

Predictive Power of Distal Radial Metaphyseal Tenderness for Diagnosing Occult Fracture

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Purpose To correlate the physical examination finding of distal radial metaphyseal tenderness with plain radiographic and magnetic resonance imaging after acute wrist injury to diagnose occult distal radius fractures. We hypothesized that persistent distal radial metaphyseal tenderness 2 weeks after acute injuries is predictive of an occult fracture.

Methods Twenty-nine adult patients presented, after acute trauma, with distal radial metaphyseal tenderness and initial plain radiographs and/or fluoroscopic images that did not show a distal radius fracture. Patients were reevaluated clinically and radiographically at approximately 2 weeks after initial presentation. Patients with persistent distal radial tenderness and negative radiographs underwent magnetic resonance imaging to definitively diagnose an occult distal radius fracture. We calculated the sensitivity and positive predictive value for persistent distal radial metaphyseal tenderness using a 95% confidence interval and standard formulas. Both radiographs and magnetic resonance imaging were used as our endpoint diagnosis for a distal radius fracture.

Results We diagnosed 28 occult distal radius fractures, 8 by follow-up radiograph and 20 by magnetic resonance imaging. The positive predictive value for patients who completed the protocol was 96%. One patient who did not have an occult distal radius fracture had a fracture of the ulnar styloid.

Conclusions Tenderness of the distal radial metaphysis after wrist injury is strongly suggestive of a distal radius fracture despite both normal plain radiographs and fluoroscopic images. (*J Hand Surg Am.* 2017; ■(■):1.e1-e4. Copyright © 2017 by the American Society for Surgery of the Hand. All rights reserved.)

Type of study/level of evidence Diagnostic III.

Key words Distal radius fracture, wrist, trauma, occult fracture, radiographic diagnosis.



FRACTURES OF THE DISTAL RADIUS are common injuries, with approximately 200,000 cases reported each year in the United States.¹ Not all distal radius fractures are evident on initial or follow-up radiographs, particularly if they are

nondisplaced or incomplete.^{2–4} Some distal radius fractures may displace and develop deformity during the first few weeks after injury, potentially compromising the normal kinematics of the wrist.^{5,6} Certain subsets of patients, particularly those over the age of

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50, are more likely to have fractures displaced due to decreased bone mineral density.⁷ Displacement could necessitate reduction and internal fixation, and unrecognized displacement could result in malunion. Other complications associated with nondisplaced distal radius fractures include extensor pollicis longus rupture and complex regional pain syndrome.^{8,9} Previous studies have reported extensor pollicis longus rupture in up to 3% of nondisplaced distal radius fractures.^{10,11} When an occult distal radius fracture is suspected, these are important complications to discuss with the patient.

Jorgsholm et al¹² found a 43% sensitivity in the diagnosis of distal radius fractures using only plain radiographs compared with magnetic resonance imaging (MRI). Although there have been several studies that document the occurrence of occult distal radius fractures, to our knowledge there is no current evidence that guides their evaluation and diagnosis without the use of additional imaging.^{8,13–15} The goal of this study was to provide a simple protocol for identifying occult distal radius fractures using clinical examination.

MATERIALS AND METHODS

This prospective study was approved by our institutional review board and informed consent was obtained from all subjects. Patients presenting with tenderness of the distal radial metaphysis within 2 weeks after trauma were included. Patients meeting the inclusion criteria of our protocol were enrolled from June 2010 until August 2014. The areas of tenderness included radial side of the metaphysis, ulnar side of the metaphysis, volar and dorsal aspects of the metaphysis, distal radioulnar joint, radial styloid and just proximal to Lister's tubercle. Patients were eligible to be included in the study if they were tender in one or more of the specified areas. All patients who presented had 3 or more areas of tenderness (range, 3–6). All initial radiographs, whether obtained at our institution or an outside facility, were negative for distal radius fracture. Sixteen of the initial images were obtained at our institution using fluoroscopy, and the remaining 13 were plain radiographs obtained from an outside facility. The exclusion criteria were patients who were pregnant, the presence of other acute fractures of the hand or wrist except the ulnar styloid, and a history of previous ipsilateral distal radius fracture.

Demographic information was collected at the initial visit as was smoking status, mechanism of injury, and associated injuries. Patients were asked to rate their pain using a visual analog scale (“none” [score of 0] – “severe” [score of 7–10]) at initial and follow-up visits.

Patients were seen at an initial visit and then followed up at 2, 4, and 6 weeks. Repeat images were obtained and subjects were monitored for persistent tenderness. All patients were evaluated by one of 3 fellowship-trained orthopedic hand surgeons. The physical examination included palpation for tenderness at the metaphyseal locations described above, as well as physician rating of overall severity of tenderness and degree of swelling using none, mild, moderate, and severe grades. If a patient had tenderness suggestive of a distal radius fracture and negative radiographs when initially seen, he/she was treated with a plaster, fiberglass, or thermoplastic orthosis as if there was a nondisplaced fracture, removing it only for bathing. The patients returned for the first follow-up visit 2 weeks after the initial visit. If the physical examination showed persistent tenderness, follow-up radiographs were obtained. If a fracture was present, the diagnosis was confirmed and immobilization was continued. If the radiograph did not show a fracture, an MRI scan of the wrist was obtained. If the MRI showed a fracture, the wrist was immobilized for a total of 4 to 6 weeks, followed by progressive mobilization. If the MRI did not show a fracture, the patient was permitted to wean from orthosis use as tolerated.

Statistical analysis

We calculated the sensitivity and positive predictive value for continued distal radial metaphyseal tenderness using a 95% confidence interval and standard formulas. Both radiographs and MRI were used as the reference standard for a distal radius fracture.

RESULTS

A total of 35 patients (36 wrists) presenting with acute wrist trauma, tenderness of the distal radial metaphysis, and negative radiographs were prospectively enrolled in the study. Six patients did not complete the protocol, leaving 29 patients (29 wrists) to be included in our analysis. One of these patients, who had incomplete follow-up, presented with bilateral distal radial metaphyseal tenderness and both wrists were initially included. There were 23 female and 6 male subjects with a mean age of 54 years (range, 24–81 y). The dominant hand was injured in 17 patients. The mechanism of injury was a fall on an outstretched hand in all patients. Initial presentation occurred an average of 3.5 days after injury (range, 0–11 d) and patients reported an average pain score of 4.8 (range, 0.5–8).

A distal radius fracture was diagnosed in 28 of the patients who completed the protocol (96.5%). Eight of these fractures were diagnosed on follow-up

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