Rupture of the Extensor Pollicis Longus Tendon

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ABSTRACT: Twenty-one patients with rupture of the extensor pollicis longus tendon are reviewed. Fourteen had sustained a single episode of trauma prior to rupture, and six had rheumatoid arthritis. In four of 11 patients with prior distal radial fractures, an offending exostosis was resected. Prerupture thumb function may reliably be restored with extensor indicis proprius tendon transfer following attritional extensor pollicis longus rupture. Intercalated grafting also may provide excellent results, provided that an exostosis is not overlooked and that a tendon graft of sufficient length is available.

Introduction

In 1876 Duplay became the first to describe rupture of the extensor pollicis longus (EPL) tendon when he recorded this injury in a patient who fell and injured her hand without apparently sustaining a fracture.1 Twenty years later, Dums demonstrated the etiology of "drummer-boy's palsy," a condition in which EPL rupture was caused by repetitive thumb motion, chronic tenosynovitis, and tendinous attrition.2 Since these early reports, most reported cases of spontaneous EPL rupture have occurred either in rheumatoid arthritis (RA) patients or in patients with prior fractures of the distal radius.

When all tendon ruptures, regardless of etiology, are grouped together, the EPL is the most frequent tendon of the hand to rupture.3 Treatment recommendations have varied in the past. In cases preceded by distal radial fracture, the precise etiology of tendinous attrition has been disputed.

This investigation focuses upon rupture of the EPL by considering the relevant anatomy, pathology, and natural history. The authors' experience with surgical treatment alternatives for this condition has been reviewed.

Anatomy

Though our cadaver dissections generally confirm previous findings, several specific clinically relevant features merit repetition. The excursion of the EPL tendon is 6.0 cm.4 The EPL muscle arises from the proximal dorsal surface of the ulna and from the interosseous membrane. The EPL tendon runs through the radial groove on the dorsal distal radius, under cover of the annular ligament. While there is attachment of the extensor retinaculum to bone on either side of the groove, the EPL tendon is remarkably unrestrained with demonstrable potential for proximal retraction should laceration occur. The EPL tendon passes ulnarly to Lister's tubercle, close to the junction of that prominence with the dorsal carpal ligament. The EPL tendon then angles abruptly radially, forming the dorsal boundary of the anatomical snuff-box, prior to entering the thumb. This course provides the EPL with a lever-arm in its plane of action. The angular apex of its course, however, creates a site of vulnerability since any small tendon defect in this region is subjected to further irritation and propagation. This situation is depicted diagrammatically in Figure 1.

The EPL has a dual function. It extends the thumb interphalangeal joint as well as elevating the thumb as a unit. Thumb elevation is particularly important in power grip.5 The EPL assists in extending and abducting at the carpometacarpal joint, and in supinating the thumb.
<table>
<thead>
<tr>
<th>Trauma Type</th>
<th>Crush</th>
<th>Colles</th>
<th>Colles</th>
<th>Colles</th>
<th>Colles</th>
<th>Smith's</th>
<th>Scaphoid</th>
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<tr>
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<td>EIP</td>
<td>EIP</td>
<td>ECR/L</td>
<td>IG</td>
<td>IG then EIP</td>
<td>EIP</td>
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<td>Hand Dominance</td>
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<td>D</td>
<td>D</td>
<td>D</td>
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<tr>
<td>Number of Patients</td>
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<td>41, 55</td>
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<td>M</td>
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<td>SE</td>
<td>CRC</td>
<td>CRC</td>
<td>CRC</td>
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<td>ORIF</td>
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<td>Time in months—</td>
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<td>Trauma to EPL Rupture (mean)</td>
<td>4, 8</td>
<td>(4)</td>
<td>3, 4</td>
<td>2, 6</td>
<td>10, 14</td>
<td>RR 3, 5</td>
<td>16</td>
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<td>Time in days—</td>
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<td>EPL Rupture to Surgery</td>
<td>7, 11</td>
<td>2-23</td>
<td>5, 8</td>
<td>2, 4</td>
<td>3, 11</td>
<td>RR 2, 4</td>
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<td>Operative Findings, Rupture Site</td>
<td>LT</td>
<td>EX-1</td>
<td>EX-1</td>
<td>LT</td>
<td>LT</td>
<td>EX-2</td>
<td>DR</td>
</tr>
<tr>
<td>Length of Followup in months (mean)</td>
<td>12, 36</td>
<td>(48)</td>
<td>48, 72</td>
<td>12, 48</td>
<td>30, 54</td>
<td>18</td>
<td>9</td>
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<tr>
<td>Result</td>
<td>E</td>
<td>3E, 1G</td>
<td>G</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
</tbody>
</table>

Legend
D=dominant ND=nondominant IG=intercalated graft
M=male F=female SE=splint and elevation CRC=closed reduction and casting ORIF=open reduction and internal fixation
RR=recurrence LT=Lister's tubercle EX=exostosis DR=distal radius SB=sunbox GS=graft substance
E=excellent G=good

The EPL tendon inserts into the dorsal surface of the thumb distal phalanx. A volar expansion increases the surface area of insertion. The unwary examiner may be misled if thumb interphalangeal extension is considered synonymous with EPL integrity. In fact, the extensor pollicis brevis, the abductor pollicis brevis, or even the adductor pollicis often supply fibers that insert into the dorsal hood over the thumb interphalangeal joint, providing extensor power. It is therefore essential when assessing EPL integrity and continuity that one actually palpate the taut activated EPL tendon. This is best appreciated with the patient's hand on a flat surface and the thumb fully actively extended to raise the thumb dorsal to the plane of the hand.

Clinical Material
Twenty-seven patients with EPL rupture were treated surgically by the Hand Service at the Loyola University Medical Center and the Hines Veterans Administration Hospital from 1970 through 1981. Complete records including documentation of post-operative followup were available for 21 patients. This group differed from previously reported series because three of the patients were seen initially after surgical procedures that were carried out elsewhere failed.

Fourteen patients had experienced a single episode of significant acute hand and wrist trauma (Table 1). Eleven of these patients had sustained prior closed distal radial fractures. One of these 11 had sustained a Smith's fracture, which was treated with open reduction and internal fixation through a volar approach. The other ten had sustained Colles' fractures, which displayed varying degrees of displacement, comminution, and shortening. All were treated with closed manipulative reduction and cast immobilization for five to eight weeks. Two patients had sustained closed crush injuries without fractures, and
one patient had sustained a prior scaphoid fracture. The mean time from the initial trauma to EPL tendon rupture was five months. The mean age of this group of patients was 53 years. Only two of these patients had prodromal symptoms of mild local pain and swelling preceding rupture. Neither patient sought treatment prior to rupture.

One 54 year-old woman with EPL rupture had a three-week period of prodromal radial wrist pain and swelling. She denied a single previous episode of trauma. There was no clinical evidence to suggest RA other than her EPL rupture. She worked as a seamstress and described several continuously performed movements on the job that provoked and exacerbated her prodromal symptoms. Her tendon rupture was thus attributed to repetitive motion as described by Dums.³

Six patients with EPL rupture had an established diagnosis of RA (Table 2). Each was referred by a rheumatologist. None of these patients experienced prodromal symptoms about the radial or dorsal aspect of the wrist. Two of these rheumatoid patients had experienced previous tendon ruptures of the ring and little finger extensors. These ruptures had been treated surgically with the subluxated distal ulna resected in both instances. As suggested by Riddell, a selected referral series such as this is not a true indicator of the incidence of RA as a cause of rupture, because EPL rupture often escapes notice or may be left untreated as repair is not thought to be worthwhile.⁴

EPL rupture was demonstrated on examination in each case. With the patient's hand palm down on the examining table, the patient attempts to raise the thumb from the plane of the hand. Inability to raise the thumb as a unit above the level of the palm was appreciated, and the lack of EPL continuity was demonstrated by palpation of the EPL tendon dorsally.

### Pathology

Because normal tendon has considerable tensile strength, the musculotendinous unit subjected to excessive tension will fail by either avulsion of the periostium or bone at its insertion or less frequently by rupture at the musculotendinous junction, rather than failing by rupture along the tendon length. A tendon rupture within its substance proper implies pathological failure. Tendon may be weakened by vascular insult, chronic or acute trauma, or by tenosynovitis.

Detailed operative findings were available in all reviewed cases. Both proximal and distal tendinous attrition was apparent over a total length of approx-

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**TABLE 2**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>EIP transfer</th>
<th>ECRL transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Patients</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Mean Age</td>
<td>57</td>
<td>61</td>
</tr>
<tr>
<td>Sex</td>
<td>3 male, 1 female</td>
<td>female</td>
</tr>
<tr>
<td>Mean Duration of RA in Years</td>
<td>17</td>
<td>24</td>
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<tr>
<td>Prior Hand Tendon</td>
<td>none</td>
<td>ring and little</td>
</tr>
<tr>
<td>Ruptures/Surgery</td>
<td></td>
<td>finger ruptures/distal ulnar resection</td>
</tr>
<tr>
<td>Operative Findings</td>
<td>frayed EPL</td>
<td>frayed EPL/diseased EIP</td>
</tr>
<tr>
<td>Mean Length of Followup in Years</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Result</td>
<td>fair</td>
<td>fair</td>
</tr>
</tbody>
</table>
imately 1 cm in each instance. The distal aspect of the proximal portion of the tendon was usually located near the junction of the middle and distal thirds of the forearm. In no patient could the frayed tendinous edges be fully approximated even when the wrist and thumb were fully extended.

Contributing patholology was sought in each instance. A sharp exostosis was found and resected from the radial groove in four of 11 patients who had experienced previous radial fractures.

Each of the rheumatoid patients demonstrated diffuse synovial membrane hypertrophy about the adjacent extensor tendons. The ruptured tendon was invariably surrounded by hypertrophied tenosynovium. Periosteal erosion along the EPL’s course in the radial groove was evident in two of the previously unoperated rheumatoid wrists.

Surgery

Patients in this series were treated surgically by either an intercalated palmaris longus tendon graft or by tendon transfer into the debrided distal EPL remnant. Either the extensor indicis proprius (EIP) tendon or the extensor carpi radialis longus (ECRL) tendon was selected to provide proximal motor power for the tendon transfer.

In the trauma group, both patients who had sustained previous crush injuries were treated with EIP transfer. Seven patients with prior radial fractures were likewise treated with tendon transfer, five using EIP and two ECRL. Intercalated grafts were used in two patients after the frayed proximal and distal tendon ends were resected.

Two patients with prior radial fractures had been treated elsewhere with intercalated grafts and reruptured four and nine months after surgery. Both were noted to have ruptured within markedly frayed tendon graft substance. Both underwent resection of prominent sharp exostoses at the time of revision. The graft segments were excised and EIP transfers performed.

One patient with a healed scaphoid fracture was ineffectively treated elsewhere for EPL rupture with EPL tenodesis when a harvested palmaris longus graft was of inadequate length to bridge the EPL defect. The graft, which had been woven into the ECRL, ruptured eight weeks after surgery. The failed graft segment was removed and EIP transfer carried out.

The single patient with a history of repetitive motion was treated with EIP transfer.

Six patients with EPL rupture secondary to RA were treated with a tendon transfer. EIP transfer was performed in four and ECRL transfer in two. In the latter group, ECRL transfer was elected because of extensive rheumatoid tenosynovial involvement of the EIP tendon.

Postoperatively, all patients were immobilized with the wrist in moderate extension and the thumb in full extension-abduction for a period of four to five weeks. Active motion was then instituted.

Results

We have used Riddell’s method of classifying results following surgery for EPL rupture. 1) Excellent; the thumb is indistinguishable from normal, the tendon transfer or repair with graft having assumed normal EPL function. 2) Good; extension of the interphalangeal joint is normal, but there is some loss of flexion with the thumb in the adducted position, or where there is inability to elevate the thumb to the level of the second metacarpal. 3) Fair; there is lack of full extension of 15° or less of the interphalangeal joint with the wrist dorsiflexed and the thumb abducted and extended, but in which extension is full with the thumb adducted and flexed across the palm. 4) Poor; there is severe extension lag with functional disturbance. 5) Bad; there is complete failure of the procedure.

Using this functional classification, both patients with prior crush injuries had excellent results one and three years postoperatively. Four of five patients with prior radial fractures who also had EIP transfers had excellent results at follow-up averaging 3½ years. The fifth patient in this subgroup had a good result two years after EIP transfer. She is a 75-year-old woman with basal joint arthritis whose function equals that of her contralateral thumb. Two patients with prior radial fractures treated with ECRL transfer have good results at four and six years. The patients treated with intercalated grafts have excellent results at one and four years. Both patients treated with EIP transfer after failed intercalated grafting have excellent results 2½ and 4½ years after revision.

The patient who had a prior scaphoid fracture and failed grafting has an excellent result nine months after EIP transfer.

All six RA patients have fair results with a minimum of two years followup since tendon transfer. All are satisfied with functional recovery and feel that they have regained prerequisite thumb function.

The patient whose only history prior to EPL rupture was repetitive motion has an excellent result 14 months following EIP transfer.
The ultimate functional result did not appear to be dependent upon the length of time from rupture to repair, but intercalated segment grafting as a rule was not carried out in relatively longstanding ruptures where retraction of the proximal tendon portion had become marked.

Discussion

Among the 11 patients with prior distal radial fractures, four had definite sharp exostoses along the radial groove that appeared to incite the tendinous attritional process. No exostosis could be detected in the other seven cases. Kleinschmidt experimentally produced distal radial fractures in human cadavers, and in each case found a small tear of the EPL tendon caused by a small bony spike. He concluded from this experimental finding that at the time of the injury a defect in the tendon is created, which sets up a course of tenosynovitis and attrition.7 Other investigators have disputed this and believe that tearing of the mesotendon at the time of injury interferes with the blood supply to the tendon and causes avascular necrosis; a sudden muscle contraction on the weakened tendon causes it to rupture.5,8,9,10 The lack of a demonstrable exostosis in seven of our patients lends credulity to the second hypothesis, at least in these patients. It should be emphasized that two of our patients reruptured intercalated grafts, and an offending exostosis was found in each case at the time of revision. It is clear that, at least when intercalated graft is chosen, resection of an exostosis if present is crucial. Furthermore, these data suggest two etiologies among our trauma patients. The exostosis played a role in EPL attrition in one subgroup, and in those patients in whom an exostosis was sought but not found, the vascular insult hypothesis may be applicable.

Helal, et al recently reported a higher risk of EPL rupture in undisplaced Colles fractures than in those that are displaced.11 They surmised that the integrity of the extensor retinaculum in undisplaced Colles fractures caused the tendon to be held tightly against the fracture callus, leading to attritional rupture, whereas in displaced fractures the extensor retinaculum was torn from the bone and the tendon thereby escaped contact with the fracture site. Our results do not support this concept as all the radial fractures in our series were initially displaced and required manipulative reduction.

In RA it is likely that direct involvement of the tendon in the rheumatoid process is the cause of attrition and eventual rupture.12 Myostatic contracture and more importantly a discrete length of tendon involved with attritional damage preclude primary repair of ruptures of the EPL tendon. Intercalated grafting or tendon transfer remain as surgical options. Hamlin and Littler demonstrated the efficacy of an intercalated graft in a 12 patient series with attritional EPL rupture. There were eight excellent and four good results. Only five of the 12 had prior distal radial fractures, though, and two of these five had good results.13 Pressly and Goldner favored ECRL transfer. They described results of good thumb motion and strength, and satisfactory restoration of fine and power pinch. EIP transfer and grafting were less satisfactory in their series.14

Riddell reported a series of patients with EPL rupture, most of whom had a history of either prior distal radial fracture or RA. All were treated with either EIP or ECRL tendon transfer.6 As in our patients, no patient with ECRL transfer in Riddell's series had an excellent result because of inability to elevate the thumb to the second metacarpal level. This is due to insufficient excursion of the ECRL, this tendon's having significantly less excursion than the EIP.5,9 Excursion of the ECRL is 3.0 cm. and for EIP 5.0 cm.4

Summary

In some patients with prior distal radial fractures and ensuing attritional EPL rupture, a bony exostosis plays an etiologic role in the attritional process.

In all patients with attritional EPL rupture, especially those with prior fracture, a sharp exostosis should be sought and excised if found, particularly if intercalated graft is elected. If not excised, the exostosis may again incite attrition and rerupture.

Prerupture thumb function may reliably be restored with EIP tendon transfer following attritional rupture. ECRL transfer appears less suitable because of insufficient excursion, but may be satisfactory in cases of EIP rheumatoid involvement.

Intercalated grafting also may provide excellent results in patients with prior trauma and EPL rupture, provided that an exostosis is not overlooked and that a tendon graft of sufficient length is available.

References