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EVALUATION OF PHYSICAL FINDINGS IN ACUTE WRIST TRAUMA IN THE EMERGENCY DEPARTMENT

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ABSTRACT

Objective: *The aim of the study was to evaluate the value of physical findings to predict fracture in patients with acute wrist trauma.*

Methods: *This prospective clinical study was conducted over a period of four months from December 1998. The patients who were older than 18 years and presenting with acute wrist trauma within 24 hours of the time of injury were included in the study. Magnetic resonance imaging (MRI) was done for the patients who had inconsistency between clinical and radiographic diagnosis.*

Results: *Fifty-five patients were included in the study. Four fractures were diagnosed on the MRI of eight patients who have contradiction between clinical diagnosis and X-ray studies. The positive predictive values of edema, localized tenderness, pain on active and passive motion, pain with grip and pain in supination were found as 95.2%, 67.3%, 77.3%, 91,7%, 89.3%, and 96%, respectively. Physical findings having high sensitivity were found as localized tenderness (94.3%), pain on the active and passive motion (97.1%, 94.3%, respectively). Pain on the active and passive motion were determined as physical findings with highest negative predictive values (%90.9, %89.5, respectively).*

Conclusion: *Edema, pain on grip and supination, and especially pain on pasive and active motion and localized tenderness can be valuable to predict or rule out fracture in acute wrist trauma cases who have no deformity.*

Key words: *Wrist trauma, emergency medicine, physical examination*

INTRODUCTION

Acute wrist trauma comprises a substantial number of trauma visits to the emergency department (ED). Since there is no pre-determined decision rule, most clinicians prefer to use radiography routinely in acute wrist trauma cases. This conservative approach is understandable considering the busy environment of the ED, restricted time for physician – patient relationship, follow – up access problems, the expectation by most of the patients that X-rays would be done, and possible medicolegal problems of a missed fracture.[1] The downside of this routine performance of radiographs is that it may contribute to overcrowding in the ED, extend patient's waiting time, increase cost of care for each patient, and cause unnecessary radiation exposure.[2] Our objective in this study was to evaluate the physical findings in patients who present with acute wrist trauma to the ED, and determine the value of these findings to predict wrist fracture.

METHODS

This prospective clinical study was conducted in a university hospital - ED which has 56.000 (adult and pediatric) visits annually, an Emergency Medicine (EM) residency program, and 24 hour per day attending emergency physician (EP) coverage. The study was planned over four months (December 1998 – March 1999) after acceptance by the hospital research ethics committee. Prior to the study, a two hour wrist trauma and X-ray interpretation lecture was given to the EM residents and EP's.

The inclusion criteria were age over 18 years, acute wrist trauma presenting within 24 hours of time of injury, and lack of altered mental status (traumatic, or caused by drugs or alcohol, etc.), open fracture, multiple trauma, and distracting injury. Cases were examined in a blinded fashion by three different EP's. Data for each case were recorded as follows: age, gender, painful area, mechanism of trauma, presence of ecchymosis, deformity, edema, localized tenderness, pain on active and passive motion (flexion, extension), pain on grip, pain on supination, and any sensation deficit (pure sensation test for radial, ulnar and median nerves). Agreement of two of the three physicians for each clinical exam finding was

accepted as the final recorded one. Physicians noted their clinical impression as, suspected presence or absence of fracture, and thereafter conventional radiographs of the wrist region (anteroposterior, lateral, and 45° posteroanterior oblique view) were performed on all patients. Additional radiographs were also done, such as special scaphoid view for the patients who needed further radiographic evaluation. The wrist X-rays were then evaluated by a senior radiology resident, EM resident and EP who were on duty. Physicians recorded their final radiographic and clinical diagnosis on each case. All patients were transfered to orthopedics clinic for the follow-up. Each set of wrist radiographs were evaluated by a group of specialists (an EP, an Orthopedic Surgeon, a Radiology Attending) for final direct radiographic diagnosis on the same day or the next day. The reading by the radiology attending was considered the "gold standard", but in any inconsistency between the three specialists, the radiographs were re-evaluated by the radiology attending. Magnetic resonance imaging (MRI) was applied within ten days to obtain a final diagnosis for patients who had inconsistency between their clinical and final direct radiograpic diagnosis. MRI scans were evaluated by two radiology attendings. Statistical correlation of each physical finding with the final diagnosis was done by using the SPSS 8.0 for Windows.

RESULTS

923 adult trauma patients presented to the ED during the study period. The number of wrist trauma patients was 71 (7.7%). Fifty - five patients were enrolled in the study and sixteen were excluded for the following reasons: seven patients were examined by only two physicians, one patient was mentally retarded and could not accomodate to the exam, four patients were intoxicated with alcohol, three patients had distracting injury, and one pregnant patient did not want to enroll in the study.

Thirty - three (60%) patients were male, and twenty - two (40%) female. In a total of 35 cases, fracture was determined as the final diagnosis. Diagnosed wrist fracture was higher in female patients (17 of 22) than males (18 of 33). Mean age of the patients was 43.5 years (SD ± 19.4); mean age of female patients was higher (54.0, SD ± 18.9) than male patients (36.5, SD ± 16.5), $p>0.05$. Mean age of fracture positive female patients was 54.5 (SD ± 18.7), compared to 35.1 (SD ± 13.7) of male patients with fracture ($p>0.05$).

The mechanisms of acute wrist trauma were as follows; fall – extension, n: 37 (67.3%), fall – flexion, n: 13 (23.6%), punch, hit, crush, strike, and traffic accident: one case each. Falling was the major cause for acute wrist injury in a total of 90.9% of all cases. Fall – extension injury was the most common trauma mechanism and was associated with most of the fractures (24 of 35, 68.6%).

The physicians' clinical impression, before radiographs, for presence of fracture was 37 cases (67.3%). After the evaluation of radiographs the physicians' radiologic diagnosis was ÅçfractureÅç in 34 cases (61.8%). Thirty -one cases (56.4%) were interpreted as fracture positive in the review by three specialists, and these were accepted as the final direct radiography diagnoses. MRI was applied to eight patients who were suspected clinically for having fracture, but had normal radiographic findings by the specialist group evaluation of radiographs. Four fractures were found in the MRI evaluation. Final radiologic diagnosis of the 55 cases is shown in Table 1.

Table 1. Final Radiologic Diagnosis

Radiologic Diagnosis	Number of Patients	Percentage (%)
Isolated distal radial fracture	14	25.5
Isolated radial styloid fracture	3	5.5
Isolated ulnar styloid fracture	1	1.8
Distal radius + ulnar fracture	4	7.3
Distal radius + ulnar styloid fracture	9	16.4
Distal radius + carpal bone fracture	1	1.8
Scaphoid fracture	2	3.6
Other carpal bone fracture (Triquetrum)	1	1.8
Soft tissue injury	20	36.4
Total	55	100

In MRI results, 35 (63.6%) patients were defined as "positive wrist fracture" cases. Radial bone fracture was found in 31 of 35 (88.57%) fracture positive cases, and ulnar fracture in 14 (40%). Other

carpal bone fractures were found in 4 of 35 (11.42%) patients.

P value, sensitivity, specificity, positive predictive value (PPV), negative preditive value (NPV) of physical findings are shown in Table 2.

Table 2. Physical Findings and Statistical Values

Findings		Fracture negative	Fracture positive	P Value	Sensitivity %	Specificity %	PPV%	NPV%
Ecchymosis	-	18	33	0.46267	5.7	90.0	50.0	35.3
	+	2	2	(NS)				
Deformity	-	20	22	0.00102	57.1	100.0	100.0	47.6
	+	0	13					
Edema	-	19	15	0.00013	57.1	95.0	95.2	55.9
	+	1	20					
Sensation deficit	-	19	26	0.05537	25.7	95.0	90.0	42.2
	+	1	9					
Localized tenderness	-	4	2	0.11950	94.3	20.0	67.3	66.7
	+	16	33	(NS)				
Pain on active motion	-	10	1	0.00006	97.1	50.0	77.3	90.9
	+	10	34					
Pain on passive motion	-	17	2	0.00000	94.3	85.0	91.7	89.5
	+	3	33					
Pain on grip	-	17	10	0.00006	71.4	85.0	89.3	62.9
	+	3	25					
Pain on supination	-	19	11	0.00001	68.6	95.0	96.0	63.3
	+	1	24					

DISCUSSION

Epidemiology of acute wrist trauma was studied by Larsen and this study showed that the incidence of wrist trauma was higher in males.[3] Incidence in the female population was noted to increase with age. According to Angerman et al, wrist trauma was responsible in 14% of total injuries, and the mean age was lower in the male population.[4] Our study found similar results, but the incidence of wrist trauma was somewhat lower at 7.7% of all injuries. Our study was carried out in the winter months, and trauma cases are seen mostly in spring and summer months in our region. Therefore, the total number of trauma cases, and the percentage of wrist trauma cases were found to be less than in Angerman's report.

Winner, et al. have reported that advanced age accompanied with osteoporosis is an important factor related to forearm fractures.[5] We found a higher mean age in female patients who had fractures than in male patients, 54.47 ± 18.73 and 35.05 ± 13.63 respectively, and also found a higher incidence of fracture in female patients (77.3%). However, we did not use the presence of osteoporosis and other diseases related to fracture

for statistical analysis because of the unreliability of history given by patients and missing data in hospital records.

Falling is the major cause (73%)3 for acute wrist injuries as we observed the same result (90.9%). The most important mechanism was falling with hand extension position[6] which occured in 67.3% of cases in our study.

Any deformity in an extremity occuring after acute trauma should be considered as a fracture until proven otherwise, and conventional radiographs should be ordered subsequent to physical exam, because deformity is one of the most objective findings of fractures.[7] Unfortunately, its' sensitivity is low. Therefore, it is not enough to say "there is no fracture" when there is absence of deformity. To rule out fracture, physicians should utilize other findings with more sensitivity. Localized tenderness, pain on active motion, pain on passive motion, pain on grip, and pain on supination are the top five physical findings which are most associated with fracture. These findings also have high NPV. Localized tenderness is described as one of the important physical findings to help to diagnose fracture[7], but it has low specificity because tenderness can originate from underlying soft tissue injury too.[8] Another advantage of these findings are that physicians can easily use them in acute wrist trauma patients in ED settings and there is no need to memorize complex tests, mentioned in textbooks.

Tests which have high specificity and high PPV are also important to diagnose fracture in wrist injury. These include deformity, edema, sensation deficit, pain on passive motion, pain on grip, and pain on supination. Presence of localized edema after trauma is an important finding which can indicate serious injury.[7] Generally patients with serious injury tend to hold their extremities motionless. Restriction of passive motion was reported as a meaningful finding indicating carpal pathologies.[8] However, restriction of motion on passive, active, grip, and supination maneuvers due to pain was found important to help in detecting and/or ruling out other fractures of the wrist in our study. Skirven noted that further evaluation is needed for patients who have pain on grip test.[9] These results indicate that pain with extremity movement is a valuable sign to predict fracture. Sensation deficit can be seen because of edema, hematoma, and also fracture in acute injury.[7] In our study, its' specificity and PPV for fracture was quite high.

Complete supination is possible with normal wrist function. Supination and pronation without pain can rule out distal radio-ulnar joint and triangular fibrocartilage complex pathology.[8] In addition, Waizenegger and et al. reported that the supination test is better than the pronation test in the detection of scaphoid fracture.[10] We found that pain in supination was highly specific and has high PPV to detect fracture in the wrist.

The "gold standard" radiologic test for wrist injuries is considered to be MRI.[11] However, its' cost and long period of time to record images restrict its use in the ED. Therefore, we used MRI in selected cases who had contradiction between clinical suspicion of a fracture and final direct radiographic interpretation. Four of these eight patients had a fracture demonstrated by MRI. So, clinicians should consider further evaluation with MRI for patients who have wrist injury with clinical and radiographic contradiction.

One limitation of this study was that we did not evaluate the findings as stages or degrees, or in point method. We determined presence of pain on motion (supination, grip, etc...) which did not let the patient finish the test. However, any point system for every level of patient ability to do the test might give more effective and objective results for the study. Therefore, we have undertaken a follow-up study to investigate staged physical exam tests.

CONCLUSION

We investigated the value of physical examination findings as predictors of wrist fracture in acute wrist trauma patients. Falling is the most common mechanism of injury, and extension – fall is most commonly associated with fracture. Female gender and older age are associated with most of fractures. Deformity after acute trauma is the most specific finding of fracture. However, fracture can occur without deformity. So, other physical findings have to be evaluated. Localized tenderness, pain on active motion, pain on passive motion, pain on grip, pain on supination and edema are the top five physical findings which can have important role to predict or rule out the fracture in the wrist. MRI can be used to evaluate the patients who have contradiction between clinical suspicion of fracture and radiographic findings. We believe that more objective results in predicting or ruling out wrist fracture can be found with further evaluation by additional prospective studies.

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