Bilateral Spontaneous Delayed Extensor Pollicis Longus Ruptures Following Distal Radius Fractures: A Case Report and Review of the Literature

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Abstract
Spontaneous delayed rupture of the extensor pollicis longus (EPL) is a rare complication following distal radius fracture. Bilateral EPL rupture following bilateral distal radius fractures is even rarer. A case report of bilateral EPL rupture following bilateral non-displaced distal radius fractures is presented along with a review of the literature regarding pathophysiology, treatment options, and technical surgical variations.

Introduction
Spontaneous rupture of the EPL is a well-described complication, with many reports of unilateral rupture with various associated pathophysiology. First reported by Duplay in 1876, there have been many cases of unilateral EPL rupture with associated underlying systemic inflammatory conditions, systemic or local corticosteroid use, trauma, and iatrogenic causes including dorsal and volar plate and screw fixation of distal radius fractures [1]. Bilateral spontaneous EPL rupture is a much more rare complication, with few reported cases of varying etiology. The authors have obtained the patient’s informed written consent for print and electronic publication of the case report.

Case Presentation
A 59-year-old, right-hand dominant female without history of systemic inflammatory disease was referred for consultation 4.5 weeks after sustaining bilateral non-displaced extra-articular distal radius fractures after falling while playing tennis. She underwent closed treatment of the bilateral distal radius fractures with splint immobilization. Four weeks post-injury, she developed spontaneous rupture of the left EPL. Initial evaluation of the left hand and wrist demonstrated an inability to retropulse her thumb and no tone with attempted IP extension, consistent with EPL rupture.

Her right hand and wrist demonstrated minimal tenderness of the distal radius as well as more pronounced tenderness over the dorsal aspect of the wrist in the area of Lister’s tubercle and the path of the EPL tendon. She maintained full active range of motion of the right hand and wrist.

Radiographs of the left hand and wrist demonstrated a healing non-displaced extra-articular two-part distal radius fracture. The diagnosis of a ruptured left EPL was determined based upon physical examination. She was offered and agreed to a reconstructive procedure in the form of extensor indicis proprius (EIP) to EPL transfer to restore thumb retropulsion and IP extension.

The patient underwent successful left EIP to EPL transfer using standard tensioning technique at five weeks post-injury. The patient returned to clinic three weeks postoperatively, at which point she had already successfully regained partial left thumb retropulsion and began hand therapy for further retraining of the transfer. Interestingly at that point (six weeks post-injury), she then reported the spontaneous inability to retropulse her right thumb that was confirmed upon examination, consistent with a new rupture of the right EPL. She also continued to have ulnar-sided wrist pain with positive fovea and triangular fibro cartilage complex (TFCC) grind tests, consistent with a right TFCC injury. She agreed to undergo a right EIP to EPL transfer and wrist arthroscopy with TFCC debridement eight weeks after the left EIP to EPL transfer to allow adequate healing and rehabilitation prior to surgery on the contralateral limb.
Eight weeks following the right EPL rupture and 14 weeks following the right distal radius fracture, the patient underwent successful right EIP to EPL transfer and wrist arthroscopy with TFCC debridement. At most recent follow up, three and five months postoperatively on the left and right hands, respectively, the patient had regained full ability to retropulse both thumbs (Figures 1 and 2) while maintaining proper resting tension (Figure 3) and thumb palmar abduction (Figure 4). Strength testing revealed right-handed grip and key pinch strengths of 45 and 10 pounds and left-handed grip and key pinch strengths of 52 and 12 pounds, respectively.

### Discussion

There have been few reported cases in the literature of bilateral spontaneous EPL rupture. Galluci reported a case of EPL rupture following tenosynovectomy for persistent EPL tenosynovitis in one wrist with subsequent rupture of the contralateral EPL following prophylactic subcutaneous EPL transposition for a prominent osteophyte at Lister’s tubercle [1]. Anwar reported bilateral ruptures in a patient with ankylosing spondylitis on prolonged systemic corticosteroid therapy [2]. Mills reported on an elite-level athlete who underwent multiple local corticosteroid injections for extensor tenosynovitis with subsequent spontaneous EPL rupture bilaterally [3]. Each of these cases of bilateral ruptures were identified in an atraumatic setting and due to some intervention.

The incidence of spontaneous unilateral EPL rupture following distal radius fracture has been reported between 0.3% and 5% and more commonly in minimally-displaced than displaced fractures [4]. EPL rupture most commonly occurs between three weeks and three months after a distal radius fracture [5]. The incidence of delayed spontaneous bilateral EPL rupture following distal radius fracture has previously been reported only twice. Hafer initially reported a case in 1987 where the patient sustained bilateral EPL ruptures separated by 18 months following separate episodes of unilateral wrist sprains [5]. More recently in 2000, Payne reported a case of bilateral delayed EPL ruptures following non-displaced distal radius fractures, however each unilateral rupture occurred two years apart following separate isolated unilateral distal radius fractures [6]. To our knowledge, there have been no reports of spontaneous bilateral EPL ruptures following bilateral distal radius fractures sustained at the same setting.

Multiple pathophysiologic mechanisms of spontaneous EPL rupture following distal radius fracture have been proposed, including attenuation and eventual failure of the tendon after repeated excursion over sharp trabecular bone [4]. Higher incidence of EPL rupture following non-displaced than displaced fracture is believed to be secondary to an intact extensor retinaculum that maintains a closed third dorsal compartment. Fracture hematoma, edema, and eventual fracture callus lead to decreased space for EPL tendon excursion via diffusion from the surrounding synovial fluid. Decreased volume and increased intra compartmental pressure resulting from the aforementioned sequelae of fracture with an intact extensor retinaculum leads to decreased synovial fluid nutritional exchange, eventually resulting in necrosis and EPL tendon rupture [1].

Once the diagnosis is confirmed, various treatment options may be considered. Primary repair, tendon transfer, free intercalated autologous tendon grafting, and thumb IP joint arthrodesis have all been described as treatment options for EPL ruptures. Primary end-to-end repair was utilized in the past; however this has fallen out of favor due to poor tendon quality and retraction in the chronic setting. More recently, both tendon transfer and free grafting have been shown to yield favorable postoperative results, thus reserving thumb IP joint arthrodesis as a secondary procedure in most cases. However, arthrodesis may be considered in heavy laborers who require only a firm base for gross movements and grasping.

EIP to EPL tendon transfer is the most widely utilized procedure [7]. Potential extensor lag of the index finger following EIP transfer has led some surgeons to favor free grafting over transfer, especially in patients who require high dexterity of the index finger such as musicians or surgeons. Postoperative weakness and extensor lag
has been shown following EIP to EPL transfer. However subjective limitation does not appear to be clinically relevant in most patients [5]. Furthermore, Schaller found no clinical nor statistically significant difference in each of the Geldmacher criterion between patients who underwent EIP to EPL transfer versus free palmaris longus tendon autograft at a mean follow up of 4.3 years [8].

Different techniques of EIP to EPL transfer have also been described, with the main variation between intra-compartmental versus subcutaneous placement of the tendon transfer. Shah studied the effect of an extra-retinacular tendon transfer on the adduction moment arm (AdMA) at the thumb CMC joint and resting muscle fiber length compared to an intra-compartmental transfer with a pulley system through the extensor retinaculum [9]. Their study found that in a cadaver model, subcutaneous EIP to EPL transfer resulted in a significantly decreased AdMA compared to an intact EPL. However, with the EIP to EPL transfer maintained through a retinacular pulley, a statistically similar AdMA was maintained. To date, there has been no data to suggest any clinical difference between intra-compartmental versus subcutaneous tendon transfer.

Variation in tensioning of the EIP to EPL transfer has also been evaluated. Postoperative extension lag of the thumb has been reported with standard tensioning, therefore leading some to advocate over-tensioning of the transfer [7]. Jung found that there was significantly greater thumb range of motion, less thumb elevation deficit, and greater thumb extension strength with no difference in thumb flexion deficit in the over-tensioned group compared to the standard tensioned group at 12 months postoperatively. However, the majority of both groups achieved favorable outcomes with no functional difference between the two groups with similar DASH scores [7].

The postoperative protocol consists of immobilization with gradual initiation of range of motion and strengthening exercises. Duration of immobilization varies with surgeon preference but has traditionally ranged between three and five weeks, with some authors advocating early dynamic range of motion to hasten the recovery period and return to work [10].

Spontaneous delayed rupture of the EPL remains a rare complication following distal radius fracture. Cognizance toward the possibility of delayed spontaneous EPL rupture is important at each clinical follow up, especially in patients with other risk factors including systemic inflammatory disease or a history of corticosteroid therapy. EIP to EPL tendon transfer has shown to produce excellent postoperative outcomes and continues to be the most commonly utilized treatment.

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**References**