therefore, the side of deviated mouth opening is the same with the condyle fracture.

The results from table 5 showed no relation between the number of injuried sides and premature contact on posterior teeth ($p > 0.05$). However, in the case of patients with unilateral condylar fractures, there is a relation between the side of premature contact and the injured side. Specifically, the side of this symptom coincides with the side of the condylar fractures. These findings are consistent with the theoretical basis proposed by Bonanthaya (2021) [14].

In addition, table 5 indicates a relation between limited mouth opening and the location of fractures. In most cases of condylar head fractures, the patient's mouth opening range is normal. This can be attributed to the fact that condylar head fractures often occur within the joint capsule, allowing the movement of the fractured condyle to still function under the influence of masticatory muscle. Addtionally, there is a relation between the location of fractures and the symptom of posterior contact on posterior teeth.

Furthemore, there is a relation between the premature contact on the posterior teeth and dislocation of the condyle head. This can be explained that joint dislocation on the injured side

will alter the height of the mandible ramus, resulting in the observed premature contacts.

4.3. Strength and limitation of study

4.3.1. Strength of study

In this study, our dental clinicians have trained about the new mandibular condylar fracture classification of AOCMF (2014). Therefore, all of our data is assessed and examined in the same way. Besides, we have used the new classification with CT Scan, which becomes more and more popular radiography in clinical settings. It helps us to determine the accurate site of condylar fractures and the relation between clinical features and morphologies of mandibular fractures. Therefore, we can diagnosis more accurate and earlier.

4.3.2. Limitation of study

Despite of the strengths, this study also has some limitations. Samples size is not big enough to determine the relation between all clinical features and radiographic features.

5. CONCLUSION

Fractures of condylar neck was the most common fractures in the mandibular condyle, which resulted in malocclusion, interferences on posterior teeth, limited and deviated mouth opening. There was a relationship between deviated mouth opening and premature contacts on posterior teeth with the fractured side.

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