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Distal Radius Radiographic Indices and Perilunate Fracture Dislocation

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Abstract

Background: Distal radius radiographic indices may play a role as risk factors in pathogenesis of Kienbock's disease, scaphoid fracture and nonunion. Perilunate fracture dislocations are devastating wrist injuries, and their relationship and distal radius indices have not been addressed in the literature.
Objectives: The aim of this study was to evaluate the possible role of distal radius radiographic indices including radial height, radial inclination, ulnar variance and volar tilt as risk factors in the perilunate fracture dislocation injury of the wrist.
Patients and Methods: We studied distal radius radiographic indices including radial height, radial inclination, ulnar variance and volar tilt in 43 patients with perilunate fracture dislocations and compared them with 44 wrists in the control group.
Results: The mean values of the radial height, radial inclination, ulnar variance and volar tilt were 12.74 (5 - 18), 24.20 (7 - 35), -0.73 (-5 - 4) and 12.28 (2 - 20) in the patient group. These values were 12.68 (9 - 22), 23.22 (17 - 30), -0.11 (-4 - 3) and 11.05 (-3 - 20), respectively in the control group. There was no statistically significant difference between the two groups.
Conclusions: This study did not show that distal radius anatomical indices including the radial height, radial inclination, ulnar variance and volar tilt influence perilunate fracture dislocation as risk factors.

Keywords: Anatomical indices, Distal Radius, Perilunate Fracture Dislocation

1. Background

Perilunate fracture dislocations (PLFDs) are potentially devastating wrist injuries that can impose severe disabilities and complications to the functional status of the upper extremity. Distal radius radiographic indices including radial height (RH), radial inclination (RI), ulnar variance (UV) and volar tilt (VT) were focused for decades regarding their role in different areas of hand surgery (1, 2). UV has been proposed as a powerful risk factor for Kienbock's disease (2). The role of UV has been investigated in carpal instability, scaphoid fracture and nonunion (3-5).

We could not find any study in the literature considering possible role for distal radius radiographic indices in perilunate fracture dislocations of the wrist.

2. Objectives

This study was designed to evaluate the role of distal radius radiographic indices including RH, RI, UV and VT as risk factors in the PLFD injury of the wrist.

3. Patients and Methods

The study was approved by the institutional review board of our center. We evaluated standard wrist radiographs of patients admitted in our hospital due to PLFD injury of the wrist between December 2008 and December 2012 to measure distal radius radiographic indices including RH, RI, UV in posteroanterior (PA) view and VT in lateral view.

Inclusion criteria were all cases with PLFD in skeletally mature adult patients who had acceptable standard posteroanterior and lateral plain radiographs. We used the most appropriate X-Rays that could meet the mentioned criteria for acceptable radiographs, pre- or post-reduction.

Exclusion criteria were all cases with a history of previous trauma, infection, surgery, congenital deformities, neuromuscular or rheumatologic diseases in the affected upper extremity or having distal radius or ulnar fracture during PLFD.

We also excluded radiographs that did not meet the standard criteria as recommended by Palmer (6, 7). In our institution, all anteroposterior and lateral wrist ra-

diographs were taken in standard manner described by Palmer and colleagues (6). We considered posteroanterior radiography of the wrist as standard X-ray when the groove of the extensor carpi ulnaris was located completely radial to the ulnar styloid process (8). The lateral X-ray was accepted as a true lateral radiography if the palmar aspect of pisiform located between the capitate and the volar surface of distal scaphoid (9).

For the control group, we used the wrist radiographs of uninjured side of patients admitted to our clinic due to distal radius fracture. In our institution, X-ray of the uninjured side was used as template for comparison with the fractured side during the reduction process. The intraobserver and interobserver reliability of the distal radius radiographic indices including RH, RI, UV and VT were evaluated and reported relatively well in a recent study (10). To determine the indices we used the measurement instructions recommended in the classic textbooks (11). Student's t-test was used to compare the groups and P value less than 0.05 was considered as statistically significant.

4. Results

We had 43 cases in the PLFD group and all of them were male. In the control group, we studied 44 radiographs of 44 males. The mean age of patients and control groups were 26.4 (17 - 56) and 25 (18 - 60), respectively. Table 1 summarizes data regarding radiographic indices of the distal radius of the both groups. As indicated in the table, there was no statistically significant difference between the two groups regarding radiographic indices of the distal radius including RH, RI, VT and UV.

Table 1. Distal Radius Radiographic Indices of the Both Control and Patients Groups With Perilunate Fracture Dislocation

Variable	Control Group[a]	PLFD Group[a]	P value
Radial height, mm	12.74 (5 - 18)	12.68 (9 - 22)	0.840
Radial inclination, deg	24.20 (7 - 35)	23.22 (17 - 30)	0.326
Volar tilt, deg	12.28 (2 - 20)	11.05 (-3 - 20)	0.215
Ulnar variance, mm	-0.73 (-5 - 4)	-0.11 (-4 - 3)	0.183

Abrreviation: PLFD, perilunate fracture dislocation.
[a]Data are expressed as mean (min - max).

5. Discussion

It is for decades that distal radius anatomical indices were under investigation for their role in the pathophysiology of different diseases and injuries in the wrist. Although there is no published research to indicate that PLFD does not alter the UV individually in the absence of distal radius fracture, numerous studies implicated possible role of UV in the pathogenesis of Kienbock's disease, or instability in the wrist and carpal ligamentous disruption (3, 12-14).

Biomechanical studies indicate that anatomic relationship between the distal radius, ulna and the carpal bones are delicate. Even small changes in this precise relationship can result in great load bearing and force vectors modification (15).

Newer anatomical studies resulted in new concepts and knowledge of the biomechanics of the wrist and consequently can add to our better understanding of the pathophysiology of different injuries and disease in this area. Recently, the role of anatomical indices of distal radius have been addressed as possible risk factors in carpal bones fracture and wrist instabilities (4, 5, 12).

Voorhees et al. observed an association between the incidence of negative ulnar variance and carpal ligamentous instabilities (12). They could not delineate the reasons for this association, but they showed that presence of a negative ulnar variance may serve as a risk factor for ligamentous instability (12).

Ramos-Escalona et al. reviewed radiographs of 66 scaphoid fractures to evaluate UV and found significant difference in distribution of UV compared to published studies (4).

Jafari et al. retrospectively reviewed posteroanterior wrist radiographs of 65 cases with established scaphoid nonunion and compared them with 65 normal wrist radiographs; they found statistically significant difference in UV between the two groups and concluded that UV may influence developing nonunion process in scaphoid bone fracture (5).

PLFDs are among the most devastating closed injuries of the wrist. They are often missed on initial evaluation resulting in severe consequences of disabilities in the upper extremity (16).

PLFDs occur following high energy trauma in young adults due to loading of a hyperextended, ulnar ward deviated hand. Depending on the loading pathways, this can result in traumatic rupture of the radioscaphocapitate, scapholunate and the lunotriquetral ligaments with different combinations of the radial styloid and carpal bone fracture (17).

Literature review encounters paucity of studies regarding the association between PLFD and distal radius indices. The current study was conducted to elucidate the possible role of distal radius indices in the pathophysiology of these devastating injuries. By comparing the anatomical indices of distal radius in patients with PLFD and normal wrists of the control group, we could not find any association between these indices and PLFD.

There were several limitations in our study. First of all we used relatively small number of patients and secondly we did not study other wrist and distal radius anatomical indices including carpal height, radial carpal distance, ulnar carpal distance, scapholunate angle, distal radio ulnar joint angle, carpal height ratio, lunate uncover age length and lunate uncover age ratio.

Another shortcoming is a concern about the control group. We used the uninjured wrist of patients referred to the institution after distal radius fracture and we did not use healthy people as a control group to compare with the PLFD group.

We recommend continuing anatomical studies of the wrist, especially the indices not included in the current study to reveal the possible association between these indices and pathologic conditions and wrist injuries. Finally, this study did not show that distal radius anatomical indices including RH, RI, VT and UV influence perilunate fracture dislocation as risk factors.

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Footnote

Authors' Contribution: Study concept and design: Farid Najd Mazhar, Abolfazl Bagherifard; acquisition of data: Hassan Keihan Shokouh, Ebrahim Motavallian; drafting of the manuscript: Davod Jafari, Abolfazl Bagherifard; critical revision of the manuscript for important intellectual content: Farid Najd Mazhar, Abolfazl Bagherifard, Davod Jafari; statistical analysis: Hassan Keihan Shokouh, Ebrahim Motavallian; administrative, technical and material support: Farid Najd Mazhar, Abolfazl Bagherifard, Davod Jafari; study supervision: Farid Najd Mazhar, Abolfazl Bagherifard.

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