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PERSISTENT WRIST PAIN IN A MATURE GOLFER

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ABSTRACT

Clients presenting with ulnar-sided wrist pain can provide diagnostic and management challenges for physical therapists. Symptoms in this region may originate from multiple structures. Integration of clinical examination and diagnostic imaging results is often required for optimal decision-making and patient management. To obtain the most informative imaging results, practitioners need an understanding of injury patterns and their detection by various imaging modalities. This case describes a mature golfer who presented with persistent ulnar-sided wrist pain and was eventually determined to have a fracture of the hook of the hamate accompanied by neighboring soft tissue involvement also contributing to his symptom complex. His history and the diagnostic process are detailed along with a brief discussion of his subsequent management post-operatively.

Level of Evidence: 5 (Single Case Report)

Key Words: wrist pain, hamate fracture, golf injury

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INTRODUCTION

The hook or hamulus of the hamate arises palmarly as a curved process from the body of the bone and serves as a pulley for the fourth and fifth flexor tendons.[1,2] The hook also provides a point of attachment for the flexor retinaculum at its peak. Other attachments include the flexor carpi ulnaris, flexor digiti minimi, and opponens digiti minimi.[2] By virtue of these attachments, the hook of the hamate contributes to the borders of the carpal tunnel and tunnel of Guyon. The latter tunnel provides for passage of the ulnar artery and nerve to pass distally into the palmar aspect of the hand.[3]

From an embryological perspective, the body and the hook of the hamate develop separately before fusing at approximately 15 years of age. Occasionally, this fusion may not occur, resulting in an ossicle located volarly to the body of the bone. The presence of such an accessory ossicle can sometimes complicate interpretation of imaging, mimicking a fracture.[4]

Fractures of the hook of the hamate are considered to be relatively rare. The reported frequency with which they occur, however, lacks current data.[5] Some investigators suspect fractures of the hook of the hamate are increasing in frequency because of growing popularity of sports such as golf, baseball, tennis, and other racquet sports, increasingly played year-round.[5,6] The onset of symptoms in many individuals may be a stress related sequence of events because of the repetitive grasping and loading of the hypothenar eminence with sports requiring an implement.[2,7-9] In sports in which a racquet is held, the dominant hand is usually affected. In sports in which both hands grasp an object, the leading or non-dominant hand is most frequently affected.[2] In addition to sports with a piece of equipment being grasped, hook of the hamate fractures have also been reported with rock climbing due to the repetitive grasping required in this activity.[10] The mechanism of injury can also be macrotraumatic, such as falling on an outstretched hand or other direct trauma.[8,11] Fractures of the hamate are generally classified as being Type I, involving the hook of the bone, and Type II, with the fracture line being in the body. Some authors further distinguish fractures based on the orientation of the fracture line within the body.[6]

Correct diagnosis and management of ulnar-sided wrist pain can present a dilemma for the physical therapist. Among the causes of pain to be considered during the process of differential diagnosis are ulnar nerve injury, intercarpal instability, extensor carpi ulnaris tendon subluxation, tenosynovitis, triangular fibrocartilage complex injury, ulnar impaction syndrome, ulnar artery thrombosis, Kienböck's disease, or potentially fractures of the regional osseous structures such as the ulnar styloid process, triquetrum, or hamate. Hook of the hamate fractures may be particularly difficult to identify because of the base of the hook of the hamate not being well visualized with the usual radiographic views and a lack of distinguishing findings on clinical examination. Understanding and integrating the patient's history, clinical examination findings, and diagnostic imaging indications and results are important for optimal decision making and patient management. In this case report, each of these aspects of the individual patient were informative in arriving at a correct diagnosis and guiding the course of care.

CLINICAL PRESENTATION

A 66 year-old retired male reported a 10 to 12 week history of left ulnar aspect wrist pain without recollection of a specific event initiating the pain. He noted the symptoms being present only intermittently during golf, specifically upon striking the golf ball. He was unaware of any symptoms during his daily activities otherwise. With rest and non-use of the involved hand, his symptoms would completely subside. With golf, however, the symptoms would occasionally reach 8 of a possible 10 on a verbal analog numerical pain scale (0 = no pain, 10 = extreme pain). In an attempt to manage his pain, he taped his wrist or used another form of an external support wrap.

On a particular occasion of playing golf in cooler weather, he struck the golf ball for a drive, experiencing a sudden, marked increase of pain. This exacerbation did not quickly subside and he was subsequently unable to continue playing. He began use of an over-the-counter wrist splint and sought care within the military medical system with which he was associated.

Initial radiographs were ordered by a certified hand therapist (CHT) as the primary contact clinician. These radiographs, in posterior-anterior and lateral views, were interpreted as negative for fractures by a radiologist within the same medical system (Figures 1 and 2). At this time, mild edema was evident in the hypothenar region and along the ulnar aspect

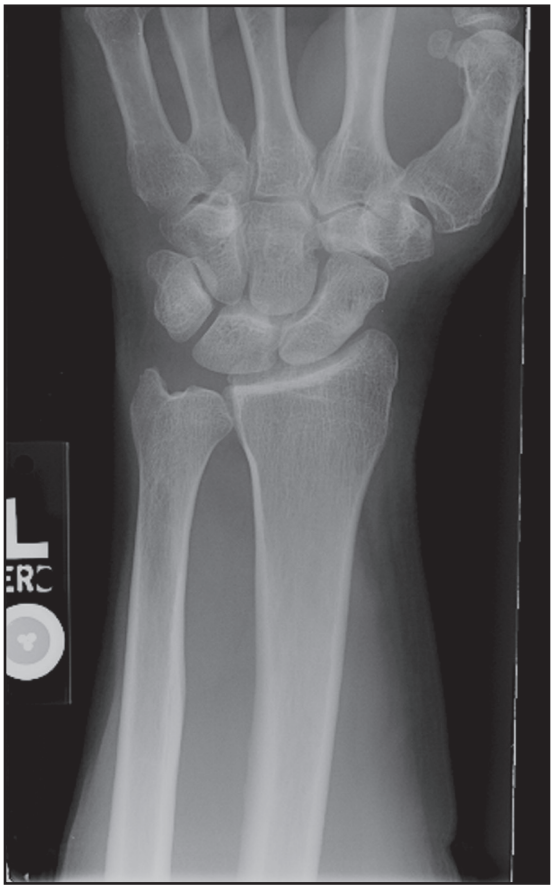

Figure 1. *The initial posterior-anterior view radiograph of the patient's symptomatic hand and wrist. Note the hook of the hamate cannot be well visualized from this view.*

of his wrist. Pain was reproduced with active ulnar deviation and passively in the same motion with overpressure, and also with active radial deviation, and with resisted wrist extension combined with ulnar deviation. Active wrist flexion and extension and the same passive motions with and without overpressure were of normal range and pain-free.

Palpation revealed mild to moderate diffuse tenderness and pain on the palmar and ulnar areas of the left wrist. This included along the ulnar collateral ligament, extensor carpi ulnaris, the hook of the hamate, and dorsally at the distal end of the ulna. Additionally, tenderness was noted in hypothenar region of the left palm, but localization was difficult because of acuity and the diffuse nature of the pain. Light touch sensation and two-point discrimination were noted to be intact and comparable to the unaffected hand. Grip strength was decreased as measured at 80 pounds on the affected left side and 160 pounds on the dominant right (Jamar® Hydraulic Hand Dynamometer # J00105, Lafayette Instrument Co., Lafayette IN).

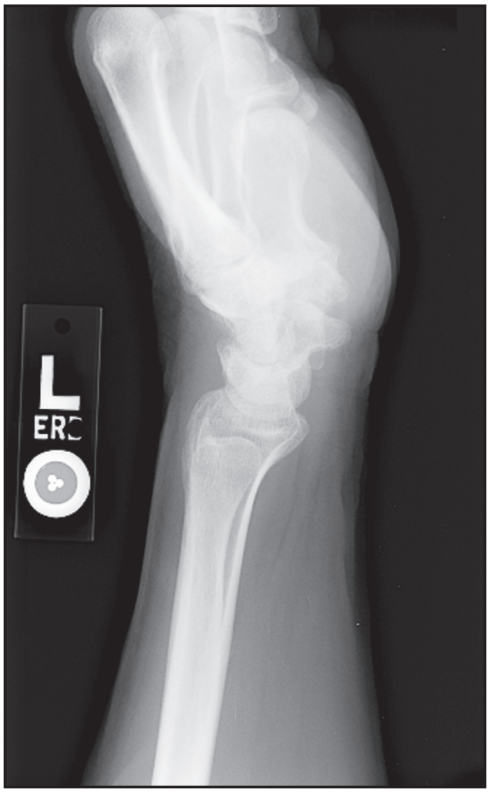

Figure 2. *The initial lateral view radiograph also fails to allow adequate visualization of the hook of the hamate.*

Additional Imaging

Upon the patient's consultation with an orthopedic surgeon, the decision was made to obtain magnetic resonance imaging (MRI) of the wrist for suspicion of injury to the triangular fibrocartilage complex. The MRI revealed, however, a nondisplaced fracture of unknown duration near the base of the hook of the hamate (Figure 3). On the T2-weighted MRI sequences, changes in signal intensity were also present surrounding the tendon of the extensor carpi ulnaris, suggesting inflammation of this structure. Also present was intermediate signal intensity degeneration of the scapholunate ligament and lunotriquetral ligaments without specific evidence of a tear or interval widening. These finding are consistent with degenerative change, but findings suggestive of instability were not present. The initially suspected origin of symptoms, the triangular fibrocartilage complex (TFCC), demonstrated degeneration, particularly at the ulnar attachments without evidence of a focal tear. Note the heterogenous signal intensity within

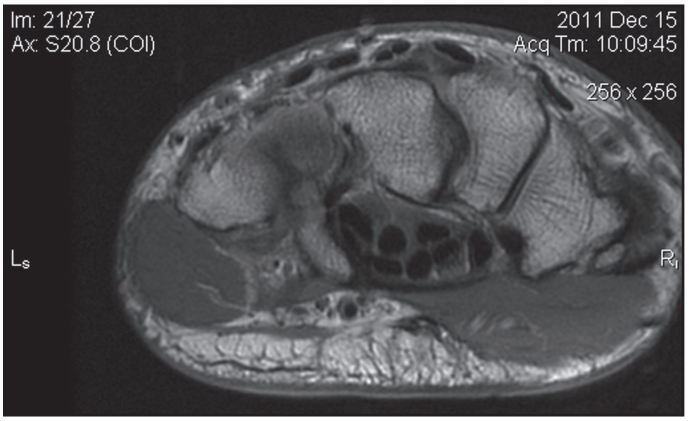

Figure 3. *An axial slice proton density weighted MRI image through the patient's wrist reveals the nondisplaced fracture through the base of the hook of the hamate as suggested by the decreased signal intensity (darker region). Also note the proximity of the flexor tendons to the hook of the hamate.*

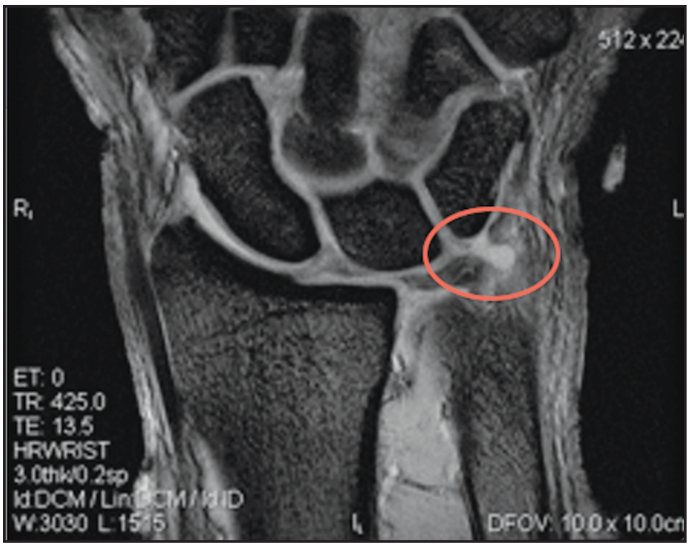

Figure 4. *MRI image demonstrating visualization of the triangular fibrocartilage complex, as noted in the colored oval.*

the TFCC and the fenestration of its attachments as demonstrated in Figure 4. There was also mild reactive marrow edema of the adjacent ulnar styloid.

Initial Management

Given the unknown age and nondisplacement of the hamate fracture accompanied by multiple soft tissue findings, a trial of conservative care was initially chosen. A six day course of methylprednisolone was prescribed to address inflammation and a custom-made splint was fabricated to limit wrist motion while allowing metacarpophalangeal motion. These

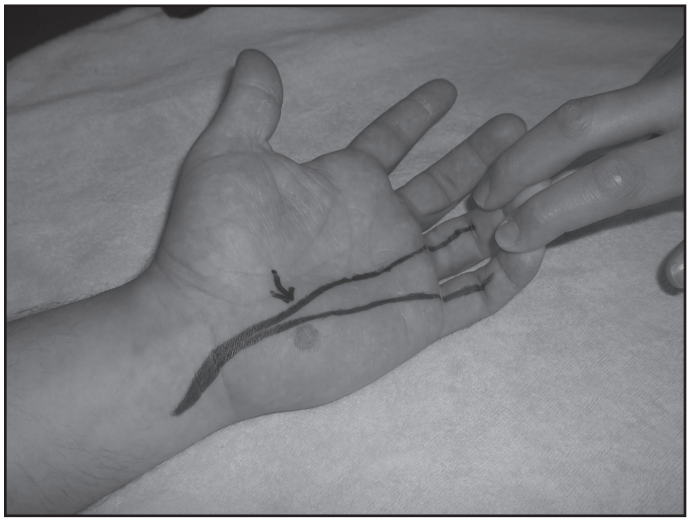

Figure 5. *The Pull Test. The patient flexes the fingers of the involved hand then the examiner attempts to pull the fingers distally out of the flexed position. A positive test is focal reproduction of pain at the area of the hamate.*

interventions resulted in reduction of symptoms to a focus in the ulnar aspect of the wrist. At this time, further examination using the Pull Test resulted in provocation of pain at that specific focal area. The Pull Test as a specific clinical exam procedure has been proposed to screen for hook of the hamate fractures.[1] For this exam procedure, the patient's wrist is placed in full ulnar deviation with the digits of the involved hand flexed. The examiner then pulls distally on the fourth and fifth digits with the patient attempting to resist the examiner's pull (Figure 5). If positive, the test will result in pain provocation in the patient's wrist and palmar area. The focal area of pain is likely to be the hook of the hamate. The test has only been reported for its accuracy in a case series of five patients with exam results in all five matching computed tomography (CT) imaging.[1] Psychometric values have yet to be established to determine its overall clinical utility. Additionally, palpation now similarly revealed isolated pain over the hook of the hamate as the surrounding tenderness had subsided. These clinical findings combined with the MRI results were viewed as confirmatory regarding the hook of the hamate fracture being the symptom origin.

One week later, the hook of the hamate was excised. Excision of the fractured hook of the hamate is the typical course of care for fractures at the base of the hook, and has been found to provide reasonably

good long-term results with few complications.[6,7,9] Immediate post-operative care consisted of dressing for the wound and a protective splint.

EVALUATION AND IMAGING

The interview with the patient with a hook of the hamate fracture will usually be informative with regard to a history of onset of pain when swinging an implement such as a bat, golf club, or racquet.[1] Rock climbing, as previously noted , has also been implicated as an activity precipitating similar symptoms.[10]

Palpation of the hook of the hamate is often most easily done by locating the pisiform and then moving one finger width distally and one finger width radially. Tenderness upon direct palpation of this structure is one of several findings that would raise suspicion of a possible fracture. Other findings could include palmar pain increased by grasping, pain with combined wrist extension and ulnar deviation, pain with flexion of the fourth and fifth digits (particularly when resisted), decreased grip strength, and paraesthesia of the fourth and fifth digits.[2,5,7] Injury of the flexor tendons may also occur and may actually be the precipitating symptoms causing care to be sought.[5] Accurate diagnosis often delayed with stress fractures because of the absence of trauma, despite persistent pain.[1,4,12,13]

Particular clinical suspicion for the possibility of a hook of the hamate fracture may be appropriate when pain in the region persists with a history and exam findings as described above along with no diagnostic imaging or limited radiographic views. Unless a fracture of the hook of the hamate is specifically considered, the applicable radiographic views or more sensitive diagnostic imaging may not be completed. Posterior-anterior (PA) and lateral view radiographs of the wrist often do not reveal a discrete fracture line within the hamate.[2,5,9,14] Thus, the interpretation of radiographs from conventional PA and lateral views as negative for fracture does not necessarily rule out the possibility of the presence of a fracture at the base of the hook. Carpal tunnel view radiographs have been advocated,[15] but full wrist extension is required for the base of the hook to be visualized and may not be available because of pain. Additionally, identification of fractures has been reported using oblique view or modified semisupinated oblique view radiographs, if such positioning is tolerated.[2,4,5] These views are described in the American College of Radiology (ACR) Appropriateness Criteria, which states that when fractures of the hook of the hamate are suspected, semi-supinated and carpal tunnel projections are indicated in addition to standard PA and lateral views of the wrist. Within the ACR Appropriateness Criteria, various forms of clinical presentations are described to provide evidence supported corresponding best imaging methodology. This taxonomy provides for levels of recommendations of indicated imaging modalities and their applications. Under Variant 8 of Hand and Wrist Trauma within the ACR Appropriateness Criteria, CT is recommended, if radiographs are equivocal in the presence of strong clinical suspicion. The additional radiographic special views and CT are each recommended at the highest level of 9, as being the most indicated.[16] The multiplanar capabilities of CT provide for a greater level of accuracy in fracture detection. Radiography employing the special views has been described as having 80.5% to 90% accuracy in detecting hook of the hamate fractures, whereas CT has been noted to be 97.2% to 100% accurate.[17,18] The axial CT views are often most revealing of the fracture.[5,18] Additionally, CT can provide information as to the severity of displacement, if present, which may be valuable in decision making.[14] In non-displaced fractures, MRI may be of value for showing localized bone edema and involvement of surrounding soft tissue, but fractures of the cortical bone may not be well demonstrated.[2,4]

In the case of this patient, the initial standard view radiographs were interpreted as negative. Because the fracture was not displaced, cortical disruption was not evident. Additionally, superimposition of bony layers may have also contributed to the initial radiographs being interpreted as negative. Because of the suspicion of soft tissue involvement, MRI was the imaging modality chosen for further investigation with this patient. Although MRI is not sensitive to cortical disruption, it is extremely sensitive to demonstrating edema within bone, consistent with non-displaced fractures. Thus, while the advanced imaging in this case did not apparently match imaging decision making criteria, sufficient information was revealed to guide appropriate management of the patient.

INTERVENTIONS FOR HOOK OF HAMATE FRACTURES

Reported outcomes for patients with hook of the hamate fractures are restricted to results from case series because of the infrequency with which the injury occurs.[6] Some authors have reported good outcomes with conservative management, but mal-union and non-union complications are more common after cast immobilization.[13] In one case series, five of the six patients treated conservatively had non-union of the fractures.[13] Additionally, because of the edges of the unhealed fracture, subsequent trauma to the flexor tendons and other surrounding soft tissues have also been reported as sequelae from failed conservative management. Finger movement, which may contribute to motion of the hook fracture fragment, may promote non-union. Additionally, suboptimal blood supply to the hook fracture fragment may lead to non-union and osteonecrosis.[12]

Internal fixation has been described with satisfactory results although the procedures may be technically challenging for the surgeon. The use of both Kirschener wires and screw fixation have been described, both eventually leading to good outcomes.[7] Most recently, a dorsal surgical approach has been described in order to minimize soft tissue trauma and reduce the risk of ulnar nerve injury.[19] The need for surgical stabilization of hamate fractures is suggested to be greater when the fracture involves the body rather than the hook.[6,20]

The most common course of action is the simple approach of excision of the hook fracture fragment. Most patients do quite well, with expected recovery to return to participation in premorbid activities.[6,9,12] Residual grip strength deficits have been reported and have been theorized to be as a result of loss of the pulley mechanism for the ulnar-sided flexor tendons provided by the hook.[21]

POST-OPERATIVE PHYSICAL THERAPY MANAGEMENT

At nine days post-operatively, physical therapy was initiated for this individual. The patient reported no symptoms in the wrist at rest and one of 10 on a numerical pain scale during activities of daily living and self-care. The pain was noted to increase, however, with full grasping and with the compressive forces often encountered when the hand was used to push. Active wrist motion was measured at 70 degrees each flexion and extension. Full motion was available in all digits. Grip strength of the affected hand was not initially measured because of the immediate prior removal of sutures and intolerance to pressure on the hypothenar eminence. Mild edema around the wrist was noted to be present along with tenderness in the area of the incision, now healing well.

The initial chosen interventions included Fluidotherapy® (Chattanooga Group, Inc., Hixson, TN), active wrist motion in flexion and extension, and tendon gliding exercises. One week later, his left wrist active range of motion had increased to 75 degrees extension and 85 degrees flexion. Left grip strength on this occasion was measured at 45 pounds. Additions to his course of care at this time included grasping of putty to improve grasping ability and soft tissue mobilization over and around the healed incision site.

At four weeks post-operatively, his grip in the affected hand measured 85 pounds. His wrist motion was unchanged from the prior visit. The recommendation to wear an occlusive dressing (Mepiform®, Mölnlycke Health Care, Gothenburg, Sweden) to assist in scar remodeling and reduction was added, which he wore for three weeks with daily changes of the dressing. He also used a mini-vibrator for 5-10 minutes three times per day for two weeks to assist in minimizing the scar sensitivity.

At approximately eight weeks from the time of surgery, he returned to playing golf, but had significant pain during and subsequent to that initial attempt. With the assistance of an external support (Wrist Widget™, Waimea, HI) directed at the ulnar aspect of the wrist (Figure 6), his tolerance to playing golf was dramatically improved within two weeks. He experienced a flare-up of his symptoms because of using his affected hand to brace a fall with an outstretched upper extremity. This exacerbation of symptoms from the fall persisted approximately three weeks.

OUTCOME

At six months post-operatively, he continues to report sensitivity of the proximal hypothenar region with direct application of pressure in specific circumstances, such as pushing through his hands on the arms of a chair when rising. Because of this persistent sensitivity,

Figure 6. *The external support worn by the patient and found to be helpful in pain management during return to golfing activities. (Wrist Widget™, Waimea, HI)*

he has adapted several tasks to minimize direct pressure application to the affected area. He has otherwise returned to his premorbid activities. Final grip strength measurement for the affected hand was 110 pounds. In the limited available literature on this topic, recovery time for return to daily activities following excision has been reported as approximately three to four weeks with return to sporting activities in six weeks.[12,22] This patient required a greater period of time for recovery, potentially because of more than one problem existing at the time of initial presentation. The multiple soft tissue findings present on the MRI, including edema in multiple structures, ligamentous signal intensity changes, and degeneration of the triangular fibrocartilage, likely contributed to his delay in diagnosis as well as his extended rehabilitation.

At last report, the patient describes one to two rounds of playing golf without the preferred external support on the wrist as continuing to provoke ulnar wrist pain, but with a focus of pain different than that during the episode of the hook of the hamate fracture. Wear of the external support reportedly results in significantly greater pain control. The additional MR imaging findings of degeneration of the triangular fibrocartilage complex and its attachments along with the ligamentous changes are likely considerations in his remaining symptoms as tasks requiring axial compressive forces through the ulnar aspect of his wrist are typically irritating. Thus, his residual ulnar wrist pain may be arising from structures not directly related to the hamate fracture. This patient likely had more than one anatomical origin to his presenting symptoms. The pain originating from the hamate fracture appears to have been successfully managed overall, while those symptoms from the triangular fibrocartilage and neighboring structures are persisting and are problematic without external support.

RECOMMENDATIONS

The physical therapy evaluation of persistent ulnar-sided wrist pain in elite and recreational athletes using a racket, golf club, or similar implement should include the possibility of a subtle stress fracture or a more overt osseous disruption of the hook of the hamate in the differential diagnostic process. The patient may present with conventional radiographs in the postero-anterior and lateral views being interpreted as negative for fracture. These views, however, may be insensitive to revealing the most common type of hamate fracture at the base of the hook. Clinical suspicion may be further elevated with point tenderness with palpation of the hook of the hamate and with positive findings from the newly reported Pull Test. Specific radiographic views or supplementary CT imaging are often required to achieve differential diagnosis. With radiography, special views consisting of semi-supinated oblique and carpal tunnel projections are considered to be more revealing than standard views for this particular pathology. Computed tomography axial reconstructions of the wrist have the highest diagnostic accuracy for hook of the hamate fractures and should be considered if radiographs are negative or equivocal in the presence of a high index of suspicion based on the history and the clinical examination findings. This region is susceptible to multiple problems. Extensive clinical reasoning may be required to manage the symptoms and impairments with which patients may present.

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