

DYNAVISC®

Adhesion Barrier Gel
for Tendon and Peripheral Nerve Surgery



CASE REPORT

Surgical Approach for a Closed Rupture of Extensor Hallucis Longus

Tendon Reconstruction and Peritendineous
Scar Management Strategy with Adhesion
Barrier Gel Application



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Case Introduction

Closed rupture of the extensor hallucis longus (EHL) tendon is a rare yet impactful occurrence in daily life. It is predominantly caused by activities involving extreme dorsiflexion against resistance, degenerative conditions like arthritis, iatrogenic injuries such as those resulting from ankle arthroscopy, and attritional ruptures linked to tendon degeneration induced by local steroid injections. While primary suturing proves effective for acute injuries, the scenario becomes more complex in cases of chronic tears.

Persistent injuries lead to tendon contracture, widening of the gap between tear edges and precluding the possibility of an end-to-end suture. Consequently, secondary reconstruction becomes a necessary intervention. Various surgical techniques for EHL tendon reconstruction have been described, exhibiting satisfactory outcomes. These include interpositional fascia lata allograft, extensor digitorum longus (EDL) tenodesis, and free tendon autograft reconstruction utilizing semitendinosus or gracilis. However, despite the success of these procedures, a frequently reported post-repair complication for EHL tendon injuries is the development of painful scars and fibrotic adhesions, affecting up to 38% of patients.

Addressing this issue is crucial, emphasizing the need for interventions to mitigate fibrosis formation. The application of an adhesion barrier gel is an exceptional tool to reduce adhesions and enhance tendon gliding post-reconstruction. The inclusion of such measures not only improves patient outcomes but also addresses a pivotal aspect of postoperative care in cases of closed EHL tendon ruptures.

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Case Presentation

A 24-year-old female patient presented to the outpatient clinic with complaints of pain in the left foot and difficulty extending her great toe. These symptoms occurred following a cycle of local corticosteroid injections for pain relief following a traumatic injury that occurred two years prior. Physical examination revealed no visible lacerations or scars on the left foot, but there was mild, painful swelling around the affected toe. The toe exhibited a plantar-flexed position, and while passive extension was intact with no limitation of motion, there was dysfunction in active extension (fig. 1). Sensory examination showed no signs of dysfunction.



Figure 1. Preoperative assessment showing no dorsiflexion of 1^o toe.

No biomechanical dysfunction was observed in other ligaments, and there were no deformities in any other phalanx or foot joint except for those associated with the extensor hallucis longus (EHL) tendon. Considering the clinical findings, an iatrogenic subcutaneous rupture of the EHL tendon was hypothesized, prompting the request for magnetic resonance imaging (MRI).

T2-weighted sagittal MRI revealed a loss of continuity in the EHL tendon at its attachment site to the distal phalangeal base. The proximal part of the tendon exhibited retraction to the metatarsophalangeal joint. This imaging confirmed the suspicion of EHL tendon rupture and provided information on the extent of the injury. This case underscores the potential complications associated with local corticosteroid injections, particularly in the context of tendon function. It emphasizes the importance of thorough evaluation including imaging in diagnosing iatrogenic tendon ruptures and in guiding appropriate management strategies for optimal patient outcomes. In the subsequent sections, we discuss the treatment approach and the patient's progress following intervention.

Operative Treatment

The patient was positioned supine, and a pneumatic tourniquet was applied. Subsequently, a dorsal Z-shaped incision was created along the extensor hallucis longus (EHL), extending from the first tarsometatarsal (TMT) joint to the base of the proximal phalangeal joint. This incision provided access to the EHL tendon and the common extensor tendons of the second (II) and third (III) toes. The intraoperative assessment (fig. 2) confirmed the MRI diagnosis of a complete rupture of the EHL tendon at the metatarsophalangeal joint level, with a 4 cm gap filled with scar tissue. Excision of the scar tissue was performed to facilitate tendon mobilization for repair.

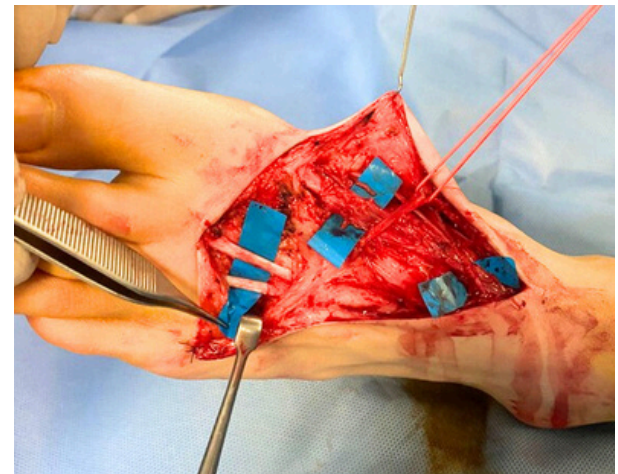


Figure 2. Intraoperative findings: Extensor hallucis longus interrupted at the level of the metatarsophalangeal joint. Presence of scar tissue present up to the proximal stump of the tendon, under the extensor retinaculum.

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Figure 3. Tenotomy of the extensor digitorum longus of 2° toe pro EHL.



Figure 4. Dissection and re-routing of the extensor tendon of the 2° toe for tenodesis to the distal stump of the EHL.

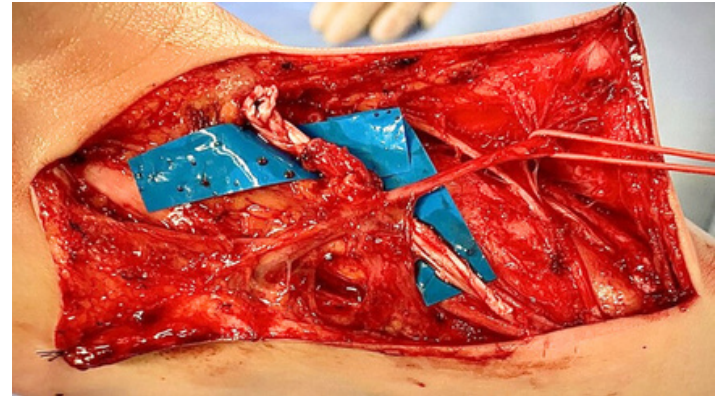


Figure 5. Tendon suture with Pulvertaft technique.

Identification of the extensor digitorum longus (EDL) tendons to the second and third toes followed. Tenotomy of the EDL of the second toe was conducted (fig.3), and the EDL tendon was then retrieved at the proximal wound and rerouted to the distal stump of the extensor hallucis longus tendon (fig.4). Tendon repair utilized the Pulvertaft technique, ensuring a robust suture, appropriate tensioning, and minimizing the need for prolonged immobilization (fig.5). Subsequently, a tenodesis of the remaining distal stump of the EDL of the second toe to the EDL of the third toe was performed.

To mitigate the risk of scar formation due to tendon size mismatch and potential extrinsic adhesion formation, a topical adhesion barrier gel (Dynavisc®, FzioMed, San Luis Obispo, CA, USA) was applied. Dynavisc is a gel composed of two polymers –Carboxymethylcellulose (CMC) and Polyethylene Oxide (PEO)– that serve as a temporary mechanical barrier, persisting at the application site for 28–30 days. This proactive measure effectively separates opposing tissue surfaces during the healing process, preventing the undesirable deposition of scar tissue around the tendons. Wound closure was conducted in a layered fashion. This comprehensive approach not only addressed the ruptured EHL tendon but also incorporated strategic measures to minimize adhesion formation during the recovery phase.

Post-op Management

Following the surgical procedure, the patient's foot and ankle underwent the application of a well-padded, short-leg plaster cast with toe extension in the operating room. Strict, non-weight-bearing instructions were provided for the initial 3 weeks postoperatively. At three weeks post-op, the sutures were removed, and a CAM Walker Boot was introduced for an additional 3 weeks, allowing for partial weight bearing as tolerated. Scar massage with silicon-based cream 2–3 times a day was started. At the 6-week post-op, physical therapy was begun using progressive passive and active range of motion exercises specifically targeting the hallux in a physiotherapy rehabilitation center. The phased reintegration of sports activities was introduced around 3 months postoperative.

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Results

No wound complications, such as infection or dehiscence, were encountered in the first postoperative examination. The patient was then consistently followed throughout the postoperative management and evaluated at 1 week, 3 weeks, 1 month, 6 months, 1 year, and 2 years. Video documentation of mobility progress was taken at 1 month, 1 year, and 2 years, assessing the patient's dorsiflexion and gait. No complications were reported, with optimal progressive outcomes assessed using the American Orthopedic Foot and Ankle Society (AOFAS) Hallux Metatarsophalangeal Interphalangeal score and the Lipscomb and Kelly grading system for EHL tendon repairs.



Early one-month evaluation video.

[LINK to 38 second 1-Month to 2-Year Follow-up VIDEOS](#)

<https://youtu.be/X5kUG90xDm0>



One-year follow-up evaluation video.

At the one-year follow-up, the patient demonstrated complete successful recovery with regained active and passive hallux extension at the metatarsophalangeal joint. No loss of active or passive plantarflexion in the hallux interphalangeal joint was observed. Optimal gliding of the tendons was observed, with no formation of adhesions or painful scars. Regarding the second toe, the patient experienced no dysfunction, and there were no secondary deformities noted during follow-up assessments.

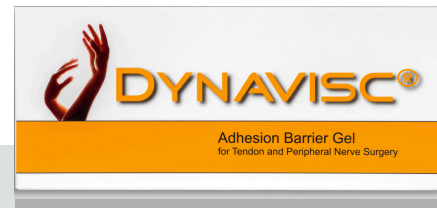


Two-year follow-up evaluation video.

No scar complications or late ruptures were encountered, and the patient reported complete satisfaction with the procedure during the final follow-up at two years.

Discussion

The presented case report addresses the challenges and surgical complexities of managing a closed rupture of the extensor hallucis longus (EHL) tendon. Closed EHL tendon ruptures, though infrequent, demand understanding due to their impact on daily activities. This case, triggered by local corticosteroid injections, emphasizes the importance of evaluating the right treatment choice and the risk involved with this procedure.



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Discussion continued

The treatment landscape for chronic EHL tendon tears presents a complex scenario. While acute injuries may benefit from primary suturing, chronic tears necessitate secondary reconstruction due to tendon contracture and the widening gap between tear edges. This case employed functional reconstruction with tenodesis of the extensor digitorum longus (EDL) from the second toe and tendon suture with the Pulvertaft technique and the application of Dynavisc adhesion barrier gel to mitigate postoperative adhesion complications.

Despite various surgical techniques demonstrating satisfactory outcomes in EHL tendon reconstruction, the persistent issue of painful scars and fibrotic adhesions post-repair remains a challenge. For this reason, the application of an antiadhesion gel, such as Dynavisc, is a promising strategy to address this concern. By reducing adhesions and facilitating enhanced tendon gliding, Dynavisc plays a central role in postoperative care for EHL tendon ruptures and reduces the chances of re-operation due to adhesions.

The surgical procedure described in this case report involved several steps, including scar tissue excision, tendon repair, and the use of Dynavisc to prevent adhesion formation. The subsequent sections highlighted the importance of a postoperative management plan involving adequate immobilization and rehabilitation protocol with a specific physical therapy-guided protocol, with the goal of optimizing functional outcomes.

Conclusion

This case report not only addresses the complexity of closed EHL tendon ruptures but also introduces a surgical approach incorporating an antiadhesion gel application. The positive outcomes observed in this case underscore the potential of adhesion barrier gels in minimizing postoperative complications such as adhesions, thereby enhancing the success of EHL tendon reconstruction. Further clinical research and broader clinical studies are warranted to validate the efficacy of such strategies and contribute to the evolving landscape of tendon repair and reconstruction.

The postoperative results in this case were favorable, with no encountered wound complications or complications related to the surgical procedure. The patient's recovery, assessed through various follow-up intervals, showcased regained hallux extension, preserved plantarflexion, and optimal tendon gliding. The absence of scar complications, late ruptures, and the patient's reported satisfaction at the final follow-up at two years emphasize the success of the chosen management strategy.

Bibliography:

- Kass J.C., Palumbo F., Mehl S., Camarinos N. Extensor hallucis longus tendon injury: An in-depth analysis and treatment protocol. J. Foot Ankle Surg. Off. Publ. Am. Coll. Foot Ankle Surg. 1997;36:24-27. doi: 10.1016/S1067-2516(97)80006-3.
- Kurashige T. Chronic extensor hallucis longus tendon rupture treated with double-bundle autograft of extensor hallucis capsularis: A case report. SAGE Open Med Case Rep. 2019 Apr 9;7:2050313X19841962. doi: 10.1177/2050313X19841962. PMID: 31007922; PMCID: PMC6457017.
- Kim WJ, Jung KJ, Ahn H, Yeo ED, Lee HS, Won SH, Lee DW, Ji JY, Yoon SJ, Hong YC. Reconstruction of a Neglected, Extensor Hallucis Longus Tendon Rupture Using Interposed Scar Tissue: A Case Report and Literature Review. Int J Environ Res Public Health. 2021 Nov 19;18(22):12157. doi: 10.3390/ijerph182212157. PMID: 34831920; PMCID: PMC8619473.
- Wong J.C., Daniel J.N., Raikin S.M. Repair of acute extensor hallucis longus tendon injuries: A retrospective review. Foot Ankle Spec. 2014;7:45-51. doi: 10.1177/1938640013514271.
- Corduneanu-Luca AM, Pasca SA, Tamas C, Moraru DC, Ciuntu B, Stanescu C, Hreniuc-Jemnoschi I, Tecuceanu A, Stamate T. Improving flexor tendon gliding by using the combination of carboxymethylcellulose-polyethylene oxide on murine model. Exp Ther Med. 2022 Jan;23(1):105. doi: 10.3892/etm.2021.11028. Epub 2021 Dec 1. PMID: 34976147; PMCID: PMC8674966.
- Riccio, Michele. "Prevention Of Peritendinous Adhesions After Tenolysis By Means Of A Carboxy-Methylcellulose (Cmc), Poly-Ethylene Oxide (Peo) Based Gel: A Light And Electron Microscope Study In The Rabbit." (2015).
- Bassetto F, Pajardi G, Battiston B, Corain M, Sargenti S, Scarpa C, Novelli C, Tiengo C, Vitali A, Facchin F, Bertolini M, Cara L, Caruso G. Efficacy And Safety Of Dynavisc® Gel In Prevention Of Scar Adhesions Recurrence After Flexor Tendons Tenolysis In Zone 2. Multicenter Retrospective Cohort Study. Ann Ital Chir. 2023;94:529-536. Pmid: 38051506.
- Bastias GF, Cuchacovich N, Schiff A, Carcuro G, Pellegrini MJ. Technique tip: EDL-to-EHL double loop transfer for extensor hallucis longus reconstruction. Foot Ankle Surg. 2019 Jun;25(3):272-277. doi: 10.1016/j.fas.2017.11.005. Epub 2017 Dec 6. PMID: 29409181.
- Tuennemann L, Jordan MC, Paul MM, Jansen H, Meffert RH, Hoelscher-Doht S. Local Autograft and Strong Pulvertaft Fixation Technique for Reconstruction of a Rupture of the Extensor Hallucis Longus Tendon: A Case Report. J Foot Ankle Surg. 2019 Nov;58(6):1276-1280. doi: 10.1053/j.fas.2019.03.017. Epub 2019 Sep 25. PMID: 31562065.