Cureus
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Open Access Case Report

Double Extensor Digiti Minimi Transfer for Thumb Extension: A Case Report

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Review began 10/25/2026
Review ended 11/09/2026
Published 11/12/2026

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DOI: 10.7759/cureus.119536

Abstract

The extensor indicis proprius (EIP) tendon is the most commonly utilized tendon for transfer to restore thumb extension after the loss of extensor pollicis longus (EPL) function. However, certain intraoperative findings, such as frayed or multiple smaller strands, uncertain identification of the tendons, or even the absence of the EIP, may necessitate consideration of an alternative tendon transfer. We present the case of a 54-year-old right-hand-dominant woman who suffered a cat bite two months prior, resulting in a dropped thumb and an inability to extend it. A thorough examination, along with intraoperative findings, confirmed a rupture of the EPL tendon. The EIP tendon could not be utilized because it was absent. Consequently, we successfully reconstructed thumb extension using a double extensor digiti minimi (EDM) tendon transfer. Six months postoperatively, the patient was pain-free and had returned to her previous level of activity. She demonstrated full thumb extension, flexion, opposition, and radial abduction. One year postoperatively, her outcome, assessed using the Geldmacher scoring method, was rated as excellent. Reconstruction of thumb extension using a double EDM tendon transfer should be considered a viable option when the EIP is unavailable as a donor tendon, as it can yield excellent outcomes. To the best of our knowledge, this is the first reported case of such a tendon transfer in an adult following a cat bite, in which the absence of the EIP necessitated a double EDM transfer.

Categories: Plastic Surgery, Trauma, Orthopedics
Keywords: double, extensor digiti minimi, extensor pollicis longus, tendon transfer, thumb extension

Introduction

Thumb extension plays a crucial role in initiating grip and facilitating thumb-index pinch, making the extensor pollicis longus (EPL) vital for nearly all manual activities. Chronic EPL rupture is highly disabling and cannot be addressed with direct suturing because of tendon attrition and muscle retraction [1,2]. Consequently, treatment typically involves tendon transfers or grafts. However, anatomical variations and individual characteristics can contraindicate these procedures [3,4]. Over the years, alternative transfers and tendon plasty techniques have emerged, showing promising outcomes when extensor indicis proprius (EIP) transfer is not feasible [5-8].

The EIP tendon, typically located on the ulnar side of the extensor digitorum communis (EDC) tendon to the index finger, is the preferred option for reconstructing the EPL [9]. However, variations in the extensor tendons of the fingers are common. The typical configuration includes a single EIP tendon inserting ulnar to the EDC tendon of the index finger, single tendons from the EDC to the index and middle fingers, double tendons from the EDC to the ring finger, absence of the EDC tendon to the small finger with a substantial junctura tendinum from the ring EDC to the extensor digiti minimi (EDM), and double EDM tendons inserting into the metacarpophalangeal (MCP) joint hood of the little finger [10].

Given the considerable variability in the anatomy of the extensor tendons of the index finger, certain intraoperative findings may cast doubt on the reliability of the standard EIP transfer method [10]. Such conditions include frayed strands, multiple smaller strands, uncertain identification of the tendons, and even the absence of the EIP [11,12]. In these cases, alternative transfers using the extensor carpi radialis brevis (ECRB), abductor pollicis longus (APL), extensor carpi radialis longus (ECRL), extensor pollicis brevis (EPB), or EDM have been employed to restore EPL function and thumb extension [13-16].

To date, reports of EDM-to-EPL transfers have primarily involved cases of posterior interosseous nerve (PIN) injury, in which the EIP was unavailable because of injury [15], or patients with hypoplastic thumbs and absent EPL, EPB, and EIP tendons [13]. In these cases, single EDM-to-EPL transfers were successfully used as substitutes. However, no prior reports have detailed the use of a double EDM transfer for EPL reconstruction. In this report, we present a successful reconstruction of thumb extension and retropulsion using a double EDM-to-EPL transfer in a patient who suffered an EPL rupture following a cat bite.

Case Presentation

Clinical findings

A 54-year-old right-hand-dominant woman presented two months after being bitten by a cat on her left hand. She was initially diagnosed with a cat bite complicated by cellulitis and was treated successfully with local wound care and oral antibiotics. Although the wound healed, she subsequently noticed a significant problem: her thumb had dropped, and she could no longer extend it.

Physical examination of the left hand revealed a complete loss of active thumb extension at both the MCP and interphalangeal joints, as well as an inability to perform thumb retropulsion. Thumb abduction strength was diminished. Additionally, index finger extension strength was reduced, and the patient was unable to extend the index finger independently, suggesting the absence of an effective independent extensor mechanism (Figure *1*).



FIGURE 1: Preoperative clinical photograph illustrating the extension deficits of both the MCP and IP joints of the left thumb.

IP, interphalangeal; MCP, metacarpophalangeal

Surgical procedure

With a diagnosis of a neglected EPL rupture, a 3-cm transverse incision was made along the dorsum of the

wrist at the site of the old scar. Upon exploration, we identified a ruptured EPL tendon in extensor tendon Zone VII (Figure 2). Our initial plan was to reconstruct thumb extension by performing a tendon transfer using the EIP tendon. A transverse incision was therefore made at the MCP joint of the index finger to locate the EIP. However, only a single extensor tendon was found at the site, indicating the absence of the EIP tendon (Figure 3).



FIGURE 2: Intraoperative photograph revealing the rupture of the EPL tendon.

EPL, extensor pollicis longus

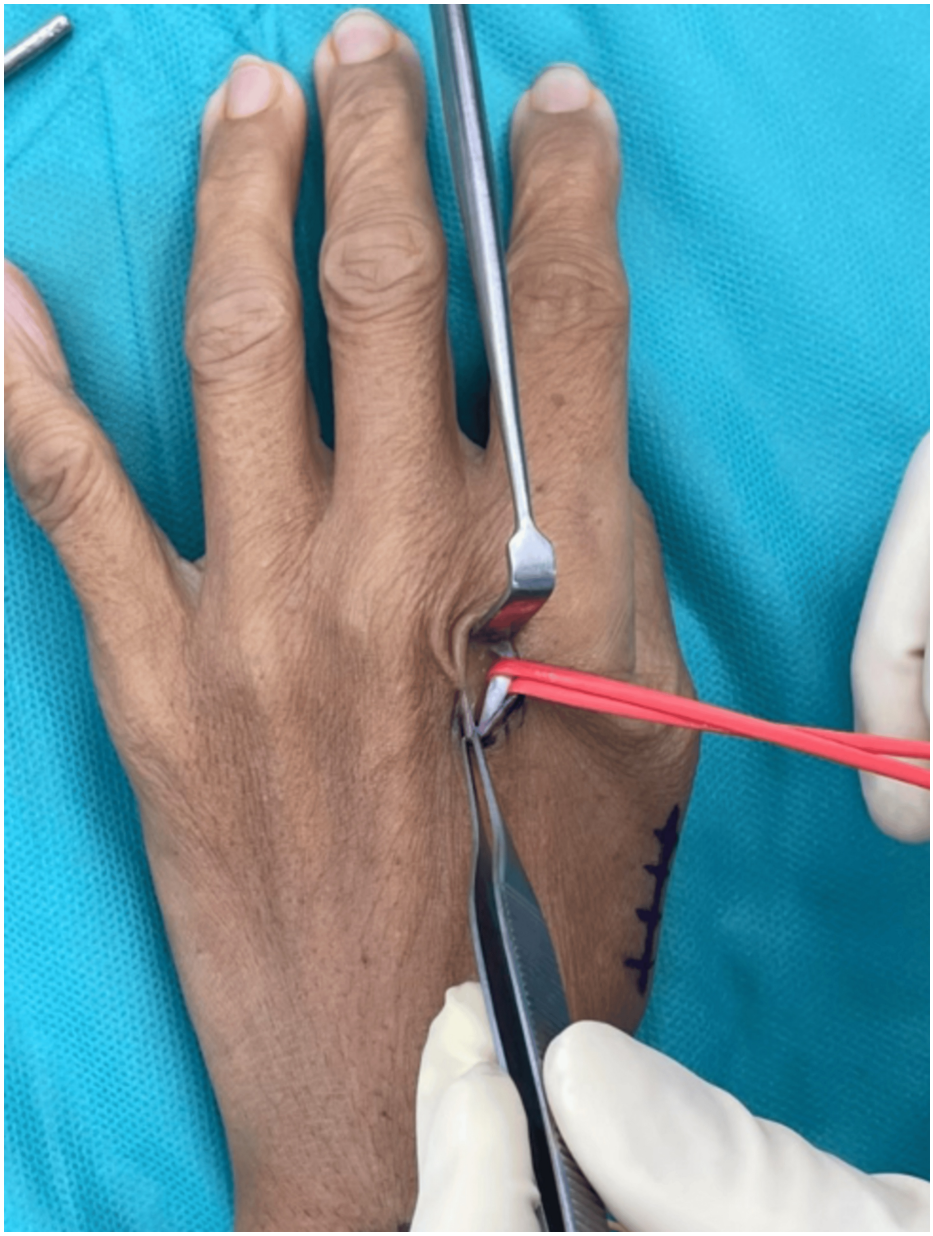


FIGURE 3: Intraoperative photograph demonstrating a single EDC tendon and the absence of the EIP tendon in the index finger.

EDC, extensor digitorum communis; EIP, extensor indicis proprius

Given the absence of the EIP tendon, we opted to perform an EDM-to-EPL tendon transfer. A separate incision was made 2 cm proximal to the MCP joint of the little finger, where we confirmed the presence of an independent slip of the EDC tendon. Additionally, we discovered a double EDM tendon with two insertions into the MCP joint hood (Figure *4A*).

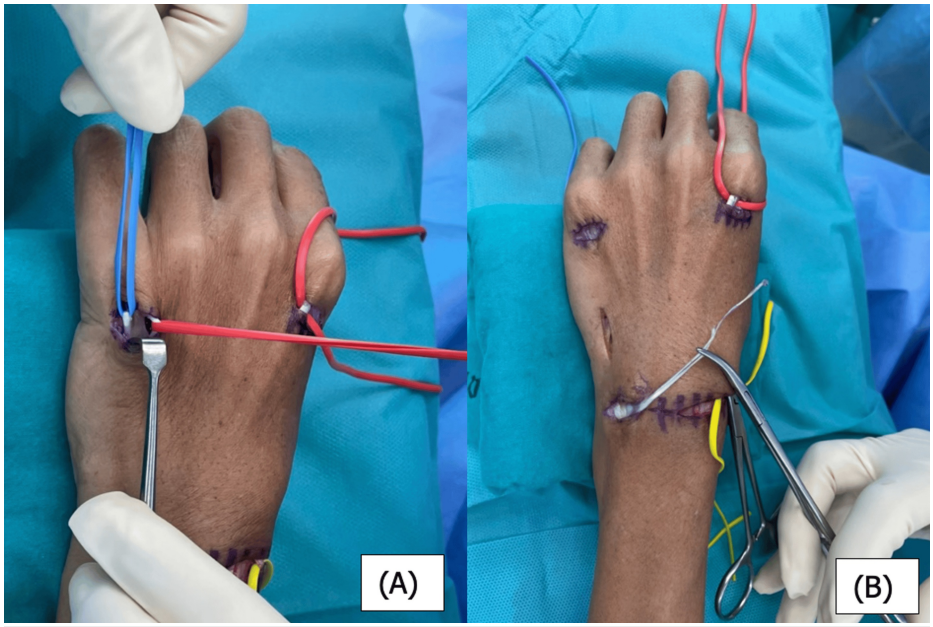


FIGURE 4: Intraoperative photographs.

(A) Double EDM tendons with two insertions into the MCP joint hood. (B) Detachment of both EDM tendon slips and their transfer to the EPL tendon.

EDM, extensor digiti minimi; EPL, extensor pollicis longus; MCP, metacarpophalangeal

Both slips of the EDM tendon were detached and transferred to the EPL tendon (Figure *4B*). A Pulvertaft weave was performed with the thumb positioned in full extension and abduction. Postoperatively, the thumb was immobilized in a short-arm volar blocking splint, with the wrist in 20° to 25° of extension and the thumb maintained in full abduction and extension for six weeks. During this period, passive range-of-motion exercises were encouraged. The patient was informed that data from her case would be submitted for publication, and she provided her consent.

Postoperative follow-up and outcomes

At six weeks postoperatively, the splint was removed, and gentle active range-of-motion exercises were initiated. By three months postoperatively, the patient was permitted to resume full activity. At six months, the patient exhibited full extension, flexion, opposition, and radial abduction of the thumb. At one year postoperatively, her outcome was assessed using the Geldmacher method, a standardized measure of extensor tendon repair outcomes. Her score was 24, with a radial abduction angle of 80°, an elevation deficit of 0.5 cm, an opposition distance of 1.5 cm, and a flexion-extension deficit of 5°, all indicating an excellent result (Figure *5*).



FIGURE 5: Postoperative photograph demonstrating full extension, flexion, opposition, and radial abduction of the thumb at six months.

Discussion

Most patients with an EPL rupture present some time after the injury, making direct repair rarely feasible. Mench first described the use of the EIP tendon for transfer in 1925, and it remains the most commonly used

method for restoring thumb extension [17]. Several alternative tendon transfer methods for EPL reconstruction have been reported, utilizing tendons such as the ECRL, ECRB, APL, and EPB. However, these tendons have notably different force and excursion potentials compared with the EPL [18].

Brand et al. (1981) found that, while the EIP and EPL share parallel origins on the ulna and interosseous membrane, with similar resting excursion potentials, the EPL has approximately 30% greater tension potential than the EIP. They also noted that the EDM has comparable force and excursion potentials to those of both the EPL and EIP [18]. Lieber et al. (1992) conducted a study measuring the force potential (physiological cross-sectional area) and excursion potential (fiber length) of all forearm muscles. They discovered that the individual digital extensor muscles, including the EDM, EIP, and EPL, were relatively similar in architectural structure. Thus, the EDM is considered a viable option for tendon transfer to restore thumb extension and retropulsion [19]. von Schroeder and Botte documented numerous variations of the EDM tendon, including a double tendon extending from origin to insertion; a single tendon with two slips and two insertions; a double tendon that splits into two slips distally with a triple insertion; a double tendon that runs from origin to insertion, featuring a communicating slip between the two; and a triple tendon, with one slip inserting into the ring finger and the other two inserting normally into the small finger [10].

Previous reports have also demonstrated the successful use of the EDM for EPL reconstruction when the EIP is unavailable. Gong et al. described successful reconstruction of thumb extension using an EDM transfer in a child with hypoplasia of both the EPL and EPB, along with the absence of the EIP. The procedure achieved an excellent outcome, with a Geldmacher score of 24 [13]. Similarly, Iyer reported a rare case involving an isolated injury to a branch of the PIN in an adult male patient. Thumb extension was successfully reconstructed using the EDM because both the EIP and APL were unavailable as donor muscles [15]. In our case, the absence of the EIP led us to choose the EDM for transfer. Notably, the EDM tendon consisted of one tendon that split into two slips distally. Therefore, we performed a double EDM transfer to effectively restore thumb extension.

Conclusions

When the EIP tendon is unavailable because of absence, injury, or paralysis, the EDM can serve as an effective alternative donor for restoring EPL function. Moreover, a double EDM transfer for thumb extension has demonstrated excellent results, with complete restoration of thumb extension, flexion, opposition, and radial abduction.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Veeranon Chunyawongsak

Acquisition, analysis, or interpretation of data: Veeranon Chunyawongsak, Nuttapol Khajonvittayakul, Arkaphat Kosiyatrakul, Kittiwan Supichyangur

Drafting of the manuscript: Veeranon Chunyawongsak, Nuttapol Khajonvittayakul, Arkaphat Kosiyatrakul, Kittiwan Supichyangur

Critical review of the manuscript for important intellectual content: Veeranon Chunyawongsak, Nuttapol Khajonvittayakul, Arkaphat Kosiyatrakul, Kittiwan Supichyangur

Supervision: Veeranon Chunyawongsak

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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