Association of Mandibular Chin Angle, Age, Gender and Anterior Fracture Type with Condylar Fracture: A Cross-Sectional Study

Abstract

Introduction: Symphysis and parasymphysis fractures are significantly related to mandibular condyle fractures. The aim of this study was to determine the relationship between mandibular chin angle, age, gender, anterior fracture type and condyle fracture.

Materials and Methods: This cross-sectional study was carried out in 142 patients with symphysis-parasymphysis fracture. The patients CT scans with symphysis-parasymphysis fractures were examined. Study samples were divided into two groups, with condylar fracture and without condylar fracture. Mandibular chin angle was measured in the CT scan scout view using the Image-j tool. Demographic data was extracted from patient’s information stored in their medical records. The results were analyzed using SPSS 26 software.

Results: The mean ± standard deviation of Chin angle in patients with condylar fracture and without condylar fracture was 129.07 ± 8.68 and 127.03 ± 8.11, respectively, which difference was not statistically significant (P = 0.151). The incidence of condylar fractures in men with parasymphysis fractures was 2.43 higher than in women, which was statistically significant (P = 0.032). The mean ± standard deviation of age in patients with condylar fracture was 27.87 ± 9.20 and in patients without condylar fracture was 27.22 ± 8.41. This difference was not statistically significant (P = 0.350). The condylar fracture rates in patients with parasymphysis fractures and symphysis fractures were 52.25% and 41.94%, respectively, which were not statistically significant (P = 0.31).

Conclusion: The gender of patients should be taken into consideration in the clinical evaluation of condylar fractures.

Key words: Mandibular Fractures, Mandibular Condyle, Maxillofacial injury

Introduction

Mandibular fractures are the second most common maxillofacial fractures after nasal fracture(1). Complications following mandibular fractures can have a significant impact on quality of life, including sensory disturbances, malocclusion, and masticatory pain(2). A comprehensive understanding of the various factors that affect the location of mandibular fractures are essential for optimizing clinical management(3). This factors include external factors (intensity, location and direction of force) and internal factors (bone shape, bone density and thickness, muscles in the area, presence or absence of teeth and type of occlusal support)(4-6). However, there is limited information on the anatomical factors for mandibular fractures(3, 7). Due to the structural characteristics of the mandible, most mandibular fractures are multiple(8).Trauma may result in a direct fracture at the site of impact and an indirect fracture at a distant location(9). Condylar fractures account for 29% to 52% of mandible fractures(10, 11). The diagnosis of condylar fractures is of high value as it may influence chewing, speech and occlusion(7). Fractures of symphysis and parasymphysis are strongly correlated with condylar fractures(12). When high force is applied to the anterior mandible, condylar fracture often occurs in combination with symphysis fracture(13). The prominence and angulation of the chin determines resistance of the symphysis area and may predispose to indirect condylar fracture(14). Computed tomography (CT) is the modality of choice for mandibular fracture diagnosis(15). The scout view in CT is created by the radiation of fixed X-rays to the film, which is commonly used to locate scan slices, but may also provide diagnostic information(16). A new angle called the mandibular chin angle (measured digitally on two-dimensional CT scans) has been proposed as an indicator of the anterior mandibular morphology and its possible influence on the risk of condylar fractures(9). This study aimed to evaluate mandibular condylar fracture in relation to mandibular chin angle, age, gender and type of anterior fracture in patients with symphysis and parasymphysis fractures.

Material and Methods

This cross-sectional study was approved by the institutional ethics committee (IR.TBZMED.REC.1402.624). Medical records and CT scans of all patients with mandibular fractures who were referred to the Oral and Maxillofacial Surgery Department of Imam Reza Hospital in Tabriz between the years 2022 and 2023 were retrospectively reviewed. Due to the retrospective design, informed consent was waived; however, all patient data were treated with strict confidentiality. Inclusion criteria included full CT scan prior to surgery and symphysis or parasymphysis fracture of the mandible (with or without condylar fracture). CT scan of patients who had mandibular pathologic fractures, missing and displaced teeth (outside the dental arc) in anterior mandible, complete edentulous and partial edentulous in anterior mandible, as well as CT scans that had an incomplete view (which the measurement of the angle was not possible), were excluded from the study. Based on inclusion and exclusion criteria, CT scans of 142 patients with symphysis or parasymphysis fractures following trauma to the chin area were investigated (71 with and 71 without condylar fracture). Samples from this study were split into two groups. Group1.Anterior mandibular fractures with condylar fracture, divided into two subgroups: symphysis fractures with condylar fracture (1a) and parasymphysis fractures with condylar fracture (1b). Group2. Anterior mandibular fractures without condylar fracture, divided into two subgroups: symphysis fractures without condylar fracture (2a) and parasymphysis fractures without condylar fracture (2b).

Table1. Classification of patients based on fracture site

|  |  |  |
| --- | --- | --- |
| Mandibular condyle fracture? | Anterior fracture | type |
| Yes | Symphysis fx (1a) | Parasymphysis fx (1b) |
| No | Symphysis fx (2a) | Parasymphysis fx (2b) |

**Measurement of Mandibular Chin Angle and Statistical Analysis**

The mandibular chin angle was measured in CT scout views using two reference lines. The first line is drawn from apex of the mandibular central incisor in parallel with its longitudinal axis. The second line extended from the B point (the deepest area on the anterior mandible) to pogonion (the most anterior area on the chin prominence). The angle formed by these two lines will be the mandibular chin angle (Fig 1). This angle was measured using the Image-J software, a powerful image analysis and comparison software. All measurements were performed by one investigator blinded to the condylar fracture status of the patients. Descriptive statistics were reported as mean ± standard deviation (SD) for continuous variables and as frequency and percentage for categorical variables. The chi-squared test was used to compare the frequency distribution of people based on gender and type of posterior fracture between two types of anterior fracture (symphysis and parasymphysis). An independent T-test was used to compare the mean angle between two fracture groups (patients with and without condylar fractures). Logistic regression analysis was conducted to assess the impact of demographic factors on the incidence of condylar fractures in patients with symphysis and parasymphysis fractures. Statistical analyses have been performed using SPSS version 26.

Figure1: Measurement of the mandibular chin angle in scout view of CT images



Results

A total of 142 patients with mandibular fractures were evaluated. The mean age of the study population was 27.55 years (range: 8 to 80 years). Of these, 46 patients were female (32.4%) and 96 patients were male (67.6%). Regarding the location of the fracture, 111 patients had parasymphysis fractures (78.2 %) and 31 patients had symphysis fractures (21.8 %). Concerning condylar involvement, 71 patients (50%) had a sustained condylar fracture and 71 patients (50%) had no condylar fracture (Table 2).

Table2. Distribution of patients based on demographic characteristics and fracture site

|  |  |  |  |
| --- | --- | --- | --- |
| Demographic or fracture variable | Anterior fracture type (%) | Total (%) | P-value |
| Parasymphysis | Symphysis |  |  |
| Gender | Female | 37(33.33) | 9(29.03) | 46(32.39) | 0.65 |
| Male | 74(66.67) | 22(70.97) | 96(67.61) |
| Posterior fracture type | Without condylar fracture | 53(47.75) | 18(58.06) | 71(50) | 0.31 |
| With condylar fracture | 58(52.25) | 13(41.94) | 71(50) |
| Age | Average age | 27.36 ± 8.73 | 28.23 ± 9.10 | 27.55 ± 8.79 | 0.63 |

The incidence of condylar fractures in patients with parasymphysis fractures was 52.25% and in patients with symphysis fractures was 41.94%. The chi-square relationship between the incidence of condylar fractures and the type of anterior fracture was not statistically significant (P = 0.311).

The mean ± standard deviation of age in patients with condylar fracture was 27.87 ± 9.20 and among patients without condylar fracture was 27.22 ± 8.41. This difference was not statically significant (P = 0.350). The incidence of condylar fractures in men with parasymphysis fracture was 2.43 times higher than in women, statistically significant (P = 0.0321). Conversely, the incidence of condylar fractures was not significantly changed (P = 0.951) when the age of patients with anterior parasymphysis fractures increased by one unit. The incidence of condylar fracture in men with symphysis fractures was 1.31 times higher than in women. This was not statistically significant (P = 0.751). Also, with a one-unit increase in the age of patients with symphysis fractures, the incidence of condylar fractures was 1.04-fold higher. This was not statistically significant (P = 0.361). The mean ± standard deviation of chin angle in patients with symphysis fracture who had condylar fracture was 133.59 ± 10.79 and in patients without condylar fracture was 126.63 ± 9.95 (Figure 2,3). This difference was not statistically significant based on independent t-test (P =0.074). The mean ± standard deviation of the chin angle in patients with parasymphysis fracture who had condylar fracture was 128.05 ± 7.89 and in patients without condylar fracture was 127.17 ± 7.49. This difference was not statistically significant (P = 0.550). In general, the mean ± standard deviation of chin angle in patients with condylar fracture and without condylar fracture was 129.07 $\pm $8.68 and 127.03$ \pm $8.11, respectively (Figure 4). This difference was not statistically significant (P = 0.151).

Figure2. Comparison of the mean chin angle in patients in patient who had symphysis fracture

Figure3. Comparison of the mean chin angle in patient who had parasymphysis fracture

Figure4. Comparison of the mean chin angle in patients with condylar fracture and without condylar fracture

Table3. Summary of findings

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variables | Patient with condylar fracture | Patient without condylar fracture | P-value | Odds ratio(OR) | Confidence interval (95$\% $CI) |
| Gender | Male | 53 | 43 | 0.106 | M/F=1.92 | 0.94-3.92 |
| Female | 18 | 28 |
| Age(Mean$\pm SD$) | 27.87$\pm 9.20$ | 27.22$\pm 8.41$ | 0.35 | $≈$1.08 | $≈$0.25-4.58 |
| Anterior fracture site | Symphysis | 13 | 18 | 0.31 | 0.66 | 0.30-1.48 |
| Parasymphysis | 58 | 53 |
| Mandibular chin angle(Mean$\pm SD$) | 129.07$\pm $8.68 | 127.03$\pm $8.11 | 0.151 | $≈$1.001 | $≈$1.041-0.963 |

Discussion

The traumatic force usually spreads throughout the length of the mandible(17). The force applied affects the weakest area in the mandibular arch and causing bending and deformation(18). Bending in one region generates tensile forces elsewhere in the mandible, potentially leading to condylar fractures. Zachariades' et al. has been reported 72% of condylar fractures are associated with fractures in other mandible areas, such as the parasymphysis(19). Similarly, Han et al. demonstrated that morphological characteristics of the anterior mandible, particularly the chin, are related to condylar fractures following parasymphysis fractures(7). In this cross-sectional study, we assessed the effect of the mandibular chin angle on the incidence of condylar fractures in patients with symphysis and parasymphysis fractures. In addition, we analyzed the relationship between the incidence of condylar fractures and the type of anterior fracture, age, and gender.

Nayak et al. measured the mandibular chin angle in the mid sagittal plan of two-dimensional CT scan (a view that shows the aqueduct of the sylvius) to assess the effect of the morphology of the anterior mandible and the chin on the incidence of condylar fractures(9). Since sagittal CT scans are not routinely obtained in our institution, we measured the chin angle in the CT scout view, which provides a comparable sagittal perspective.

Our results indicated no significant difference in the incidence of condylar fractures between symphysis and parasymphysis fractures. This is reasonable, as force transmission from the anterior mandible to the condyle is likely similar in both regions. Most prior studies, including Cha et al., have grouped symphysis and parasymphysis fractures together and reported a significant association between anterior mandibular fractures and condylar fractures(20); however, no direct comparison has been made between symphysis and parasymphysis fractures.

The mean age of patients with condylar fractures in our study was 27.87 years, and there was no significant association between age and condylar fracture. This finding aligns with Thapa et al., who reported that the ratio of unilateral to bilateral condylar fractures remains consistent across age groups(21).

Several studies have highlighted the influence of mandibular morphology on condylar fractures. Han et al. reported that chin morphology contributes to condylar fractures in patients with concurrent parasymphysis fractures(7). Shilo et al. found that patients with a short anterior facial height had a higher incidence of condylar fractures(8). Moreover, Thapa et al. and our study found that men are more likely than women to sustain condylar fractures following parasymphysis trauma(21). In our study, chin morphology was also shown to be correlated with condylar fracture incidence in men, with the incidence of condylar fracture being statistically higher in men than in women after parasymphysis fracture. This may be because men have a larger and stronger chin, transferring trauma forces to structurally weaker areas, such as the condyles.

Panneersrlvam et al. showed that patients with increased gonial angle had decreased bone volume in the area of the angle and decreased cortical bone thickness(22). In our study, increasing the mandibular chin angle did not increase the incidence of condylar fractures statistically. This can be explained by the decreased cortical bone width of the anterior mandible with increasing angle of the chin, making the anterior mandible a structurally weaker area that absorbs force locally rather than transferring it to the condyle.

In our study, the incidence of condylar fractures was not increased with increasing mandibular chin angle in patients with symphysis fracture or patients with parasymphysis fracture. This finding is not consistent with the study of Nayak et al. study, who showed that the average mandibular chin angle in patients with condylar fracture was 15 degrees higher than in patients without condylar fracture(9). This difference may be due to differences in the study population (Indian vs. Iranian) and the CT view used for measurement (midsagittal vs. scout view). In addition, biomechanical factors such as direction, magnitude, and cause of trauma may act as confounding variables.

The limitations of our study include its retrospective design, which may introduce bias in data collection. Furthermore, the lack of statistically significant correlations in certain findings underscores the need for larger, multicenter, prospective studies with careful control of confounding factors, such as force direction and intensity, to validate these results.

Conclusion

The findings of this study indicate that likelihood of condylar fracture following parasymphysis fracture is higher in men than women. Therefore the evaluation of patients with parasymphysis fracture should be performed with consideration of the gender of the patients. Also, the mean chin angle was grater in patients with condylar fracture compared to patients without condylar fracture; however, the difference was not statistically significant.

Ethical Considerations

This research was approved by the Ethics Committee of Tabriz University of Medical Sciences. (Approval ID: IR.TBZMED.REC.1402.624)

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Authors’ Contributions

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Conflict of interest

The authors declare no conflict of interest.

Availability of data and material

The data supporting the findings of this study are included in the article. Additional raw data are available from the corresponding author, upon reasonable request.

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