

CASE REPORT

ISOLATED FRACTURE OF THE CAPITATE : THE VALUE OF MRI IN DIAGNOSIS AND FOLLOW UP

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We report 2 new cases of isolated fracture of the capitate. The diagnosis and follow-up were made with MRI. Conventional radiographs initially failed to reveal the fracture.

Both fractures were treated conservatively ; one healed completely ; the other went on to a well-tolerated nonunion.

Keywords : capitate ; fracture ; MRI.

Mots-clés : grand os ; fracture ; IRM.

INTRODUCTION

Fractures of the capitate are considered uncommon injuries of the wrist. They are usually associated with other carpal bone fractures and/or ligamentous injuries ; the naviculocapitate syndrome of Fenton falls into this group. Delay in diagnosis in these cases may however result in prolonged disability and avascular necrosis.

Isolated, usually non-displaced, fractures are extremely rare. We report two cases in which MRI provided the key to diagnosis.

CASE REPORTS

Case 1

A 15-year-old boy fell from a height of one meter onto his outstretched right hand. The hand was swollen and very painful. Radiographs were considered normal. A cast was applied for 10 days, followed by a brace for a few weeks.

Two months later he was still experiencing pain. The bone scan demonstrated a high uptake into the center of the wrist and repeat radiographs (still considered negative at the time) revealed, viewed retrospectively, a clear transverse fracture with a step-off, both in the AP and in the lateral view (fig. 1). MRI examination was performed and was highly suggestive of avascular necrosis (fig. 2a). Immobilization was continued and 6 weeks later, revascularization on the MRI was visible (fig. 2b). The fracture line was clearly visible. Healing was uneventful. At 2¹/₂ years follow-up, the wrist appeared normal with occasional tenderness under heavy duty. The range of motion was symmetrical : extension 60°, flexion 60°, radial deviation 15° and ulnar deviation 25°. The grip strength was 52 kg. (54 kg. on the left side). MRI demonstrated a completely normal capitate (fig. 2c).

Case 2

A 19-year-old student fell on his outstretched right hand during a rugby game. He was examined in the emergency room. Physical examination of his hand showed tenderness of the carpus and localized swelling over the dorsum. Initial radiographs were considered normal. Immobilization in

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Fig. 1. — Case 1 : Initial plain AP radiographs. The fracture line and the slight displacement are visible, but were only seen *a posteriori*.



Fig. 2b. — Case 1 : MRI, 3 months posttrauma with the fracture line still present, but with reduction of the edema.



Fig. 2a. — Case 1 : MRI demonstrating the transverse fracture and severe edema of the bone suggesting avascular necrosis.



Fig. 2c. — Case 1 : MRI, 18 months later, demonstrating the normal aspect and density of the capitate.



Fig. 3a. — Case 2 : Initial plain AP radiographs. The fracture line is visible.

Fig. 3b. — Case 2 : Initial lateral radiograph.

a short forearm cast for 3 weeks was started, followed by a brace for 1 month.

Four months after the initial trauma he was seen in our outpatient clinic while still experiencing wrist pain. Physical examination revealed diminished range of motion of the wrist : extension 45°, flexion 40°. The grip of his right hand was weak : 18 kg instead of 46 kg on his nondominant left side. There still was some swelling on the middle side of the carpus.

Radiographs were still considered to be normal (fig. 3). MRI clearly delineated this fracture line with a low signal on T₂ of the proximal pole (fig. 4a and 4b). We allowed him to mobilize the wrist without putting too much strain on it. Three months later an MRI check was done, which showed no signs of avascular necrosis of the proximal pole and less bone edema (fig. 4c).

Evolution was uneventful. At 13 months postinjury, the wrist looked normal with restored symmetrical range of motion and grip strength. MRI demonstrated nonunion of the fracture. Since no symptoms were present, no treatment was proposed.

DISCUSSION

The capitate bone is situated in a relatively protected environment, surrounded by the other carpal

bones (the hamate, the lunate, the scaphoid and the trapezoid) and rigidly fixed to the articulating base of the third and fourth metacarpal bones. The center of rotation of the wrist lies within the head of the capitate, which makes the lever arm into the capitate rather short. Gelberman has studied the vascularity of the capitate and an at risk vascularity pattern was demonstrated (9) : blood vessels enter the neck and waist distally, ultimately supplying the proximally located head of the capitate. This distal-to-proximal flow across the waist explains why fractures through the neck of the capitate may lead to avascular necrosis of the head. Any fracture surface separation may delay revascularisation and union.

Fractures of the capitate are usually associated with additional carpal bone fractures (scaphoid or hamate) (2, 15), or are part of the scaphocapitate syndrome of Fenton (transscaphoidal, transcapitate perilunate carpal dislocation ; proximal transverse fracture of the capitate with 90 to 180° rotation of the proximal fragment) (2, 7).

Isolated fractures of the carpal bones, except for the scaphoid, are rare. Adlar and Shaftan (1) reviewed isolated fractures of the capitate and added 6 cases of their own. Since then only 20 cases of isolated fracture of the capitate have been reported over the past 30 years. Most papers report isolated cases or limited series (1, 2, 4, 5, 10, 11, 17, 20, 21).

They are transverse across the waist or oblique, involving the distal dorsal rim (2, 1). An incidence of 0.3 up to 1.3 % of carpal injuries has been described (16). This reported incidence of isolated capitate fractures might be underestimated, due to the difficulties in recognition of the fracture radiologically (57 % of initial xrays failed to show the fracture or were considered normal).

Different mechanisms of injury, producing capitate fractures, have been proposed (1, 7, 12, 17). The most common is a fall onto the outstretched hand with an extended wrist (77%). This applies a dorsiflexion force to the wrist whether in neutral or ulnar deviation, or in radial deviation (producing an associated perilunar dislocation (Fenton)). Second in line is a fall onto the dorsum of the hand (15.4%), which applies a flexion force to the wrist.



Fig. 4a and b. — Case 2 : MRI demonstrating the transverse fracture and edema.

A direct blow or an axial trauma, transmitted through the heads of the second and third metacarpal bones in a clenched fist and flexed wrist, are also possible causes. Often though, the exact mechanism of injury is difficult to determine. Stress fractures and pathological fractures have also been described (3, 6, 19).

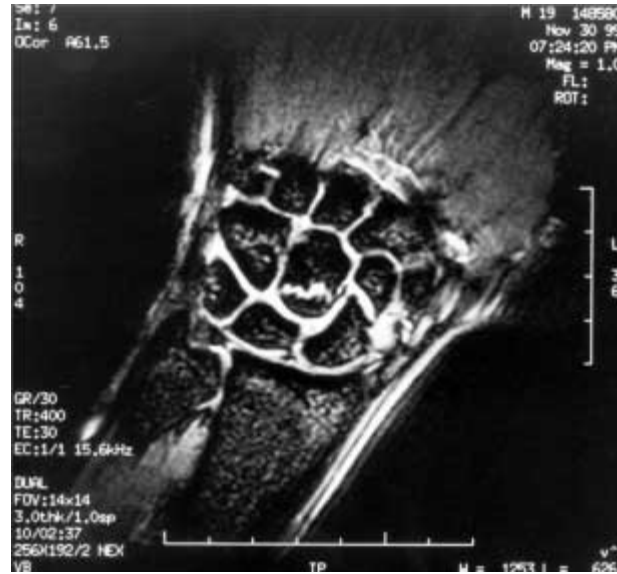


Fig. 4c. — Case 2 : MRI, 4 months posttrauma with the fracture line still present, but with reduction of the edema.

Physical examination provides important diagnostic information with localized point tenderness and swelling over the capitate.

The diagnosis may be difficult radiologically (1) and when in doubt an isotope bone scan (12), a CT-scan (2) or MRI (4) may be helpful or even necessary. The ^{99m}Tc bone scan is a sensitive means of confirming and localizing bone injury. An abnormal bone scan warrants further investigation with CT scanning. We therefore prefer MRI. This is the technical investigation of choice as it clearly depicts the fracture pattern and as it is a sensitive tool in the follow-up of avascular necrosis and fracture healing (resolution of edema).

Recommended treatment for capitate fractures has included early mobilization, excision of the proximal fragment, open reduction and internal fixation, and wrist arthrodesis (1,7). The outcome and the treatment modalities of the isolated capitate fractures are not well determined. It is our opinion that conservative treatment with initial analgesic cast immobilization (generally 6 to 12 weeks immobilization), followed by mobilization within pain limits, still has its place in the treatment of non-

displaced fractures. Several cases of nonunion have however been reported. Some authors suggested that treatment should be as aggressive regarding anatomic reduction as in the case of scaphoid fractures. Displaced fractures should be reduced and internally fixed with K-wires (5, 11, 20) or a Herbert screw (17).

The complication rate for capitate fractures is relatively high and consequences are important. Nonunion (8, 18) has been associated with persistent pain and disability, similar to chronic wrist sprain associated with untreated scaphoid fractures and even carpal tunnel compression syndrome (1, 3, 15, 18, 20). Avascular necrosis of the proximal pole of the capitate is frequently seen in displaced fractures. The avascular proximal end of the capitate can be revascularized if reduced anatomically and immobilized until healing is complete (14). Nonunion is rare. Seven cases have been reported (3, 8, 13, 16, 18, 19). Nonunion is associated with absorption of the fracture surfaces and shortening of the capitate, which induces a collapse deformity (16). Nonunion can be treated with intercalary bone grafting (8, 15, 16) and/or open reduction and internal fixation, by partial resection (of the proximal fragment) and/or carpal fusion, or by wrist arthrodesis (1, 3, 7, 16). Other possible complications are dorsiflexion instability and capitulunate fusion.

With regular MRI examination, the diagnosis can be confirmed and the evolution can be followed. When bone circulation remains compromised or when the healing seems to slow down, operative treatment should be considered.

CONCLUSION

The excellent short term results obtained in our first patient, suggests that cast immobilization with early mobilization within pain limits (after 6 weeks), can lead to clinical and radiographic union in non-displaced isolated capitate fractures.

Even a nonunion without carpal collapse appears to be well tolerated.

We find MRI the technical investigation of choice in the diagnosis and follow up of these fractures.

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SAMENVATTING

F. DE SCHRIJVER, L. DE SMET. Solitaire fractuur van het os capitatum : belang van MRI onderzoek.

Wij beschrijven 2 nieuwe gevallen van geïsoleerde fractuur van het os capitatum. Voor de diagnose en opvolging werd beroep gedaan op MRI beeldvorming. Beide werden conservatief behandeld waarvan één met volledige heling en de andere met zeer goed getolereerde non-union.

RÉSUMÉ

F. DE SCHRIJVER, L. DE SMET. Fracture isolée du grand os : intérêt de l'IRM pour le diagnostic et le suivi.

Les auteurs rapportent deux nouveaux cas de fracture isolée du grand os. Le diagnostic a été posé grâce à l'IRM, qui a aussi été utilisée dans le suivi. Au départ, le diagnostic avait échappé à l'examen radiologique standard. Les deux fractures ont été traitées de façon conservatrice ; l'une d'entre elles a consolidé, tandis que l'autre a évolué vers une pseudarthrose bien tolérée.