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# Humerus Fractures Resulting from Wrist Wrestling: An Observational Diagnostic Study

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## Abstract

**Objective:** Wrist wrestling is a sport in which two individuals position themselves on a table or a bar facing each other, with their elbows resting on the table, aiming to touch their opponent's hand to the table surface. Among adults participating in this sport, humerus shaft fractures are the most commonly observed injuries. In this study, our goal was to perform a systemic video analysis of humerus fractures occurring during wrist wrestling and to examine the mechanisms of these injuries. We assumed that identifying the positions commonly associated with injuries could be useful for injury prevention.

**Methods:** On May 1, 2023, a search was conducted on YouTube using the terms "arm wrestling fracture," "arm wrestling humerus," and "arm wrestling humerus fracture." Inclusion criteria were videos clearly showing humerus fractures and allowing clear evaluation of athletes. Videos suspected of having humerus fractures, repeated videos, videos with unclear athlete evaluation, and videos not related to wrist wrestling were excluded. Authors examined body tilt nad rotation, coronal shoulder position, sagittal shoulder position, shoulder rotation, sagittal elbow position, coronal elbow position, forearm rotation and sagittal wrist position.

**Results:** All 31 athletes included in the study were male. When examined for intra- and inter-observer agreement, it was observed to be nearly excellent ($k=0.959$, $p<0.001$; $k=0.946$, $p<0.001$). Out of the wrist wrestling matches, 19 (61.3%) were conducted with the athletes standing, while 12 (38.7%) were performed with them in a seated position.

**Conclusion:** Humerus fractures occurring during wrist wrestling do not appear to be significantly influenced by the athlete's shoulder, elbow, and wrist positions or whether the athlete is standing or sitting. Body position and changes in the center of mass during the competition might be contributing factors to humerus fractures.

**Keywords:** Humerus fracture, video analysis, wrist wrestling

## INTRODUCTION

Wrist wrestling is a sport in which 2 individuals position themselves on a table or a bar facing each other, with their elbows resting on the table, aiming to touch their opponent's hand to the table surface (1). Among adults participating in this sport, humerus shaft fractures are the most commonly observed injuries (2).

Fractures of the humerus during wrist wrestling can be influenced by the morphological characteristics of the bone, muscle contractions, and body positions during wrist wrestling (3-7). Forearm length discrepancy between wrist wrestlers, control of the center of mass, and stabilization of the arm at the shoulder (glenohumeral) joint are crucial for preventing injuries (5). Additionally, wrist wrestling rules define a dangerous scenario as follows: "A straightened arm in a critical position or beyond the restraining line of the attacker's shoulder in the attacking direction of the humerus can be classified as dangerous" (7). When a wrestler straightens the arm of the competing side and lowers their shoulder below the plane of the table, a risky

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position emerges. This position seems to protect the wrestler from defeat. Furthermore, this position places significant stress on the elbow and shoulder joints, potentially leading to severe injuries (7).

Understanding the injuries and mechanisms involved in wrist wrestling is crucial for implementing safe practices in this sport (8). Video analysis is a method used to thoroughly determine the injury mechanisms (9). In this way, the body and extremity positions of the athletes at the time of injury and the maneuvers associated with the injury can be revealed. As far as we know, a systematic video analysis of wrist wrestling injuries is not currently available in the literature. In this study, we aimed to perform a systemic video analysis of humerus fractures occurring during wrist wrestling and to examine the mechanisms of these injuries. We assumed that identifying the positions commonly associated with injuries would be useful for injury prevention.

## METHODS

On May 1, 2023, a search was conducted on YouTube using the terms "arm wrestling fracture," "arm wrestling humerus," and "arm wrestling humerus fracture." Videos were watched by an author to identify those featuring humerus fractures. No Ethical Committee approval or informed consent was required for this study, as the athletes' information is in the public domain and freely available on the web without any restriction. However, the privacy of the athletes was maintained as no direct reference to their identity was made in the text. The inclusion criteria were videos clearly showing humerus fractures and allowing clear evaluation of athletes. Videos suspected of having humerus fractures, repeated videos, videos with unclear athlete evaluation, and videos not related to wrist wrestling were excluded. Four videos with unclear images, ten repeated videos, eight videos showing non-humerus fracture injuries, and 19 videos removed by YouTube during evaluation by observers were excluded. The remaining 31 injury videos were included in this study.

The included videos were watched at 0.25x speed. The authors examined body tilt (ipsilateral, contralateral), body rotation (ipsilateral, contralateral), coronal shoulder position (neutral, abduction, adduction), sagittal shoulder position (neutral, flexion, extension), shoulder rotation (neutral, internal, external), sagittal elbow position (flexion, extension), coronal elbow position (neutral, varus, valgus), elbow rotation (supination, pronation), and sagittal wrist position (neutral, extension, flexion). The authors determined the moment of injury by watching the video together. Taking into account the timing of the injury, the exact moment of humerus fracture during the injury event, the athlete's facial expression, the time when deformity began in the arm, and the initial reaction to the injury, the authors identified the time of injury (10). Subsequently, body positions at the moment of injury were blindly evaluated by 2 observers. These data were statistically analyzed, and inter-observer and intra-observer agreement were assessed.

Whether the athlete was sitting or standing at the time of injury, the level of the shoulder relative to the table, the positions of the shoulder, body, elbow, and wrist, and whether the athlete was professional or amateur were evaluated. The obtained data were analyzed statistically.

### Statistical Analysis

Intra- and inter-observer agreement was investigated using the Fleiss kappa (k) statistics for categorical data. The inter-observer agreement percentages were calculated by dividing the number of occasions of the complete agreement by the total number of occasions. It was interpreted as follows: <0.00= poor agreement; 0.00-0.20= slight agreement; 0.21-0.40= fair agreement; 0.41-0.60= moderate agreement; 0.61-0.80= substantial agreement; and 0.81-1.00= almost perfect agreement. Statistical significance was set at $p<0.05$. SPSS® version 25.0 was used forin the statistical analyses.

## RESULTS

All 31 athletes included in the study were male. Of these, 18 (58.1%) were amateurs, while 13 (41.9%) were professionals. When examined for intra-and inter-observer agreement, it was observed to be nearly excellent (k=0.959, $p<0.001$; k=0.946, $p<0.001$) (Table 1). At the moment of injury, in 10 individuals (32.3%), the opposing player brought their shoulder below the table level, whereas in 2 individuals (6.5%), the injured athlete managed to bring their shoulder below the table level. Out of the wrist wrestling matches, 19 (61.3%) were conducted with the athletes standing, while 12 (38.7%) were performed with them in a seated position. The body, shoulder, elbow, and wrist positions of the injured athlete at the moment of injury are summarized in Table 2.

## DISCUSSION

The most important finding of this study was that humerus fractures in arm wrestling frequently occurred when the body was leaning forward, with the shoulder in flexion and external rotation, the elbow in flexion and in a valgus position, and the wrist in flexion with the forearm in supination (Figure 1). However, even though the most common positions were as

described, it is noteworthy to mention that no dominant position was identified in this research.

The seemingly harmless competition of wrist wrestling can result in humerus fractures as a consequence of high rotational force applied to the upper extremity (1). While some studies during wrist wrestling argue that the players' position (seated or standing) could increase the risk of fractures, the literature suggests that players' position, stage of the match, side, and dominant extremity do not make a difference (1,5,11-13). The results of this study also supported this notion. There was no significant positional dominance observed during fractures in the shoulder, elbow, and wrist positions. As previously mentioned in other studies, sudden muscle contractions during wrist wrestling could be a key factor in humerus fractures (5,14). On the other hand, the proportion of athletes standing was high in this study. However, due to the nature of injury videos included in the study being collected through a video platform, it is not possible to claim that standing injuries were more frequent.

Differences in forearm length among wrist wrestlers, control of the center of mass, and stabilization of the arm at the

**Table 1. Fleiss-kappa values and percentages of intraobserver and interobserver agreement**

| | k | % |
|---|---|---|
| **Intraobserver agreement** | 0.959 | 91.6 |
| **Interobserver agreement** | 0.946 | 86.5 |

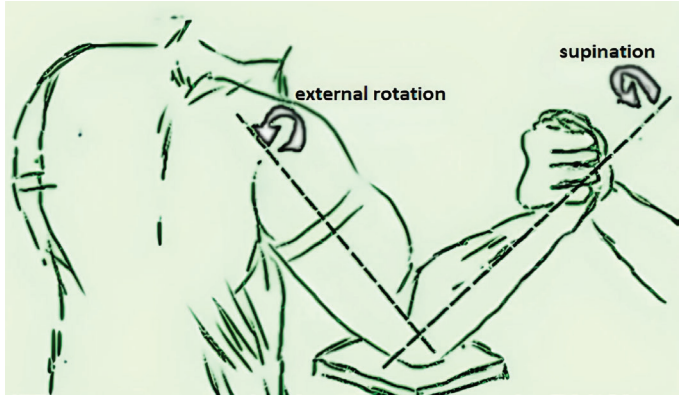


**Figure 1.** Humerus fractures in arm wrestling frequently occurred when the body was flexion, with the shoulder in flexion and external rotation, the elbow in flexion and in a valgus position, and the wrist in flexion with the forearm in supination position

**Table 2. Distribution of body, shoulder, elbow and wrist positions of athletes at the time of injury**

| Anatomical part | Position | Position of movement relative to planes | Number of cases (n) | Distribution of cases (%) |
|---|---|---|---|---|
| **Trunk** | **Trunk position** | ***Flexion*** | 31 | 100 |
| | **Trunk tilt** | ***Neutral*** | 1 | 3.2 |
| | | ***Ipsilateral*** | 15 | 48.2 |
| | | ***Contralateral*** | 15 | 48.2 |
| **Shoulder** | **Shoulder position (sagittal)** | ***Flexion*** | 31 | 100 |
| | **Shoulder position (coronal)** | ***Neutral*** | 14 | 45.2 |
| | | ***Abduction*** | 10 | 32.3 |
| | | ***Adduction*** | 7 | 22.6 |
| | **Shoulder rotation** | ***Neutral*** | 9 | 29 |
| | | ***Internal*** | 2 | 6.5 |
| | | ***External*** | 20 | 64.5 |
| **Elbow** | **Elbow position (sagittal)** | ***Flexion*** | 31 | 100 |
| | **Elbow position (coronal)** | ***Neutral*** | 11 | 35.5 |
| | | ***Valgus*** | 20 | 64.5 |
| **Wrist** | **Wrist position (sagittal)** | ***Neutral*** | 11 | 34.5 |
| | | ***Flexion*** | 17 | 54.8 |
| | | ***Extension*** | 3 | 9.7 |
| | **Wrist position (coronal)** | ***Ulnar deviation*** | 10 | 32.3 |
| | | ***Neutral*** | 21 | 67.7 |
| **Forearm** | **Rotation** | ***Supination*** | 16 | 9.7 |
| | | ***Pronation*** | 3 | 51.6 |
| | | ***Neutral*** | 12 | 38.7 |

shoulder are important factors for injuries (2,5,15,16). Marks et al. (5) emphasized the importance of maintaining participants' balance (center of mass) for preventing humerus fractures during wrist wrestling. In this study, athletes frequently altered their body positions to either defeat their opponents or resist them during the competition. As previously suggested by Marks et al. (5), control of the center of mass by referees throughout the match could be effective in preventing humerus injuries.

Winning in wrist wrestling involves flexing the elbow while anchoring the body to the table during the first half of the match. This position could be explained by the importance of elbow flexion and proximity between the elbow and the body in gaining an advantage in wrist wrestling (17). When the wrestler straightens the arm of the competing side and lowers their shoulder below the plane of the table, a risky position emerges. This position seems to protect the wrestler from defeat. Furthermore, this position places significant stress on the elbow and shoulder joints, potentially leading to severe injuries (7). In this study, approximately % of cases used the strategy of lowering their body below the table level to gain an advantage and win the match. This maneuver could potentially apply extra stress to the opponent's humerus, leading to fracture.

### Study Limitations

This study has some limitations. First, the study is retrospective and relies on video footage from social media platforms. This can introduce bias, as the videos are likely to be shared for entertainment or to gain followers. Additionally, the videos evaluated often come from a single camera angle chosen by the sharer, making it impossible to accurately measure joint angles. Another limitation is the lack of access to X-rays of the injuries. Evaluating the relationship between the position of the athlete during the match and the type and location of the fracture is not possible. However, some authors believe that the position of the arm during the competition can determine the location and type of fracture (18). Despite these limitations, this study is the first to provide a systematic video analysis of humerus fractures in wrist wrestling. We believe that this study provides valuable insights into this subject.

## CONCLUSION

Humerus fractures occurring during wrist wrestling do not appear to be significantly influenced by the athlete's shoulder, elbow, and wrist positions or whether the athlete is standing or sitting. The impact of confounding factors such as body position and centering mass should be further investigated in future studies.

### Ethics

**Ethics Committee Approval:** No Ethical Committee approval or informed consent was required for this study, as the athletes' information is in the public domain and freely available on the web without any restriction.

**Informed Consent:** No Ethical Committee approval or informed consent was required for this study, as the athletes' information is in the public domain and freely available on the web without any restriction.

**Peer-review:** Internally peer reviewed.

### Authorship Contributions

Surgical and Medical Practices: A.Y., M.Y., N.E., A.F.U., H.G., Concept: A.Y., M.Y., N.E., A.F.U., H.G., Design: A.Y., M.Y., N.E., A.F.U., H.G., Data Collection or Processing: A.Y., M.Y., N.E., A.F.U., Analysis or Interpretation: A.Y., M.Y., N.E., A.F.U., Literature Search: A.Y., M.Y., N.E., A.F.U., H.G., Writing: A.Y., M.Y., N.E., A.F.U., H.G.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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