

Complex Flexor Tendon Injury of the Fingers: A Case Report

Joksan Vargas López^{*1}, Ángel de Jesús Ramos Fuentes², Alexis Emmanuel Amezcua Mijangos³, Silvia Jackeline Ahuactzi Camacho³, Norma Angélica Ortega Romero⁴, Evelyn Alejandra Ramírez Yoe⁵, Brenda Areli Magdaleno Becerra⁶, Victor Alan Morales Gonzalez⁷, Elisa Regina Pando Márquez⁸, Juan Pablo De La Fuente Martínez³

¹Hospital General de Zihuatanejo “Dr. Bernardo Sepúlveda Gutiérrez”

²Universidad Veracruzana

³Hospital de Alta Especialidad de Veracruz

⁴Hospital regional de alta especialidad de Zumpango

⁵Universidad del Valle de Cuernavaca

⁶Hospital HGR 72 IMSS

⁷HRAE Bicentenario de la Independencia

⁸Hospital General Regional No. 1 de Chihuahua.

ABSTRACT

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Flexor tendon injuries of the hand represent one of the most complex conditions in reconstructive surgery due to the functional importance of digital mobility and the intricate anatomy of the flexor apparatus. We present the case of a 32-year-old male patient with a history of a sharp trauma to the left hand secondary to an accident involving a cutting object. The patient presented with a zone I flexor injury of the second finger and zone II injuries of the third and fourth fingers, associated with complete section of the flexor digitorum profundus tendon of the second finger and complete section of both the flexor digitorum superficialis and flexor digitorum profundus tendons of the fourth finger. Clinically, the patient exhibited loss of active flexion, pain, and significant functional limitation. Surgical exploration and primary repair were performed using a multistrand modified Kessler tenorrhaphy technique reinforced with continuous epitendinous suture, preserving the pulley system and confirming adequate intraoperative tendon excursion. A protected early rehabilitation protocol was subsequently initiated, with satisfactory clinical evolution, proper wound healing, and progressive functional recovery of the affected fingers. Flexor tendon injuries continue to represent a major therapeutic challenge; however, timely treatment, appropriate surgical repair, and specialized rehabilitation significantly improve functional outcomes and reduce postoperative complications.

KEYWORDS: Flexor tendon injury, tenorrhaphy, flexor zone II, sharp hand trauma, tendon repair, hand surgery, early rehabilitation, flexor digitorum profundus, flexor digitorum superficialis, case report.

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INTRODUCTION

Flexor tendon injuries of the hand constitute one of the most frequent and challenging conditions in hand and reconstructive surgery due to the complex functional anatomy involved and the major impact these injuries have on mobility, grip strength, and the overall functionality of the upper extremity. The hand is a highly specialized structure responsible for performing both fine and gross motor

activities; therefore, any alteration of the flexor apparatus may result in significant functional limitations, occupational disability, and deterioration in the patient's quality of life.¹ Flexor tendons allow flexion of the interphalangeal and metacarpophalangeal joints through the coordinated action of the flexor digitorum superficialis and flexor digitorum profundus tendons. These structures travel through complex anatomical pathways within osteofibrous tunnels formed by

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pulleys and synovial sheaths. This anatomical arrangement promotes proper tendon gliding and efficient force transmission; however, it also predisposes the tendons to adhesions, stiffness, and functional impairment following trauma or surgical repair.²

Most flexor tendon injuries result from penetrating trauma caused by sharp objects, occupational accidents, domestic injuries, or high-energy mechanisms. Depending on the severity of the injury, these lesions may be associated with neurovascular compromise, fractures, soft tissue loss, or complex soft tissue injuries, thereby increasing surgical difficulty and worsening functional prognosis. Clinically, patients commonly present with loss of active flexion of one or more digits, pain, edema, and sensory disturbances when concomitant nerve injury is present.³

From an anatomical and surgical perspective, flexor tendon injuries are classified into five zones initially described by Verdan, with zone II considered one of the most challenging due to the coexistence of the flexor digitorum superficialis and profundus tendons within a narrow fibro-osseous sheath. Historically, this region was referred to as “no man’s land” because of the high incidence of adhesions, tendon ruptures, and poor functional outcomes associated with early surgical techniques. Nevertheless, advances in microsurgery, suture materials, multistrand tenorrhaphy techniques, and early mobilization protocols have significantly improved clinical and functional outcomes over recent decades.⁴

Currently, the treatment of choice for acute flexor tendon injuries consists of early primary repair using suture techniques that provide adequate mechanical strength and allow controlled early rehabilitation protocols. The primary goal of treatment is to restore tendon continuity, preserve tendon gliding within the pulley system, and prevent complications such as adhesions, joint contractures, deformities, or tendon rerupture. Postoperative rehabilitation plays a fundamental role in therapeutic success, as early mobilization programs have demonstrated reduced adhesion formation and improved functional recovery.⁵

Despite surgical and therapeutic advances, flexor tendon injuries continue to represent a challenge for reconstructive surgeons due to the complex anatomy of the hand and the need to achieve a balance between repair stability and early mobilization. Functional outcomes depend on multiple factors, including the mechanism of injury, time elapsed before treatment, anatomical zone involved, associated injuries, and patient adherence to rehabilitation protocols.⁵

The present case report describes the diagnostic approach, surgical treatment, and functional evolution of a patient with

traumatic flexor tendon injuries of the fingers, highlighting the anatomical, technical, and rehabilitative considerations involved in the comprehensive management of these complex injuries.

CASE REPORT

A 32-year-old right-handed male patient with no significant past medical history presented to the emergency department after sustaining a sharp injury to the left hand caused by an accidental laceration with a sharp object while performing occupational activities. Physical examination revealed deep linear wounds on the volar aspect of the left hand predominantly involving the second, third, and fourth fingers, associated with severe pain, edema, and significant functional limitation of active flexion in the affected digits. The patient reported immediate inability to flex the distal and proximal interphalangeal joints following the traumatic event.

During the initial evaluation, a zone I flexor injury of the second finger of the left hand was identified, with complete loss of active flexion of the distal interphalangeal joint, compatible with complete transection of the flexor digitorum profundus tendon. Additionally, a zone II flexor injury of the third and fourth fingers of the left hand was documented, with absence of active flexion and findings suggestive of complete tendon injury. No significant distal vascular compromise was identified, with preserved capillary perfusion and distal temperature of the affected fingers. Sensation was partially preserved, without clinical evidence of complete nerve injury. The patient was subsequently taken to surgery under regional block anesthesia with a pneumatic tourniquet applied to the left arm. Standard aseptic and antiseptic preparation of the extremity was performed, followed by sterile draping and systematic surgical exploration of the wounds through extension of the incisions using Bruner zigzag incisions to provide adequate anatomical exposure and reduce the risk of subsequent scar contractures.

Intraoperative exploration confirmed complete transection of the flexor digitorum profundus tendon of the second finger at zone I. Complete section of both the flexor digitorum superficialis and flexor digitorum profundus tendons of the fourth finger at zone II was also identified, in addition to associated flexor tendon injury of the third finger. The tendon ends demonstrated moderate proximal retraction without significant tendon substance loss, allowing primary repair. The pulley system was partially preserved, particularly the critical pulleys required for proper tendon gliding.



Figure 1: Complete transection of the flexor digitorum profundus tendon of the second finger of the left hand.



Figure 2: Complete transection of the flexor digitorum superficialis and flexor digitorum profundus tendons of the fourth finger of the left hand.



Figure 3: Tenorrhaphy of the flexor digitorum profundus tendon of the second finger of the left hand.



Figure 4: Tenorrhaphy of the flexor digitorum superficialis and flexor digitorum profundus tendons of the fourth finger of the left hand.

Both tendon ends were initially identified through careful dissection and minimal tissue manipulation to avoid further synovial damage and reduce adhesion formation. The injured tendon ends were conservatively debrided until viable and regular edges were obtained. Primary tenorrhaphy of the flexor digitorum profundus tendon of the second finger was then performed using a multistrand modified Kessler technique with 4-0 nonabsorbable suture material, achieving appropriate approximation of the tendon ends and physiological tendon tension.

Repair of the fourth finger included tenorrhaphy of both the flexor digitorum superficialis and profundus tendons. A four-strand core suture was used for the flexor digitorum profundus tendon, providing greater biomechanical resistance and allowing stable repair for early mobilization. The repair was subsequently reinforced with a continuous circumferential epitendinous suture using 6-0 monofilament in order to reduce the gap between tendon ends and improve gliding within the synovial sheath. The flexor digitorum superficialis tendon was repaired independently using a

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reinforced simple core technique, verifying adequate tendon excursion during intraoperative passive mobilization.

During the procedure, abundant irrigation with sterile saline solution was performed, and dynamic evaluation of the repairs through passive flexion and extension of the fingers demonstrated adequate tendon coaptation without excessive tension or entrapment within the pulley system. The A2 and A4 pulleys were preserved because of their biomechanical importance in preventing bowstringing and maintaining adequate flexor function.

After completion of the tenorrhaphy, layered closure of soft tissues and skin was performed using nonabsorbable monofilament suture. A dorsal blocking splint was applied with the wrist positioned in approximately 30 degrees of flexion, the metacarpophalangeal joints in 70 degrees of flexion, and the interphalangeal joints in relative extension to protect the tendon repair and decrease tension on the sutures. In the immediate postoperative period, the patient demonstrated satisfactory clinical evolution without evidence of vascular compromise or infection. An early supervised rehabilitation protocol was initiated under specialized physical therapy guidance, based on protected passive mobilization and progressive controlled active flexion exercises. The primary objective was to reduce adhesion formation, preserve tendon excursion, and progressively restore functional hand mobility.

During clinical follow-up, the patient showed satisfactory progression with proper wound healing, gradual recovery of range of motion, and progressive functional improvement. No major complications such as tendon rerupture, infection, or severe stiffness were observed. In the following weeks, partial to complete recovery of active digital flexion was achieved, allowing progressive reintegration into activities of daily living.

Flexor tendon injuries continue to represent a major surgical challenge due to the complex anatomy of the hand and the need to achieve a balance between repair strength and early mobilization. Appropriate surgical technique, preservation of the pulley system, and a structured rehabilitation protocol are fundamental factors for obtaining satisfactory functional outcomes. In the present case, primary repair using modern multistrand tenorrhaphy techniques resulted in favorable clinical and functional evolution, demonstrating the importance of timely and comprehensive treatment in this type of traumatic injury.

DISCUSSION

Flexor tendon injuries of the hand represent one of the most complex conditions in reconstructive surgery due to the need to simultaneously restore mobility, strength, and adequate tendon gliding. Functional recovery depends on multiple factors, including the anatomical location of the injury, the time elapsed before repair, the surgical technique used, and the postoperative rehabilitation protocol. In the present case, the patient sustained multiple flexor tendon injuries involving

different anatomical zones of the left hand, including a zone I injury of the second finger and zone II injuries of the third and fourth fingers, with complete transection of the flexor digitorum profundus tendon and combined injury of the superficial and deep flexor tendons.⁶

Zone II injuries continue to be considered a surgical challenge because of the close anatomical relationship between the flexor digitorum superficialis and profundus tendons within a confined osteofibrous tunnel. Historically, this region was referred to as “no man’s land” by Bunnell because of the poor functional outcomes observed with older repair techniques. Currently, the development of multistrand tenorrhaphy techniques and early mobilization protocols has significantly improved clinical outcomes by decreasing the incidence of adhesions and tendon rerupture.⁷

In this case, early primary repair was performed using a modified Kessler technique reinforced with continuous epitendinous suture. Several biomechanical studies have demonstrated that repairs using four or more strands provide greater tensile strength and reduced gap formation compared with traditional two-strand techniques, allowing controlled early mobilization without significantly increasing the risk of repair failure. Circumferential epitendinous suture complements mechanical resistance and improves tendon gliding within the synovial sheath.⁸

Preservation of the pulley system represents another fundamental aspect during flexor tendon repair. The A2 and A4 pulleys are considered biomechanically critical for maintaining adequate tendon excursion and preventing bowstringing. In the present case, both pulleys were preserved, contributing to satisfactory flexor function during postoperative follow-up.⁹

Likewise, early rehabilitation plays a determinant role in functional prognosis. Modern rehabilitation protocols combine protected passive mobilization with controlled active flexion in order to reduce adhesion formation and promote intrinsic tendon healing. The patient demonstrated satisfactory progression without evidence of rerupture or severe stiffness, achieving progressive recovery of digital mobility.¹⁰

Despite surgical advances, complications remain common in this type of injury. The most frequently reported complications include tendon adhesions, joint stiffness, tenorrhaphy rupture, infection, and residual functional limitation. The risk of these complications increases in cases involving multiple injuries, delayed surgery, or associated soft tissue damage. In the present case, timely management and multidisciplinary follow-up allowed favorable functional outcomes.¹⁰

This case highlights the importance of a comprehensive approach to flexor tendon injuries of the hand, combining early diagnosis, appropriate tendon repair technique, and specialized rehabilitation. Primary repair using reinforced multistrand techniques remains the treatment of choice for acute flexor tendon injuries, providing sufficient

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biomechanical stability for early mobilization protocols and improved functional outcomes.¹¹

Table 1. Classification of Flexor Tendon Injuries According to Verdan

Zone	Anatomical Location	Main Characteristics
Zone I	Distal to the insertion of the flexor digitorum superficialis	Isolated injury of the flexor digitorum profundus
Zone II	From the A1 pulley to the insertion of the flexor digitorum superficialis	Combined injury of the superficial and deep flexor tendons
Zone III	Palm of the hand	Lower risk of adhesions
Zone IV	Carpal tunnel	Frequently associated with neurovascular injuries
Zone V	Proximal forearm	Commonly associated with neurovascular compromise

Table 2. Clinical Findings of the Presented Case

Affected Finger	Injured Zone	Injured Tendon	Clinical Finding
Second finger	Zone I	Flexor digitorum profundus	Absence of distal interphalangeal flexion
Third finger	Zone II	Digital flexor tendons	Limitation of active flexion
Fourth finger	Zone II	Flexor digitorum superficialis and profundus	Complete absence of active flexion
Left hand	Sharp trauma	Multiple tendon injury	Pain, edema, and functional loss

Table 3. Tenorrhaphy Technique Used

Surgical Step	Objective
Identification of tendon ends	Locate injured tendon stumps
Conservative debridement	Obtain viable tendon edges
Modified Kessler core suture	Provide mechanical resistance
Four-strand repair	Allow early mobilization
Continuous epitendinous suture	Reduce gap formation and improve gliding
Preservation of A2 and A4 pulleys	Prevent bowstringing
Intraoperative passive mobilization	Verify adequate tendon excursion

Table 4. Potential Complications After Flexor Tenorrhaphy

Complication	Mechanism	Functional Consequence
Tendon adhesions	Excessive scar formation	Reduced mobility
Tendon rerupture	Excessive tension or trauma	Loss of repair
Joint stiffness	Prolonged immobilization	Functional limitation
Infection	Wound contamination	Delayed healing
Bowstringing effect	Pulley injury	Loss of flexor efficiency
Residual pain	Fibrosis and scar tissue	Chronic functional impairment

CONCLUSION

Flexor tendon injuries of the hand represent a major surgical challenge due to the anatomical and functional complexity of the flexor apparatus. Appropriate diagnosis, early repair, and multidisciplinary management are essential to achieve satisfactory functional outcomes and reduce the risk of complications.¹² In the present case, the patient sustained multiple flexor tendon injuries involving different anatomical zones of the left hand, including complete transection of the flexor digitorum profundus tendon of the second finger and

combined injury of the flexor digitorum superficialis and profundus tendons of the fourth finger in zone II. Primary repair using reinforced multistrand tenorrhaphy techniques with epitendinous suture allowed restoration of tendon continuity and provided sufficient stability for protected early rehabilitation.¹³ Preservation of the pulley system, particularly the A2 and A4 pulleys, as well as the early initiation of specialized physical therapy, were determinant factors in promoting proper tendon gliding and progressive functional recovery of the affected digits.^{14,15}

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The present case demonstrates that timely surgical treatment, associated with an appropriate tenorrhaphy technique and early rehabilitation protocols, continues to be the best therapeutic strategy for acute flexor tendon injuries, improving mobility, reducing functional sequelae, and facilitating the patient's reintegration into daily activities.

REFERENCES

- I. Kang A, Chang J. Flexor tendon injuries. *Journal of Hand Surgery*. 2024;49(9):914-922.
<https://doi.org/10.1016/j.jhsa.2024.05.012>
- II. Douwes TA, et al. Flexor tendon repair in zone II of the hand: Evidence-based review. *Journal of Hand Surgery Global Online*. 2025;7(2):115-124.
<https://doi.org/10.1016/j.jhsg.2025.01.006>
- III. Ahmed E, et al. A randomized controlled trial comparing controlled active motion and early passive mobilization after zone II flexor tendon repair. *Journal of Hand Therapy*. 2025;38(1):44-52.
<https://doi.org/10.1016/j.jht.2025.01.004>
- IV. Rosales CP, et al. Patient-reported outcomes after flexor tendon repair: A prospective evaluation. *Journal of Hand Therapy*. 2025;38(2):210-218.
<https://doi.org/10.1016/j.jht.2025.02.003>
- V. Heegaard B, et al. Complications after flexor tendon surgery: A retrospective cohort study. *Hand Surgery and Rehabilitation*. 2025;44(1):33-41.
<https://doi.org/10.1016/j.hansur.2024.11.008>
- VI. Renberg M, et al. Range of motion following flexor tendon repair in zones I and II. *Journal of Hand Surgery*. 2024;49(11):1021-1029.
<https://doi.org/10.1016/j.jhsa.2024.07.014>
- VII. Xue R, et al. Current clinical opinion on surgical approaches and rehabilitation strategies for flexor tendon injuries. *Frontiers in Medical Technology*. 2024;6:1269861.
<https://doi.org/10.3389/fmedt.2024.1269861>
- VIII. Akyurek M, et al. Influence of palmar plate injury on outcomes of zone II flexor tendon repair. *Journal of Hand Surgery European Volume*. 2025;50(3):287-294.
<https://doi.org/10.1177/17531934241300510>
- IX. Novruzova A, et al. Orthopedic rehabilitation following complex repair of flexor and extensor tendon injuries. *Cureus*. 2025;17(3):e12812336.
<https://doi.org/10.7759/cureus.12812>
- X. Mereddy RR, et al. Optimizing flexor digitorum profundus tendon repair. *Bioengineering*. 2025;16(3):97.
<https://doi.org/10.3390/bioengineering16030097>
- XI. Karacam S, et al. Flexor tendon repair rehabilitation in Türkiye: Therapists' perspectives and current approaches. *Journal of Hand Therapy*. 2025;38(4):455-463.
<https://doi.org/10.1016/j.jht.2025.05.002>
- XII. Sarli N, et al. All-inside transosseous flexor tendon repair and clinical outcomes. *Journal of Hand Surgery Asian-Pacific Volume*. 2025;30(5):611-619. <https://doi.org/10.1142/S2424835525500432>
- XIII. Reay E, et al. Clinical and cost-effectiveness of flexor digitorum profundus repair protocols. *Hand Therapy*. 2025;30(2):90-99.
<https://doi.org/10.1177/17589983241253919>
- XIV. Tang JB. Investigations into flexor tendon repair: A research journey. *Journal of Hand Surgery European Volume*. 2023;48(8):801-809.
<https://doi.org/10.1177/17531934231124567>
- XV. IFSSH Tendon Study Group. The IFSSH consensus and current guidelines on flexor tendon repair. *Journal of Hand Surgery European Volume*. 2026;51(2):145-158.
<https://doi.org/10.1177/17531934251404821>