



Brief Report

Determination of radiography requirement in wrist trauma



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ABSTRACT

Objectives: The purpose of this study was to evaluate predetermined physical examination and function tests recommended to identify severe injury among patients presenting with wrist injury to the emergency department and to establish a reliable clinical decision rule capable of determining the need for radiography in wrist injuries.

Materials and methods: This was a multicenter prospective derivation study of wrist injuries. All patients were assessed in terms of mechanism of trauma, inspection findings, heart rate, sensitivity at palpation, presence of pain with active movement, grasp strength, and functional tests using an examination form under main headings. Sensitivity, specificity, and positive and negative predictive values were expressed for each sign and each examination finding.

Results: One hundred nineteen adult patients were enrolled during the 6-month study period. Fracture was identified in 24.3% (n = 29). Presence of pain on the radial deviation, dorsal flexion, distal radioulnar drawer, and axial compression tests exhibited high sensitivity (82.8%, 89.7%, 82.8%, and 86.2%, respectively) and high negative predictive values (88.6%, 81.3%, 87.5%, and 93.6%, respectively) for wrist fracture. Sensitivity of 96.6% was observed when these 4 tests were evaluated together.

Conclusions: The presence of one of these examination findings increases the likelihood of fracture and is adequate to recommend wrist radiography. In addition, there is a strong possibility of radiography being unnecessary if all 4 test results are negative in patients presenting with wrist injury, potentially preventing many nonessential radiographs being performed.

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1. Introduction

1.1. Background

Wrist injuries are one of the most common traumatic presentations to the emergency department (ED) due to trauma [1]. Radiography is frequently required in diagnosing these patients; but unnecessary radiological investigation results in increased costs, exposure to radiation, and prolonged patient waiting times. Currently, there is no algorithm available to guide clinicians in the use of radiograph for patients presenting to the ED with wrist injury. The majority of radiographs requested in wrist injuries do not demonstrate any pathology. A significant number of radiographs are inadequate in that they are unable to identify some bone pathologies and most ligamentous lesions. In

addition, it is not clear that radiograph results change the treatment plan for most patients.

1.2. Importance

For these reasons, a reliable and generally applicable clinical decision rule to determine the need for radiography in patients presenting to the ED with wrist injury is desirable [2]. Previous studies performed for this purpose have reported that some physiological examination findings and functional tests can be used to identify patients with wrist injury who do require radiography. However, no definitive conclusion has been reached because of significant limitations, primarily insufficient patient numbers [3].

1.3. Goals of this investigation

The purpose of this study was to assess the sensitivity and specificity of physical examinations findings and functional tests to establish a

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reliable and widely useable clinical decision rule to determine the necessity of radiography in wrist trauma.

2. Material and methods

2.1. Study design and setting

This research is a multicenter prospective derivation study of wrist injuries. Patients older than 15 years presenting with wrist injury to 3 hospitals in Trabzon, Turkey, were included in the study. One is a university hospital where emergency medicine residents are trained, the second is a training and research hospital where emergency medicine residents are trained, and the third is a public hospital. The study was performed between June 1, 2013, and January 1, 2014, following approval by the local ethics committee (approval no. 2013/3). The study was conducted and reported in accordance with Green principles [4].

2.2. Selection of participants

Patients older than 15 years presenting to the ED within the first 24 hours of wrist injury and giving their consent were enrolled. For all participants younger than 18 years, both the child's and parental consents were obtained. Patients with multiple injuries, altered consciousness, neuromuscular disease, ipsilateral elbow or forearm trauma, open fracture, or distracting injury were excluded. Triage was performed, and analgesia was offered. All participants were examined, and an examination form was completed for each patient. All patients were assessed for mechanism of trauma, inspection findings, radial pulse, tenderness on palpation, presence of pain with active movement, and grasp strength and in terms of functional tests.

2.3. Methods and measurements

Physicians in the participating EDs were given standard training in each wrist examination technique. To maintain consistency in examination, the examination techniques were illustrated on the examination form.

Physical examination findings and clinical findings from functional tests were evaluated in terms of their potential use as a marker of the requirement for radiography. Physicians were asked to assess patients by inspection for swelling in the distal radius and visible deformity. They were asked to use palpation to determine presence of tenderness in predetermined locations (distal radius, snuffbox, radial styloid, ulnar styloid, and Lister's tubercle) and to evaluate radial artery pulse. In addition, they were asked to assess whether pain was present with active movements (dorsal flexion, palmar flexion, supination, pronation, ulnar deviation, and radial deviation). The examination concluded with the application of the distal radioulnar drawer test and axial compression test.

Two-dimensional radiography (anteroposterior and lateral) was performed on all patients in the study, independently of the physical evaluation results. An experienced radiologist blind to the examination findings reported the radiographs. In cases in which the radiologist was uncertain about the presence or absence of a fracture, further evaluation was performed via computed tomography or second radiography 1 week later and reported by the same radiologist. Patients with a fracture identified on the first radiography and initially questionable cases in which fracture was determined on the basis of computed tomography or second radiography 1 week later were recorded as fracture positive.

2.4. Outcomes

Radiographic documentation of bony injury of the wrist was the primary end point for evaluating the validity of the proposed criteria to determine the predictive value of these criteria in establishing a

clinical decision tool for the management of patients with wrist injury. The predictive value of each criterion was evaluated independently. The combination of findings with the highest predictive values for fracture was assessed together.

2.5. Analysis

Statistical analysis was performed on SPSS (Chicago, IL) 13.0 software. Descriptive characteristics (side affected, mechanism of trauma, dominant hand) were expressed as numbers and percentages. Sensitivity, specificity, and positive and negative predictive values for all symptoms and examination findings were expressed as percentages. Incidences of symptoms between fracture and no-fracture groups were analyzed using the Pearson χ^2 and Fisher exact tests.

3. Results

3.1. Characteristics of study subjects

A total of 467 eligible trauma patients presented to the participating EDs during the study period. Two hundred twenty patients with multiple injuries, 78 patients with ipsilateral elbow or forearm injuries, and 15 patients with open fracture or distracting injuries were excluded. Thirty-five patients did not consent to participate. One hundred nineteen patients were enrolled during the 6-month study period. Age range was 16 to 65 years (mean, 27). Sixty-one percent of the patients were men and 39% women. Falling on an outstretched hand accounted for 56.3% of injuries, sports injuries for 24.4%, motor vehicle accidents for 5.9%, and other causes for 13.4%. The right hand was dominant in the great majority of patients (91.8%), and the right wrist was the more commonly affected side at 51.3%. Fracture was identified in 24.3% of patients ($n = 29$). Pathological findings for the 29 patients with fracture identified at radiography are shown in Table 1.

3.2. Main results

Physical examination findings and functional test results for patients with or without identified fracture are shown in Table 2. Predictive values of clinical findings are shown in Table 2. Of the clinical findings, pain on dorsal flexion had the highest sensitivity at 89.7% of patients with fracture. The examination finding with the second highest sensitivity was the axial compression test at 86.2%. Sensitivity of 82.8% was determined for the distal radioulnar drawer test and radial deviation test. Of the wrist examination techniques, presence of pain on the radial deviation test, dorsal flexion, the distal radioulnar drawer test, and the axial compression test exhibited high sensitivity (82.8%, 89.7%, 82.8%, and 86.2%, respectively) and high negative predictive values (88.6%, 81.3%, 87.5%, and 93.6%, respectively) for wrist fracture. Sensitivity reached the desired levels (96.6%; 95% confidence interval [CI], 80.4–99.8); in other words, nearly all cases of fracture were identified when these 4 simple, practical, and easy-to-remember tests were performed together. Specificity was observed at a low level (12.2%; 95% CI, 6.6–21.2). The negative predictive value for the 4 tests in combination is 91.7% (95% CI, 59.8–99.6). These 4 examination findings were negative in only 1 patient with wrist fracture. Examination of that patient revealed a nondisplaced fracture of the ulna styloid process. The patient reported previous trauma to that region,

Table 1
The details of patients who has fracture on wrist radiograph

Radiologic diagnosis	No. of patients	Percentage
Distal radius fracture	16	55.1
Ulnar styloid fracture	5	17.2
Distal radius + ulna fracture	4	13.7
Distal ulna fracture	2	6.8
Carpal bone fracture	2	6.8
Total	29	100

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