Open Traumatic Avulsion of the Flexor Pollicis Longus Tendon From the Musculotendinous Area: A Case Report

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A traumatic avulsion of the flexor tendon at the musculotendinous junction in nonamputated digits is a very rare injury. We present a 14-year-old girl who sustained a longitudinal, tensile, injurious force directly to the flexor pollicis longus tendon after an open thenar injury resulting in its avulsion at the musculotendinous junction. In an effort to minimize soft-tissue damage and preserve the transverse ligament of the carpus the tendon was retrieved through a separate forearm incision. Direct repair was made by encapsulation of the tendon into the muscle belly. The functional result 30 months after surgery was satisfactory. (J Hand Surg 2005;30A:850–853. Copyright © 2005 by the American Society for Surgery of the Hand.)

Key words: Flexor pollicis longus, avulsion, musculotendinous area.

The musculotendinous junction together with the bony insertion are considered the weakest links of the musculotendinous chain, the former being by far the more common site of rupture.[1] Despite this only 6 closed flexor tendon ruptures at the musculotendinous area have been reported to date.[1–3] Of these 6 ruptures 3 ruptures involved the flexor digitorum superficialis and the remaining 3 ruptures involved the flexor pollicis longus.[1–3] With the exception of traumatic conditions associated with digit amputations this type of injury is very rare for the flexor pollicis longus[1,3] where avulsions of the entire tendon length in any given digit can occur, including the thumb.[4–8] Moreover the anatomy and profound functional importance of this tendon render this type of injury unique.

We present a case of traumatic avulsion of the flexor pollicis longus tendon from its musculotendinous junction resulting from extreme longitudinal force applied to the tendon after an open hand injury. The chosen technique for direct repair led to a very satisfactory functional outcome without the need for a tendon transfer.

Case Report

A 14-year-old girl sustained direct trauma to the right dominant hand when she slipped while climbing a fence and a pointed spear-like bar entered her palm at the thenar eminence just underneath the tendon of the flexor pollicis longus. She impulsively released her grip and that left her momentarily hanging from the FPL tendon. This resulted in complete proximal avulsion of the flexor pollicis longus tendon from its

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Figure 1. Preoperative view of avulsion of the entire tendon of the flexor pollicis longus through the thenar wound.

muscle belly and laceration of the flexor pollicis brevis, the A1 pulley, and the radial digital nerve to the thumb (Fig. 1).

She was admitted to our hospital within 4 hours of the initial injury and was taken immediately to the operating room. General anesthesia was induced and a tourniquet was used after administration of intravenous antibiotics. After thorough wound debridement and copious irrigation a second incision was made in the volar aspect of the distal third of the forearm to access the muscle belly of the flexor pollicis longus. The site of avulsion at the musculotendinous junction was identified and a catheter was introduced from the thenar wound through the carpal tunnel to the forearm wound. The proximal end of the tendon stump was sutured side to side to the distal edge of the catheter. In a modification of the technique described by Sourmelis and McGrouther[9] the tendon subsequently was rerouted through the carpal tunnel to the proximal wound at the level of its own torn muscle belly at the musculotendinous junction. The tendon stump was sutured back to the muscle belly with 4 interrupted 3-0 sutures (Ethibond; Johnson & Johnson, St Stevens-Woluve, Belgium) placed through the tendon and the muscle fibers. Length and tension restoration were checked during surgery by using the tenodesis test. Because the flexor pollicis longus is a unipinate muscle, encapsulation of the tendon stump within the muscle belly was additionally performed to reinforce the repair. The technique used was that of draping the replaced tendon with muscle substance using the same suture material (Fig. 2). Subsequently the A1 pulley was reconstructed and augmented using part of the flexor pollicis brevis tendon. The radial digital nerve of the thumb was sutured end to end with 2 epineural interrupted 8-0 sutures (Prolene; Johnson & Johnson) under microscope magnification. Finally the skin was closed with a 4-flap Z-plasty at the site of the basal skin crease of the thumb to avoid skin contracture. Cefuroxime in conjunction with amikasin and metronidazole were administered for 3 days. An above-elbow plaster cast was used for 3 weeks, followed by below-elbow immobilization for a further 3-week period with the thumb held in moderate flexion and abduction. Passive continuous motion as postoperative rehabilitation was commenced the second postoperative day and active mobilization was initiated 6 weeks after surgery.

The wounds healed promptly and no complica-

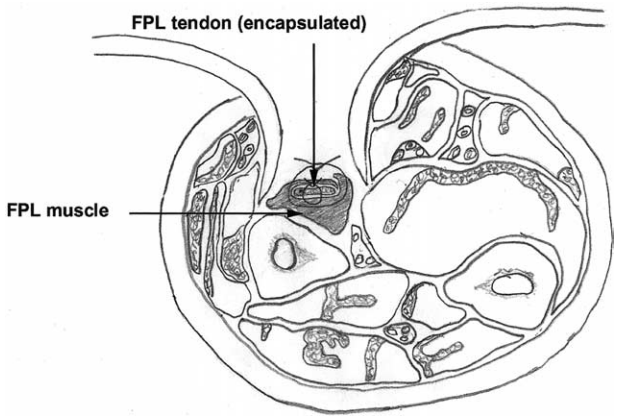

Figure 2. Tendon reconstruction and augmentation with encapsulation of the tendon in the flexor pollicis longus muscle belly.

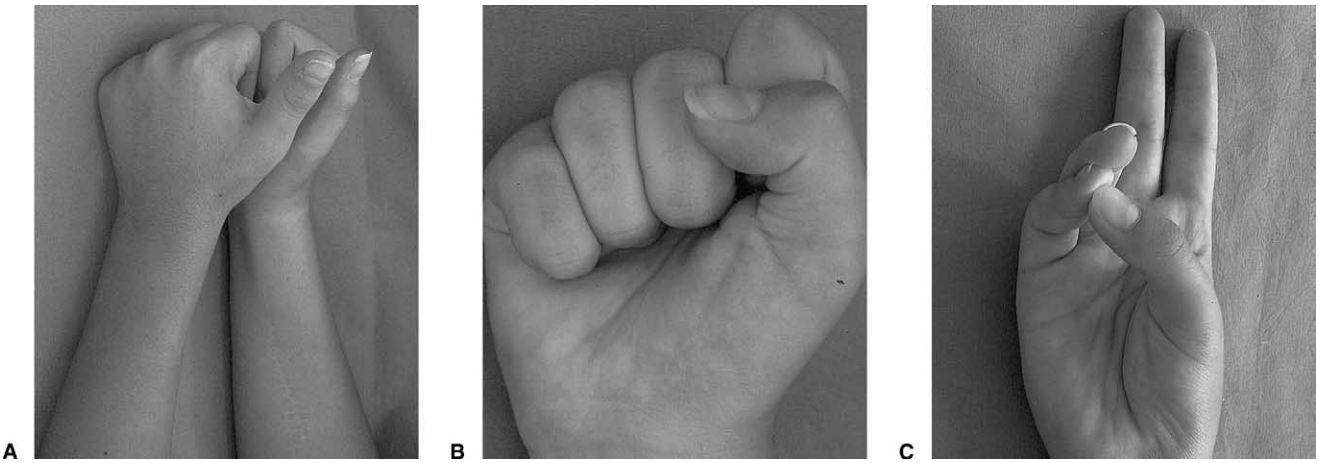

Figure 3. The hand 30 months after surgery. Thumb movement regarding (A) extension, (B) flexion, and (C) opposition at both the metacarpophalangeal and interphalangeal joints returned very close to normal.

tions were observed. Thumb movement at both the metacarpophalangeal and interphalangeal joints returned very close to normal within 4 months (full flexion, 10° extension deficit of the interphalangeal joint of the involved side, full opposition) (Fig. 3). On final follow-up evaluation 30 months after surgery the functional result as evaluated according to the criteria of Fitoussi et al[10] was excellent with a score of 9 of 9. Grip strength was tested with a dynamometer (5030 J1 Jamar Hand Dynamometer; Sammons and Preston, Bolingbrook, IL) and reached 93.7% of the strength of the uninjured side. Key, pulp, and tripod grip strengths were tested with a pinch meter (Baseline Link Pinch meter; Waldemar Link, Hamburg, Germany) and reached 81%, 97.7%, and 90.2% of the strength of the uninjured side, respectively. Two-point discrimination on the patient's thumb was 5 mm at the sensory area of the repaired digital nerve compared with 4 mm on the uninjured side.

Discussion

Avulsion-type injuries of the flexor tendons at their bony insertion and disruptions in the musculotendinous junction associated with traumatic digit amputations have been well documented in the literature.[1,3,5,6,11,12] Subcutaneous rupture of apparently normal flexor tendons occurs infrequently and little has been reported about these ruptures. Isolated flexor tendon rupture at the musculotendinous junction in the absence of digit amputation is a very unusual injury pattern and is believed to result from prolonged longitudinal traction.[1] Only 6 such cases have been reported to date, 3 involving the flexor digitorum superficialis and 3 involving the flexor pollicis longus.[1–3] The rarity of this injury to the flexor pollicis longus combined with the anatomy and profound functional importance of this tendon—because the thumb provides more than 40% of the entire hand's function—render this injury unique and justify every effort for primary repair.[8] Only 3 such cases of closed rupture of the flexor pollicis longus tendon at the musculotendinous junction have been reported to date: 2 by Boyes et al[1] in which no further details were provided by the authors and 1 by Takami et al[3] in a 23-year-old woman who had closed rupture of the flexor pollicis longus while bowling. None of the earlier-described 3 cases was open, nor did these patients have immediate surgery. In the last case a direct repair was impossible, necessitating a tendon transfer in which the flexor digitorum superficialis tendon to the ring finger was transferred to that of the flexor pollicis longus. Furthermore the 2 cases described by Boyes et al[1] occurred through diseased tendons. Our case seems to be the second that occurred through apparently normal tendon. In our case the hand injury was open and the injurious force was extreme. The force was applied directly to the tendon itself, leading to its avulsion from the musculature of the flexor pollicis longus. It is well known from the experimental work of McMaster[13] that when a normal muscle–tendon system is subjected to severe strain the tendon does not rupture. Instead rupture may occur at the insertion of the tendon to bone, at the musculotendinous junction, through the belly of the muscle, or at its origin from the bone. In our case the original soft-tissue trauma involved the thenar region and the base of the thumb. In an effort to minimize further induced soft-tissue trauma and to

preserve the carpal tunnel we used a modification of a technique described by Sourmelis and McGrouther[9] for retrieving retracted flexor tendons with the aid of a catheter. We believe that in the context of extensive soft-tissue trauma in the region, preservation of the carpal tunnel, which is an all-important pulley, and minimizing surgical trauma provided a more favorable environment for tissue healing and functional recovery. Healing of the muscle–tendon complex was successful, which to a certain extent can be attributed to the rich vascularization of the region.[14] There was no evidence of adhesion formation and one could argue that the chosen method of repair, in which soft-tissue trauma was minimized, might have contributed to that. The A1 pulley was repaired in an effort to avoid bowstringing of the tendon and to allow better functional recovery. It is well known that the repair of digital flexor pulleys increases the risk for adhesion formation but it was believed that the advantages that the A1 pulley repair offers in function restoration far outweighed the potential risks, especially in view of the fact that no further surgical trauma was induced with the repair technique used.

The exact type and length of postoperative immobilization after flexor tendon repair remains a matter of contention. Fitoussi et al[10] showed better functional results in patients with above-elbow immobilization for 4 to 6 weeks. The severity of soft-tissue injury in our case led us to follow a rather conservative postoperative rehabilitation regimen of above-elbow immobilization of the thumb for 3 weeks followed by a further 3-week period of below-elbow immobilization with the thumb in moderate abduction and flexion before active movements were commenced. On the other hand passive movements were started on the second postoperative day. This did not lead to functional compromise of any kind.

The case presented is rare with regard to the mechanism of injury. The patient had surgery within 4 hours and the tendon stump was rerouted and refixed to its original position with subsequent encapsulation of the tendon into the muscle belly in an effort to reinforce the repair. Primary repair of all injured tendons regardless of the injury site offers the best chance of speedy return of good function and therefore should be pursued.[11] The modification of the technique described by Sourmelis and McGrouther[9] to retrieve the proximal stump of retracted flexor tendons with the aid of a catheter was used successfully in a vice versa manner to repair the musculotendinous chain with the least possible soft-tissue damage.

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