Study Protocol – Cover Page

Official Study Title:

Aetiology and Pattern of Mandibular Condylar Fractures:

A Retrospective Cohort Study of 122 Patients

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Aetiology and pattern of 122 patients with mandibular condylar fracture

Abstract:

Objective: This research sought to examine the aetiology and pattern of Mandibular Condylar Fractures (MCF).

Methods: Data on patients who had MCF from 2018 to 2020 were documented, including fracture aetiology, site, kind, fracture line angle, and concomitant injuries. The data were further analysed with the chi-square test, t-test, and ANOVA.

Results: This research included 122 patients (94 men and 28 females), yielding a male-to-female ratio of 3.35:1 and an average age of 30.7 years. Road traffic accidents was the predominant cause of fractures, accounting for 75.4%. Of the 153 fractures, 75 (49.01%) were categorised as subcondylar fractures, 69 (45.09%) as condylar neck fractures, and 9 (5.9%) as condylar head fractures. Among several forms of MCF, MacLennan class III was the most frequent (n=56, 36.6%), whereas MacLennan class I was the least common type of fracture (n=13, 8.5%). Moreover, symphysis and maxillary fractures were more prevalent in individuals with bilateral condylar fractures compared to those with unilateral condylar fractures (p=0.017 and p=0.035, respectively). On the other hand, individuals who had unilateral condylar fractures were more likely to have mandibular body fractures than those who had bilateral condylar fractures (p = 0.015). In cases where the condylar neck and sub-condylar fractures were present, the average angle of the fracture line with the posterior border of the ramus was 120.85 11.14 degrees.

Conclusion: A motor traffic collision was the predominant aetiology of MCF. The findings indicated a substantial correlation between the severity of condylar fractures and the concomitant injuries.

Keywords: Mandibular fracture, Mandibular angle, Unilateral, Bilateral, Trauma

Introduction

Mandibular fractures are among the most prevalent injuries in individuals with craniofacial trauma (1). The prevalence of MCF has been reported as 29-52% of all mandibular fractures (2-6).

A multitude of investigations has been conducted on the aetiology of condylar fractures. Silvennoinen et al (6) mentioned violence as the most common cause of these fractures. In other studies, falls were found to be the leading cause of condylar fractures in women and children (7, 8). Recent studies, however, have shown that Road Traffic Accidents (RTA) played a significant role in these fractures (4, 5, 9, 10).

According to the anatomical level of fractures, there are three types of condylar fractures: the condylar head (intracapsular), the condylar neck, and the sub-condylar area (6, 11-13). Fracture displacement depends on the direction, degree, magnitude, and point of force application. Dentition and occlusion statuses are essential, as well (10). The fracture may be categorised as undisplaced, deviated, displaced (with medial or lateral overlap or total separation), and dislocated (external to the glenoid fossa) (14).

Understanding the pattern of maxillofacial trauma can help determine preventive policies and evaluate treatment modalities (5). The current research is to ascertain the epidemiological features and incidence of mandibular condylar fractures within a specific group. More and more in-depth articles related to the proposed topic are given below for further reading:

The (15) discusses the etiology, classification, clinical features, diagnosis, and management of mandibular condyle fractures. It highlights that these fractures account for 10-40% of mandibular trauma, with a higher incidence in children. Falls, incidents involving vehicles on the road, and injuries sustained in sports are all common causes. The chapter also covers treatment protocols for different age groups and the indications for closed versus open reduction.

The study (16) analyzes the etiology of mandibular condylar fractures in a tertiary care setting. It found that falls (45.71%) and road traffic accidents (40%) were the predominant causes. The study also noted a higher incidence of fractures in males, particularly in the third decade of life. Detailed radiological investigations were emphasized for accurate diagnosis.

The article (17) studied the prevalence and causes of mandibular condyle fractures and documented that the majority of cases were due to motor vehicle accidents (44.20%) or cycling (24.61%). The authors also recognized the anatomical predisposition of the condylar region and the impact proper diagnosis (early and accurate) has on preventing complications.

The article (18) provided information about the clinical presentation and causes of mandibular condylar fractures. The study noted accidents from road traffic or falls, and many cases involved young adults. Additionally, it highlighted the need to conduct both clinical and radiographic assessments (definitively including CBCT/CT) to facilitate reasonable treatment protocols.

The third article (19) conducted a retrospective review of the patterns and causes of mandibular condylar fractures within a defined period. They also recognized interpersonal violence (assault, etc.) and sports as additional contributory factors to falls and motor vehicle accidents. They stressed that treatment should involve a multidisciplinary approach to aid in preventing long-term outcomes.

The reference (20) provides an extensive summary of mandibular and midface fractures, examining the causes, clinical features, and diagnosis. It explains the need for dental X-rays and CT scans for accurate diagnosis. Most fractures of the mandibular condyle indeed occur from blunt trauma and commonly present with preauricular pain and restricted mouth opening. Various treatments are available for fracture repair, ranging from conservative therapy to surgical treatment, depending on the extent of the fracture and displacement.

The article (21) provides a clear discussion of the causes of condylar fractures and their treatment. According to what is written in the article, the large majority of the time, condylar fractures are a result of blunt trauma to the anterior mandible, which transfers forces to the condylar area. The variable anatomy that limits posterior jaw mobility is examined concerning the glenoid fossa, TMJ capsule, and lateral pterygoid. Management involved both open and closed reduction, with a significant emphasis on managing complications.

The (22) discusses the etiology, clinical features, and management of mandibular condyle fractures. The authors discuss clinical controversies surrounding treatment options, particularly open versus closed reduction, but emphasize the importance of understanding the anatomy of the temporomandibular joint and the need for thorough clinical and radiographic examination. The chapter also describes complications and the role of physiotherapy in managing them.

Material/Subjects/Patients and methods

The current study was approved by the Institutional Research Ethics Committee (IR.SUMS.DENTAL.REC.1399.120). The medical files of patients with facial trauma admitted to a trauma center were reviewed from January 2018 to December 2020. An investigator collated and normalized the information and data extracted from the medical files, clinical and radiographic exams, and patients' medical histories. In order to qualify for inclusion in the research, subjects had to have either unilateral or bilateral condylar fractures acquired from an external trauma. The exclusion criteria included incomplete information regarding the trauma in the medical records and a history of prior condylar fractures.

The data relating to the aetiology, location, and type of the fracture, as well as the fracture line angle and the associated injuries, were collected. The patients were etiologically divided into three groups, i.e., RTA, falling, and violence (assault). The fractures were classified using Computed Tomography (CT) examinations. According to Loukota et al (23), the fractures were classified into three categories: sub-condylar, condylar head, and condylar neck fractures by taking into consideration the position of the fractures (Fig. 1).

Moreover, based on MacLennan's research (14), fracture types were categorized into four subclasses according to the degree of displacement:

1. Non-displaced
2. Deviated
3. The condylar head was still located inside the glenoid fossa, despite the fact that the proximal and distal fracture portions overlapped one another.
4. The condylar head was dislocated, meaning that it was situated outside of the glenoid fossa (Fig 2).

In addition, the injuries that were associated with the incident were classified as fractures of the mandibular bone (including the symphysis, body, angle, ramus, and coronoid), maxillary bone, zygomatic bone, and nasal bone. The angle of the fracture line was evaluated in the sagittal view for cases with condylar neck and sub-condylar fractures (Fig. 3).

This evaluation was performed between the fracture line and the posterior border of the ramus where the fracture line was located. SPSS Statistics for Windows, version 23 (written by SPSS et al. in the United States), was used for each and every statistical analysis. The results of the descriptive analysis of the data were described using either the mean (standard deviation) or the frequency (percentage). In order to analyse the categorical variables, a chi-square test was carried out. These variables included age groups, sex, etiology, location of the fracture line, type of fracture, and associated injuries.

The purpose of this test was to determine the strength of the correlation that existed between the variables that highlighted the categories.

To establish if there was an association between the ages of the fractures and the causes of the fractures for both males and females, a t-test was performed. This was conducted to determine if a correlation existed. To establish the relationship between the mean angle of the fracture line and the etiology of the fracture, a statistical method called analysis of variance (ANOVA) was employed. This was to determine whether a connection existed and, finally, given the importance of the P-value being less than 0.05, to determine if the results were statistically significant.

Results:

This study included a total sample of 122 participants, which included 94 males and 28 females. This resulted in a male-to-female ratio of 3.35:1. The mean age of patients in the cohort was 30.70±11.39 years (range, 12 to 65 years). The breakdown of the number of sexes by age group is outlined in Table 1. The results of the chi-square test indicated an absence of a statistically significant correlation between age and sex distribution, with the majority of patients falling within the 21-30 age bracket (39.3%).

Of the 122 patients diagnosed with MCF, 91 individuals, representing 74.6%, exhibited unilateral fractures, while 31 individuals, accounting for 25.4%, presented with bilateral fractures. Among the 153 condylar fractures, 79 occurred on the left condyle while 74 were observed on the right condyle. The predominant cause of MCF was RTA (n=92), succeeded by falls (n=22) and physical assault (n=8). When it came to the causes of fractures, the chi-square test revealed that there was no statistically significant difference between the two sexes. This was the conclusion reached by the researchers. Furthermore, the t-test findings revealed no notable correlation between the aetiology of fractures and age across both genders (Table 2).

Among the various classifications of MCF, MacLennan class III emerged as the most prevalent, with a total of 56 instances, accounting for 36.6% of the cases. In contrast, MacLennan class I represented the least common type, with only 13 occurrences, which corresponds to 8.5%. The findings of the chi-square test suggested that there was no statistically significant correlation between the aetiology and the kind of fractures (p=0.706) (Table 3). This was the conclusion reached by the researchers.

In light of the geographical context, the majority of fractures (n=75, 0%) were identified as subcondylar, succeeded by condylar neck fractures (n=69, 0%) and condylar head fractures (n=9, 0%). Table 3 displays the findings of the chi-square test, which indicated that there was no statistically significant correlation between the site of fractures and the aetiology of those fractures (p=0.292).

Table 4 indicates that 91 fractures, accounting for 74.6%, were unilateral, while 31 fractures, representing 25.4%, were bilateral. The results of the chi-square test indicated a noteworthy correlation between the aetiology of fractures and the severity of injuries, specifically in the context of unilateral and bilateral condylar fractures (p=0.071).

The incidence of patients who experienced concomitant injuries alongside unilateral and bilateral condylar fractures has been enumerated and juxtaposed in Table 5. Consequently, the incidence of symphysis and maxillary fractures was notably higher in patients exhibiting bilateral condylar fractures compared to those with unilateral fractures (p=0.017 and p=0.035, respectively). In contrast, the incidence of mandibular body fractures was significantly greater in cases of unilateral fractures compared to those with bilateral condylar fractures (p = 0.015). This was true for both unilateral and bilateral fractures. When it came to the mandibular angle, there was a significant difference between individuals who had unilateral fractures and those who had bilateral fractures (p = 0.064).

When it comes to cases involving condylar neck and sub-condylar fractures, the average angle of the fracture line in regard to the posterior border of the ramus was measured to be 120.85 11.14 degrees. According to the findings of the analysis of variance, there was not a statistically significant connection between the aetiology of the fracture and the mean fracture line angle (p=0.711) (Table 6). This was the conclusion reached by scientists.

Discussion:

Epidemiological studies of condylar fractures can effectively understand the pattern of these fractures and implement preventive policies (5). The present study on MCF indicated the most involved age groups, prevalence of different etiologies, locations, types of fracture, frequency of the patients sustaining the associated injuries, and the mean of fracture line angle.

In the present study, the male/female ratio was 3.35:1, which was similar to that found in other studies (2, 3, 5, 6, 9, 10), but greater than the ratio reported by Marker et al (2:1) (4). Additionally, the mean age of the patients was 30.7 years, which was in agreement with the studies carried out by Silvennoinen et al (6), Marker et al (4), and Sawazaki et al (5). Furthermore, the 21-30 age group was more prone to condylar fractures, which was in line with the findings of other reports (5, 24). The current study findings revealed no significant relationship between age group and sex ratio. However, Zhou et al showed a decrease in the male/female ratio in the 11-20 age group compared to other age groups. This may be because women in the 11-20 age group play active societal roles. Besides, around the age of puberty, they suffer from MCF almost as much as men do. Nonetheless, the male/female ratio markedly increased in the patients aged 21-30. This may be attributed to the change in the roles played by men and women in the 21-30 age group. In this age group, men are more active in the workplace, while women are more preoccupied with childbirth and childcare (24).

Previous studies have demonstrated different etiologies of MCF in various countries. Violence has been identified as the most common aetiology in Scotland (3) and Finland (6). In addition, falls are the most common cause in Sri Lanka (2). However, recent studies have indicated that RTA has been the most common cause of condylar fractures in developed and developing countries (4, 5, 9, 10, 24). RTA was also the leading cause of trauma in the current investigation. The disparity in outcomes observed in the current study and those of other studies can be attributed to population mobility, careless driving, unsafe roads, improper road traffic policies, unsafe cars, discrepancies in geographical areas, people's socioeconomic status, and date of injury.

Loukota et al (23) a straightforward and accurate method for classifying condylar fractures was proposed. In this classification, condylar fractures have been divided into three categories, namely condylar head, condylar neck, and subcondylar fractures. In the current research, the most frequent fractures were subcondylar (49%), followed by condylar neck (45%) and condylar head (6%) fractures. Similar results were also obtained by Zachariades et al (10), Sawazaki et al (5), and Reddy et al (25). However, condylar head fractures are most common in a few studies (24, 26). Moreover, several studies demonstrated that the location of condylar fractures was directly affected by the cause of the injury (9, 10). According to Marker et al (4), condylar head fractures occurred more frequently in cases where considerable force was involved. In other words, sub-condylar fractures were more likely to occur when the damage was caused by a weak force (alleged assault). The present study results revealed no significant relationship between the aetiology and location of the fractures. However, there were no patients under 12 in this study. Children are more prone to condylar head fractures (27).

MacLennan (14) classified the types of fractures into four groups. In the current study, MacLennan's class III was the predominant type of MCF (36.6%), consistent with other studies' results (9, 10). On the contrary, Zhou et al (24) disclosed that class IV was the most common type of MCF. Research indicates that severe fractures (MacLennan's class IV) are more prevalent in instances resulting from high-velocity accidents, such as falls and road traffic accidents (RTA). In contrast, MacLennan's class I and II condylar fractures typically resulted from assaults characterised by lower force intensities (24, 26). The current investigation did not find any evidence of a substantial connection between the aetiology and the kind of fractures it examined.

The study findings demonstrated that bilateral fractures occurred slightly more frequently when a considerable force was applied (RTA). In contrast, unilateral fractures occurred when a weak force was applied (alleged assault). Similar results were obtained by Marker et al (4).

In the present study, individuals with concomitant mandibular fractures with condylar fractures comprised 68% of the sample. The most commonly associated mandibular fracture with condylar fracture was symphysis fractures, followed by mandibular body fractures. These findings were consistent with those of the previous studies conducted on the issue (5, 6, 10, 12). In the present study, symphysis fractures were found more frequently in the cases with bilateral condylar fractures, which was in line with the findings of the study by Zhou et al. (24). Nevertheless, body fractures occurred more often in instances with unilateral condylar fractures compared to those with bilateral condylar fractures. The fracture angle was marginally elevated in instances of unilateral condylar fractures. Zhou et al (24) did not find any significant relationships between mandibular body fractures and the severity of condylar fractures (unilateral or bilateral condyle fractures).

Nonetheless, they observed a significant relationship between mandibular angle fractures and the fracture severity (unilateral or bilateral condyle fracture). Generally, the mandibular body and angle fractures absorb a part of the applied force, causing unilateral fractures. However, the force exerted on the mandibular body and angle can be transmitted along the mandibular arch, leading to contralateral condyle fracture. In the research by Zhou et al (24), no significant relationship was observed between maxillary fracture and fracture severity (unilateral or bilateral condyle fracture). However, this relationship was significant in the current study. Accordingly, maxillary fracture was more frequent in the patients with bilateral condylar fractures. In individuals with bilateral condylar fractures, significant strain is exerted on the head and face, leading to maxillary fracture.

Conclusion:

The findings of the current investigation indicated that road traffic accidents were the predominant cause of mandibular condylar fractures. The findings indicated no substantial correlation between the different sources of condylar fractures and gender, age, as well as the location and type of fractures. The subcondylar region was the predominant site for condylar fractures, with MacLennan class III being the most prevalent form. Furthermore, symphysis and maxillary fractures were more prevalent in individuals with bilateral condylar fractures compared to those with unilateral condylar fractures. In contrast, mandibular body fractures occurred more often in instances with unilateral fractures compared to those with bilateral condylar fractures.

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Disclaimer:

Conflict of interest:

Funding disclosure:

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Table 1: Gender distribution across various age demographics

Age (years)	Male	Female	Total	P-value	Male:female ratio
12-20	19 (20.2%)	4 (14.3%)	23 (18.9%)	0.482	4.75:1
21-30	35 (37.2%)	13 (46.4%)	48 (39.3%)	0.382	2.69:1
31-40	22 (23.4%)	5 (17.9%)	27 (22.1%)	0.535	4.40:1
41-50	12 (12.8%)	4 (14.3%)	16 (13.1%)	0.834	3.00:1
>50	6 (6.4%)	2 (7.1%)	8 (6.6%)	0.887	3.00:1

Table 2: Sex and age distribution according to different etiologies

Etiology	Sex distribution (n=122)			Age		
	Male	Female	P-value	Male (mean ± SD)	Female (mean ± SD)	P-value
Road traffic accident	70 (74.5%)	22 (78.6%)	0.658	31.46±11.56	30.77±11.59	0.809
Falling down	16 (17.0%)	6 (21.4%)	0.594	28.69±11.38	28.68±15.83	0.997
Assault	8 (8.5%)	0 (0.0%)	0.110	29.50±6.74	-	-

Table 3: Type and location of the fractures according to different etiologies

Etiology	MacLennan class of fractures (n=153)					Location of fractures (n=153)			
	I	II	III	IV	P-value	Condylar head	Condylar neck	Subcondylar	P-value
RTA	12 (7.8%)	31 (20.3%)	41 (26.8%)	36 (23.5%)	0.706	8 (5.2%)	51 (33.3%)	61 (39.9%)	0.292
Falling down	1 (0.7%)	7 (4.6%)	10 (6.5%)	7 (4.6%)		1 (0.7%)	12 (7.8%)	12 (7.8%)	
Assault	0 (0%)	0 (0%)	5 (3.3%)	3 (1.9%)		0 (0%)	6 (4.0%)	2 (1.3%)	

Table 4: Fracture severity based on the injury's aetiology

Etiology	Severity of injury (n=122)		
	UF (n=91)	BF (n=31)	P-value
RTA	64 (70.3%)	28 (90.3%)	0.071
Falling down	19 (20.9%)	3 (9.7%)	
Assault	8 (8.8%)	0 (0%)	

UF, unilateral fracture; BF, bilateral fracture; RTA, road traffic accident.

Table 5: The incidence of individuals with concomitant injuries related to unilateral and bilateral condylar fractures

Associated injuries	Number of patients with UF (n=91)	Number of patients with BF (n=31)	Total (n=122)	P-value
Mandibular fractures				
Symphysis	39 (42.8%)	21 (67.7%)	60 (49.1%)	0.017
Body	25 (27.4%)	2 (6.4%)	27 (22.1%)	0.015
Angle	11 (12.0%)	0 (0%)	11 (9.0%)	0.064
Ramus	5 (5.4%)	2 (6.4%)	7 (5.7%)	1.000
Coronoid	3 (3.2%)	1 (3.2%)	4 (3.2%)	1.000
Maxillary fractures	18 (19.7%)	12 (38.7%)	30 (24.5%)	0.035
Zygomatic fractures	16 (17.5%)	6 (19.3%)	22 (18.0%)	0.825
Nasal fractures	14 (15.3%)	7 (22.5%)	21 (17.2%)	0.359

UF, unilateral fracture; BF, bilateral fracture.

Table 6: The average angle of the fracture line with the posterior border of the ramus in instances of condylar neck and sub-condylar fractures based on the injury's source.

Etiology	Angle (Mean ± SD)	P-value
Road traffic accident	120.83±11.79	0.711
Falling down	121.98±8.26	
Assault	118.13±11.20	

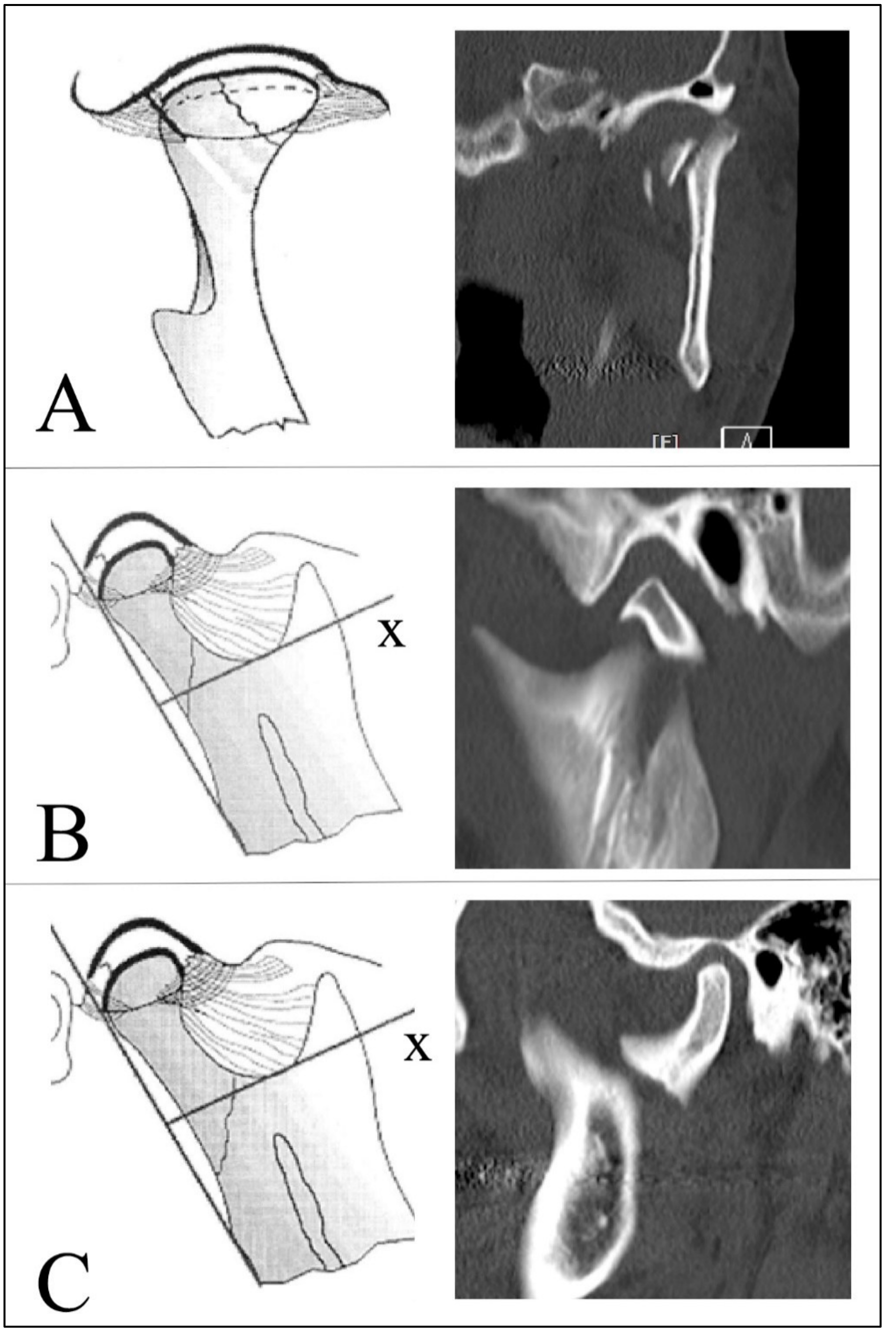

Figure 1: A: Condylar head fracture: articular surface fracture line may extend outside capsule. B: Condylar neck fracture: the fracture line begins above line x and goes above it in over half. Line x runs perpendicularly from the sigmoid notch to the ramus tangent. C: Sub-condylar fracture: below the mandibular foramen and below line x in over half.

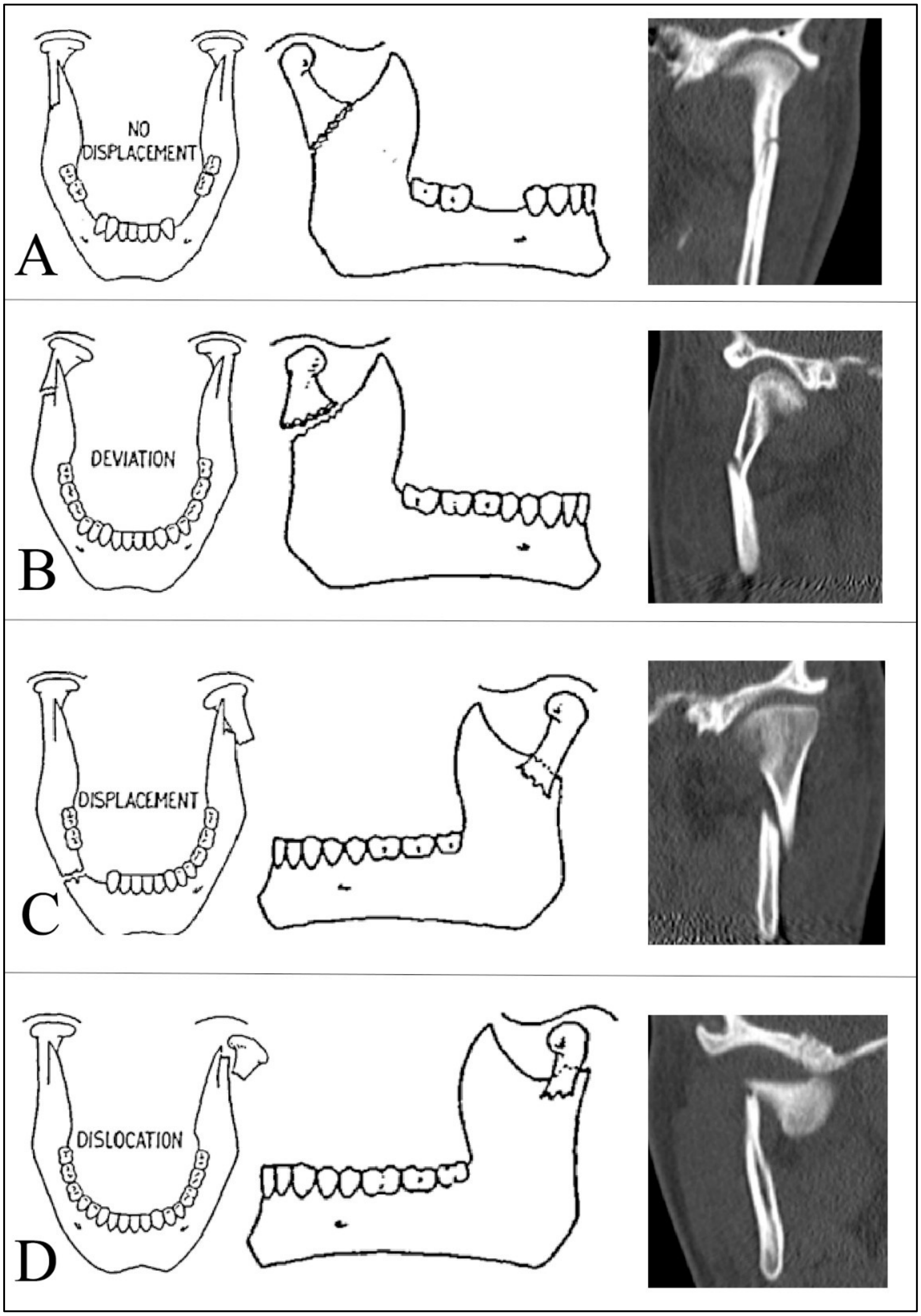

Figure 2: A: Non-displaced, B: deviated, C: displaced, D: dislocated.

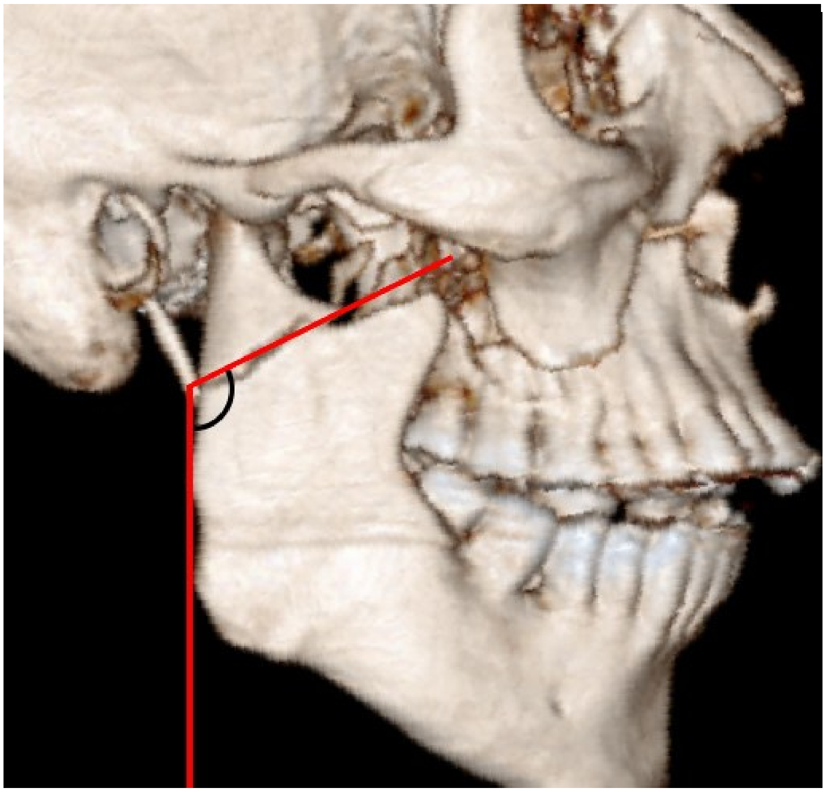

Figure 3: The fracture line angle