TENDON ENTRAPMENT IN DISTAL RADIUS FRACTURES

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We retrospectively defined the rate and clinical features of tendon entrapment in 693 consecutive patients with 701 distal radius fractures treated in a single hospital. Eight extensor tendons and one flexor tendon were entrapped. All fractures with extensor tendon entrapment were palmarly displaced (Smith type) or epiphyseal. Flexor tendon entrapment was seen in dorsally angulated (Colles type) epiphyseal fracture. The rate of tendon entrapment in acute distal radius fractures was 1.3%. Extensor tendon entrapment in palmarly displaced fractures is more common.

Keywords: complication, distal radius fracture, extensor pollicis longus tendon, Smith type fracture, tendon entrapment

INTRODUCTION

Different complications have been described after distal radius fracture, such as carpal tunnel syndrome, delayed rupture of the extensor pollicis longus (EPL) tendon, ulnar abutment syndrome and triangular fibrocartilage complex injury. Tendon entrapment at the fracture site has also been recognised, however, most of the previous reports in the literature are case reports (Hunt, 1969; Kumar and Kelly, 2003; Uchida and Sugioka, 1990) and the rate of this condition is not known. We reviewed our cases retrospectively to identify clinical features of such tendon entrapment and to define its rate.

PATIENTS AND METHODS

Our database of 701 consecutive distal radius fractures in 693 patients treated in a single hospital from 1996 to 2004 was retrospectively reviewed. There were 270 men and 423 women. Their age ranged from 1 to 95 years with a mean of 49 years. There were 363 left wrists and 318 right wrists and both wrists were involved in eight patients. The side involved was not identified in four wrists. In 633 wrists the distal radius fracture was acute and of these 196 wrists had surgery and 437 were treated in a cast. The remaining 68 fractures were malunited presenting at their first visit with residual symptoms and 14 wrists were treated with an open wedge corrective osteotomy of the radius with iliac crest bone graft, one wrist had the ulna shortened and one wrist required radiolunate fusion with iliac crest bone graft. Rupture of the EPL tendon was found in 14 fractures and all had surgery, with a tendon transferred in 11 and the tendon repaired with or without tendon graft in three.

Cases with tendon entrapment at the fracture site were identified. The preoperative radiographic findings and intra-operative findings were studied. Patients with tendon entrapment were all informed that their cases would be submitted for publication but formal consent was not required. The study was approved by the Research Ethics Board.

RESULTS

Eight of the 633 acute fractures (1.3%) and one of the 68 malunited fractures (1.5%) had tendon entrapment, with the extensor tendons interposed in eight wrists and the flexor tendon in one wrist (Table 1). Every tendon interposition was surgically confirmed. Four were male and five were female with a mean age of 35 years (range 6 to 84 years). In acute fractures, entrapment of the tendons was suspected when there was limitation of active motion of the digits in five cases, more than expected pain when the digits were fully flexed or extended in all cases and/or failure of closed reduction (performed by the first or second author) of the fracture under general anesthesia or axillary block in all cases. It can be difficult to identify this from symptoms and signs alone. MRI (Fig 1) was carried out in a patient with marked displacement of the fracture to visualise tendon entrapment preoperatively. The patient with the malunited fracture had initial treatment with closed reduction and percutaneous Kirschner wire fixation at another hospital and was then referred to our hospital 82 days after injury. Tendon interposition was suspected as active extension of the thumb was limited, there was a tenodesis effect of the thumb and index finger and a gap at the dorsoulnar aspect of the fracture on CT (Fig 2).
All fractures with extensor tendon entrapment were palmar displaced with a gap between the fragments. All had attempted reduction and this failed. The dorsal edge of the oblique fracture ran near Lister’s tubercle in all eight wrists (Fig 3). There were three epiphyseal fractures (Salter-Harris type 2). The EPL and the extensor indicis proprius (EIP) tendons were involved in all cases. The extensor digitorum communis (EDC) tendons were displaced to the palmar side in seven cases and the extensor digiti minimi tendon in one case. The proximal stump of the radius protruded through the extensor retinaculum from radial side of the EPL tendon in seven cases (Fig 4), and between the EPL and EDC tendons in one. Extensor tendons were relocated through the dorsal approach. The EPL tendon was severely crushed and damaged in two patients, including one with the mal-united fracture. The EPL tendon was repaired with a palmaris longus tendon graft. The fracture was fixed with Kirschner wires in children. In adults the fracture was internally fixed with a palmar plate through a separate palmar incision.

In one wrist with dorsally displaced epiphyseal fracture (Salter-Harris type 2) the flexor digitorum profundus tendon of the index finger was interposed between the fragments. After the entrapped tendon was relocated through a palmar approach reduction was easily achieved and the fracture was stabilised with Kirschner wires.

### DISCUSSION

Tendon entrapment in distal radius fractures has been recognised. Thomas and Kershaw (1988) described a patient with an acute palmarly displaced fracture, which could not be reduced and surgical exploration of the dorsum of the wrist identified that all extensor tendons were trapped at the fracture site. Sumner and Khuri (1984) reported entrapment of the flexor pollicis longus tendon and the median nerve in an acute dorsally displaced epiphyseal fracture.

In our patients, tendons were entrapped in eight cases out of 633 acute fractures and one case out of 68 malunited fractures. The rate of the tendon entrapment in acute distal radius fractures was 1.3%. As most of the previous reports are case reports, this rate was much higher than expected. Tendon entrapments in acute fractures are suspected when the fracture cannot be reduced, although there are reports where satisfactory reduction was obtained with the tendons still entrapped. Kumar and Kelly (2003) reported a case in which the EPL tendon was entrapped in a bony tunnel although

### Table 1—Patient data with tendon entrapment

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (yrs)</th>
<th>Gender</th>
<th>Side</th>
<th>Displacement of fracture</th>
<th>Associated ulna fracture</th>
<th>Active motion of digits</th>
<th>Preop interval (days)</th>
<th>Surgical approach</th>
<th>Entrapped tendons</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>F</td>
<td>L</td>
<td>Dorsal*</td>
<td>neck</td>
<td>limited</td>
<td>12</td>
<td>palmar</td>
<td>FDP2</td>
<td>OR and percutaneous K-wire fixation of the radius</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>M</td>
<td>R</td>
<td>Palmar*</td>
<td>neck</td>
<td>limited</td>
<td>13</td>
<td>dorsal</td>
<td>EPL,EIP,EDC</td>
<td>OR and percutaneous K-wire fixation of the radius</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>F</td>
<td>R</td>
<td>Palmar*</td>
<td>greenstick styloid tip</td>
<td>limited</td>
<td>1</td>
<td>dorsal</td>
<td>EPL,EIP,EDC</td>
<td>OR and percutaneous K-wire fixation of the radius</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td>F</td>
<td>R</td>
<td>Palmar*</td>
<td>styloid tip</td>
<td>possible</td>
<td>3</td>
<td>dorsal</td>
<td>EPL,EIP,EDC</td>
<td>OR and percutaneous K-wire fixation of the radius</td>
</tr>
<tr>
<td>5</td>
<td>37</td>
<td>M</td>
<td>L</td>
<td>Palmar</td>
<td>nil</td>
<td>possible</td>
<td>8</td>
<td>palmar, dorsoulnar</td>
<td>EPL,EIP,EDC,EDM</td>
<td>ORIF of the radius with palmar plate, TFCC repair</td>
</tr>
<tr>
<td>6</td>
<td>68</td>
<td>M</td>
<td>L</td>
<td>Palmar</td>
<td>nil</td>
<td>limited</td>
<td>4</td>
<td>palmar, dorsal</td>
<td>EPL,EIP,EDC</td>
<td>ORIF of the radius with palmar plate</td>
</tr>
<tr>
<td>7</td>
<td>73</td>
<td>F</td>
<td>R</td>
<td>Palmar</td>
<td>styloid base</td>
<td>possible</td>
<td>4</td>
<td>palmar, dorsal, palmal, dorsal, ulnar</td>
<td>EPL,EIP,EDC</td>
<td>ORIF of the radius with palmar plate, EPL augmented with PL graft, ORIF of the ulna</td>
</tr>
<tr>
<td>8</td>
<td>84</td>
<td>F</td>
<td>L</td>
<td>Palmar</td>
<td>neck and styloid base</td>
<td>limited</td>
<td>1</td>
<td>palmar, dorsal</td>
<td>EPL,EIP,EDC</td>
<td>ORIF of the radius with palmar plate, percutaneous K-wire fixation of the ulna</td>
</tr>
<tr>
<td>9</td>
<td>16</td>
<td>M</td>
<td>R</td>
<td>Palmar</td>
<td>styloid base</td>
<td>limited</td>
<td>107</td>
<td>palmar, dorsal, palmal, ulnar</td>
<td>EPL,EIP</td>
<td>Corrective osteotomy of the radius with bone graft, EPL augmented with PL graft, ORIF of the ulna</td>
</tr>
</tbody>
</table>

*Epiphyseal fracture (Salter-Harris type 2); KW: K-wire; PL: Palmaris longus.
the fracture healed in a good position with palmar plate fixation. Murakami and Todani (1981) reported a patient who had the fracture reduced and fixed with a percutaneous Kirschner wire. El-Kazzi and Schuind (2005) described a fracture treated with closed reduction and a long-arm cast. In these reports, the fractures healed in acceptable alignment despite persistent EPL tendon entrapment.
Limitation of active extension or flexion of the thumb, or other fingers, suggests tendon entrapment. However, in some of our cases movement was not limited, making diagnosis difficult. We think that tendons could still move between the fragments when the fracture was displaced and there was a gap. The fingers would lose active motion only after the tendons became tethered in the surrounding bone or after rigid fixation of the fracture or after callus formation (Akita and Kawai, 2005; El-Kazzi and Schuind, 2005; Kumar and Kelly, 2003; Murakami and Todani, 1981).

Our patients with tendon interposition demonstrated more pain than expected on movement of the fingers, especially when passively flexed or extended through their full range. We think this may be the clue suggesting tendon interposition in the acute period. We explored the fracture site to check for tendon interposition in suspicious cases and found tendon entrapment in all accounting for 1.3% of the acute fractures. Preoperative MRI may help diagnosis (Okazaki et al., 2007) and avoid the need to explore the wrist when there is no interposition.

Limitations of this study include the retrospective data collection. Radiographs of the most of our cases were not available and direction of displacement could not be established in these. Therefore the rate of tendon entrapment in palmar displaced fractures could not be calculated. As difficult cases are referred to our hospital from other practitioners and hospitals the percentage of fractures requiring surgery could be higher than in the general population and incidence of tendon entrapment could also be over-estimated. The strength of the study is that we have confirmed intra-operatively the tendon entrapment in all nine cases.

The EPL and EIP tendons are the most common tendons to be entrapped in a palmar displaced fracture with frequent entrapment of the EDC tendons as well. Surgical exploration of the dorsum of the wrist in acute palmar displaced fractures of the distal radius is advised (Itoh et al., 1987) when the fracture is markedly displaced with an oblique fracture line running near Lister’s tubercle. More pain than expected when moving the digits may indicate tendon interposition. In such patients, even if a reasonable reduction is achieved and the fingers can be flexed and extended actively, there is still the possibility of tendon entrapment. In these cases a preoperative MRI could diagnose interposition of tendons.

References


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Fig 4 The proximal stump of the radius is protruding through the extensor retinaculum on the radial side of the EPL tendon. The EPL (the tendon with tape) and EIP tendons are running from ulnar to palmar side of the proximal fragment. The tendons get entrapped between the proximal and distal fragments when reduction of the fracture is attempted by traction and compression of the distal fragment. Note that part of the extensor retinaculum is released to see the tendons.