

 Original Article

The Relationship Between Anteroposterior Shoulder Radiography in Upright and Supine Positions and the Length of the Clavicle in Clavicular Fractures

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Background: A clavicular fracture is a common bone fracture in the body and upper limb. This study investigated the effect of the anteroposterior (AP) shoulder radiographic position on clavicular length in clavicle fracture in both upright and supine positions.

Methods: A prospective cross-sectional study was conducted on patients diagnosed with a closed acute displaced midshaft clavicle fracture between June 2018 and June 2019. AP shoulder radiographs of all patients with clavicle fractures in the mid-shaft area were obtained from two supine and standing positions. Then, the obtained radiographies on the broken and healthy sides were compared, and the initial shortness of the fracture was measured and recorded in each of the two positions. Finally, an experienced person estimated absolute displacement.

Results: A total of 29 patients, including 21 (36.2%) males and 8 (13.8%) females, with a mean age of 37.7 ± 10.8 years, were evaluated in this study. Based on the independent t-test results, there was a significant difference between the mean clavicle length in the upright (15.31 ± 0.71) and supine (16.01 ± 0.4) positions ($P < 0.05$). No significant difference was observed between the mean length of the clavicle on the non-fractured side in the two standing (17.82 ± 0.45) and supine (17.77 ± 0.41) positions ($P < 0.05$). However, there was a significant difference between the mean shortening of the clavicle in standing (2.64 ± 0.48) and supine (1.95 ± 0.39) positions ($P < 0.05$).

Conclusion: Overall, a significant difference was found between the mean clavicular length in clavicle fractures on AP shoulder X-ray in the upright and supine positions. The mean clavicle length in clavicle fractures was higher on the AP shoulder radiography in the supine position than in the upright position.

Keywords: Supine position, Upright position, Radiography, Clavicle, Fractures

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Background

Clavicle fractures, which account for 2.6%–10% of all fractures, are common injuries that typically occur on the upper limb and are treated by orthopedic surgeons (1). These fractures are most often the result of an indirect blow to the shoulder or a fall on the outstretched arm (2). Non-operative therapy of the displaced midshaft clavicle fracture was the primary treatment method for identifying whether open reduction and internal fixation were required for the second half of the twentieth century (3, 4). According to a systematic review study, the frequency of non-union after non-operative treatment is 5.9% and 15.1% for all clavicle and displaced midshaft clavicle fractures, respectively (5). The high incidence of clavicular fractures in different age groups, especially in young people and athletes, occurs because of the importance of this anatomical area in performing daily activities (6).

Cautiously, if the entire clavicle length is 15–20 mm

shorter than the normal contralateral clavicle treated, displaced midshaft clavicle fractures may result in a weak functional prediction (7). According to the latest research, relative indications for fixing contain fractures with a shortening of more than 2 cm (8). Therefore, reduced shoulder strength, chronic discomfort, and changed scapular kinematics have all been documented as the side effects of the shortening (9). If shortening more than 2 cm of the displaced midshaft clavicle fracture is used as a surgical indication, a valid and reliable technique is considered for identifying patients who would properly profit from the surgery.

To this purpose, operational decisions are heavily influenced by radiographic appearance, although no standard radiographic method has so far been established in this regard. This technique is appropriate when determining the degree to which gravity influences fracture alignment during radiographic examination. Radiographs obtained from the patient's upright

position may show higher fracture displacement and allow for better measurement of trauma energy and soft tissue injury than X-rays taken from the patient's supine position (1). Based on the literature review and to the best of our knowledge, no study has so far evaluated the impact of patient location on clavicle length and fracture fragment displacement. Accordingly, this study aims to investigate the relationship between anteroposterior (AP) shoulder radiography in upright and supine positions with the clavicle length in clavicular fracture.

Methods

Upon receiving approval from the Ethics Committee of Urmia University of Medical Sciences (IR.UMSU.REC.:1395.476), 29 patients, including 21 (36.2%) males and 8 (13.8%) females, diagnosed with closed acute displaced midshaft clavicle fracture, were enrolled in this prospective cross-sectional study between June 2018 and June 2019. Patients who met the inclusion criteria were over 18, had no pathological fractures, and were expected to be treated conservatively after patient counseling. On the other hand, the rupture that affected the measurement of fractured clavicle length was considered the exclusion criterion. Furthermore, patients who suffered from ipsilateral scapular fractures, were unable to be positioned upright at the time of initial radiographs, had their injured arm supported on upright images, and had insufficient radiographic exams from the time of injury were excluded from the study. Written informed consent was obtained from all patients before the radiographic evaluation.

In this study, midshaft clavicular fractures have been defined as fractures in the middle region of the clavicle (AO/OTA 13 B). AP shoulder radiographs of all patients with clavicle fractures in the mid-shaft area were obtained from two supine or standing positions. The obtained radiographies on the broken and healthy sides underwent a comparison. The initial shortness of the fracture was estimated and recorded in each of the two positions. Next, an experienced person measured absolute displacement. The obtained data were analyzed by SPSS 17 software using descriptive (means, frequencies, and percentages) and inferential (paired t-test and chi-square) statistics. Quantitative and qualitative variables were presented as means and standard deviations, as well as numbers and percentages in the related tables and graphs, respectively. A *P* value of less than 0.05 was considered statistically significant.

Results

In this study, patients diagnosed with isolated mid-shaft clavicular fractures satisfied the inclusion criteria and were assessed from January 2019 to September 2021. The examination of the gender frequency distribution of patients with mid-shaft clavicle fractures demonstrated

that 21 (2.36%) were male and eight (8.13%) were female, with a mean age of 7.37 ± 8.10 years, and the age range of patients was between 19 years and 60 years (Table 1). The independent t-test showed a significant difference between the mean clavicle length in upright (15.31 ± 0.71) and supine (16.01 ± 0.4) positions ($P < 0.05$). No significant difference was found between the mean length of the clavicle in the non-fractured side in upright (17.82 ± 0.45) and lying in the back (17.77 ± 0.41) positions ($P > 0.05$, Figure 1). Conversely, there was a significant difference between the mean shortening of the clavicle in the upright (2.64 ± 0.48) and supine (1.95 ± 0.39) positions ($P < 0.05$, Table 2, Figure 2).

Discussion

The non-operative treatment of clavicle fractures was mostly based on 1960s articles, claiming that non-union in non-surgical treatments was less than 1%. In contrast, non-union in surgical methods was three times higher (10, 11). Previous studies, including those performed on adult patients, revealed that the rate of non-union in non-surgical treatment was substantially higher than before (3, 12). The physicians are unsure whether the shortening of the midshaft clavicle fracture is related to clinical consequences. The present study investigated the relationship between AP shoulder radiography in upright and supine positions and clavicle length in clavicular fractures. Our findings revealed a significant difference between clavicle length in the fractures in the upright and supine positions. In addition, a statistically significant difference was observed in the average measurements of relative shortening of supine and upright positions when keeping all other variables constant. Probably due to the limb's weight, the shortness of the clavicle in the upright

Table 1. Demographic Information

Variable	
Age, mean (range)	7.37 ± 8.10
Gender	
Male	21 (2.36%)
Female	9 (8.13%)

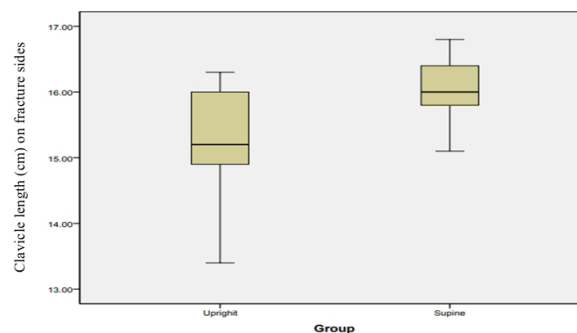
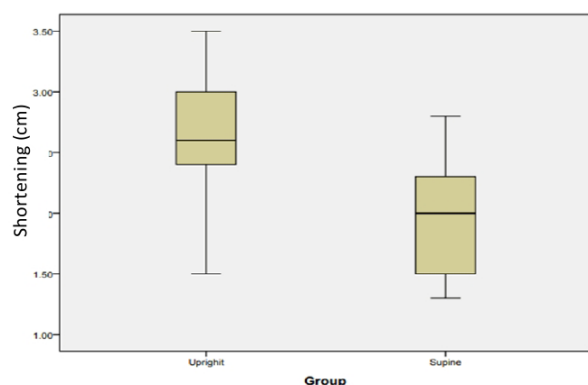


Figure 1. Clavicular length on the fracture side and compared with opposite side.

Table 2. Comparison of Clavicle Length on the Fractured and Lack of Fractured Side

	Position	Mean (SD)	P Value
Clavicle length on healthy side	Upright	17.82 (0.45)	0.695
	Supine	17.77 (0.41)	
Clavicle length on fracture side	Upright	15.31 (0.71)	0.001
	Supine	16.01 (0.40)	
Shortness	Upright	2.64 (0.48)	0.001
	Supine	1.95 (0.390)	

Note. SD, Standard deviation.

**Figure 2.** Comparison of shortening in standing and lying on your back

position is more than that in the supine position, and this difference can affect the treatment decision. However, in non-fractured clavicles, no significant difference in size was detected between upright and supine positions. Although this difference is statistically significant, estimating the clinical importance of such a minor alteration along the clavicle is difficult.

Similarly, Backus et al (1) reported that fracture movement was measured significantly more in upright radiography than in supine radiography, indicating the exact determination of the shortening in upright radiography. Likewise, Plocher et al concluded that the patient's position can change fracture displacement during radiographic assessment (13), which conforms to our findings, highlighting that upright clavicle radiographs can better evaluate the maximum fracture displacement than supine radiographs. The mean shortening in standing radiographs was 2.64 ± 0.48 mm, showing an increase of 35% compared to the shortening measured in supine radiographs.

Some studies found a link between initial displacement and a higher rate of non-unionization (7, 14, 15). Therefore, the patient's position is important during radiography. Robinson et al (12) found that displaced fractures, compared to non-displaced fractures, increase the probability of non-union 18.5 times. However, accurate determination of the initial displacement of the fracture is essential to patient care. Contrary to our results, Murray et al (4) indicated that fracture displacement

was an independent risk factor in the prognosis of the non-union clavicle, and the patient's position was not important in determining the total displacement.

Other studies demonstrated that clavicle fractures with acceptable displacement in the early stage undergo progressive deformity within two weeks, often including a conjunction of horizontal shortening and vertical movement (16-18). The amount of increasing displacement that is noticeable can impact whether or not surgery is necessary. According to the results of these studies, careful examination of the displaced clavicular midshaft fracture is essential in deciding about surgical treatment. There is no consensus on the standard radiographic projections for clavicle fractures. In various radiographic techniques, the patient may be in a standing or supine position in the AP or PA radiograph. However, our study addressed the effect of the patient's upright and supine positions on the displacement of the midshaft clavicle fracture. It seems that for all clinical and research purposes, both healthy and fractured sides must be considered in patients with clavicular shaft fractures.

The current study had several limitations. It was difficult to determine the length of the clavicle with conventional radiography. The film's sensitivity and the patient's position can influence the ability to measure precisely. More precisely, these elements can be difficult to manage in emergencies with patients who have different body habits. In older patients, soft tissue shadows conceal the exact location of the inner end of the clavicle, and optimizing chest rotation in a patient with a painful shoulder girdle is challenging. Moreover, some patients with multiple traumas may not sit or stand during radiography. It is concluded that these factors may have contributed to clavicular length measurement discrepancies.

Conclusion

In summary, the findings demonstrated that the amount of shortening measured in mid-shaft clavicle fractures in the standing and supine positions during X-rays is different. Therefore, shortening in the standing position is more than that in the supine position, which can be effective in choosing the appropriate treatment method.

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Authors' Contribution

N N: Conceptualization, the original draft writing, investigation, writing including reviewing and editing and investigation and formal analysis; A T: Conceptualization, supervision, and project administration; F Q: Investigation, Formal Analysis, Software. Final approval: Nasrin Navaeifar, Ali Tabrizi, Farzaneh Qarakhan

Competing Interests

The authors declare that they have no conflict of interests.

Ethical Approval

This study conformed to the ethical guidelines of the 1975 Declaration of Helsinki and was approved by the Ethics Committee of Urmia University of Medical Sciences (IR.UMSU.REC.:1395.476).

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