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Case Report

Continuity Of Patient's Compliance And Collaboration Between Surgery And Rehabilitation After 2nd Stage Of Flexor Tendon Reconstruction: A Case Report.

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Abstract

Background: Flexor tendon ruptures involving the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) are complex and challenging to treat. This case report illustrates a successful two-stage tendon reconstruction combined with early physiotherapy.
Case Presentation: A 29-year-old right-handed male presented with an inability to flex his right index finger six months post-injury. MRI showed a partial tear of the FDS, injury to the A2 pulley, and fibrotic tissue. Initial treatments failed to improve the condition. The patient underwent contracture release and a two-stage tendon reconstruction.
Discussion: The first stage involved contracture release surgery followed by second surgery of silicon rod placement to maintain the tendon tunnel and the last surgery consist of rod replacement with palmaris longus tendon graft. Early post-operative physiotherapy began three days post-surgery, focusing on place-and-hold exercises and active extension. At 12 months, the patient achieved nearly 90° flexion at the MCP and PIP joints, and 80° at the DIP joint, with grip strength reaching 77% compared to the unaffected hand. This aligns with literature supporting early rehabilitation.
Conclusion: This case supports the efficacy of two-stage tendon reconstruction and early physiotherapy for neglected flexor tendon ruptures. Further studies with larger cohorts are needed to validate and improve these treatment strategies.

Keywords : two-stage tendon reconstruction, FDS tear, FDP tear, rehabilitation.

INTRODUCTION

The flexor digitorum superficialis originates from multiple points on the volar surfaces of the humerus, ulna, and radius. This muscle is interconnected by a fibrous aponeurosis that overlies the median nerve and ulnar vascular bundle in the forearm. In the mid-forearm, the superficialis muscle belly divides into four bundles, forming superficial and deep layers. The superficial layer sends tendons to the long and ring fingers, while the deep layer sends tendons to the index and small fingers, though the tendon to the small finger may be absent in some individuals.[1]

The flexor digitorum profundus (FDP) is another crucial flexor of the hand, playing a vital role in daily movements. Located in the deep volar compartment, the FDP flexes the wrist and the metacarpophalangeal (MCP) and interphalangeal joints of the second, third, and fourth fingers.[2] Additionally, it assists the lumbricals in extending the fingers at the interphalangeal joints and flexing the MCP joints.[3]

Flexor tendon injuries are common due to their proximity to the skin, making them particularly challenging. These injuries typically require surgical intervention for proper healing, with an estimated incidence of 30-42 per 100,000 people.[4] The choice of surgical procedure depends on various factors, including the patient's condition. Generally, if more than three weeks have passed since the tendon rupture, initial surgery is often unsuccessful and post-surgery muscle function may not be optimal. In such cases, fusion or tendon graft surgery may be necessary.[1]

The surgical technique for flexor tendon injuries involves two

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stages. An intensive physiotherapy program is crucial before the first stage to overcome stiffness and achieve maximum passive motion in both flexion and extension.[5] During Stage I, the injured digit is examined through a Bruner incision, damaged tendons and scar tissue are removed, and any necessary soft-tissue release is performed. Intact annular pulleys are opened only if absolutely necessary, and the distal stump of the flexor digitorum profundus is preserved for pulley reconstruction. A second inverted L-shaped incision in the palm allows for further tendon retrieval and repair. An oval-shaped silicone implant is selected, and injured pulleys are repaired or reconstructed using nonabsorbable sutures and excised tendon material.[6]

After the first stage, passive motion begins three days post-surgery to achieve and maintain full passive flexion until Stage II. Stage II occurs after a minimum of three months, involving retrieval and trimming of the silicone rod, identification and preparation of the corresponding FDS, and suturing of the FDP muscle to the proximal end of the silicone rod. The tension of the graft is adjusted, and the injured finger is stabilized. A splint similar to that used in Stage I is applied, followed by an early controlled motion program. The goal is to ensure optimal tendon function and avoid flexion contractures, with splint and button removal at five weeks, followed by active motion and exercises.[5]

Postoperative care is vital to the success of flexor tendon reconstruction. In the immediate postoperative period, a Kleinert's splint is applied, and early active motion is initiated within 24 hours. The rehabilitation process includes progressive flexion exercises and splint adjustments to prevent flexion contractures and ensure optimal tendon function.[7]

This case report focuses on the importance of patient compliance and the collaborative efforts between surgical and rehabilitation teams in achieving successful outcomes after the second stage of flexor tendon reconstruction.

CASE ILLUSTRATION

Male, 29 years old right-handed patient came with inability to actively flex his right index finger due to injury 6 months before his first clinical attendance. The patient was injured while working with his index finger squashed by pressing machine. From history taking, the patient underwent primary closure treatment and physiotherapy for 6 months without any improvement. On clinical examination, the patient found with hypersensitivity on index finger and passive PIP joint $0^o/30^o$, passive DIP joint $0^o/20^o$ without active movement on both PIP and DIP joint. After gaining consent, patient was planned to undergo contracture release surgery followed by two stages of reconstruction surgery.

Surgical Approach

The first stage surgery planned to release the contracture joints with dorsal incision technique by releasing collateral ligaments to correct PIP and DIP joints extensor lag. Three days after surgery, hand physiotherapy started with Active ROM exercise focusing on index finger and scar massage for desensitisation. Clinical findings on 3 weeks follow-up showing improvement on passive PIP joint movement of $30^o/10^o$ and DIP joint movement of $0^o/30^o$.

After 3 months of the first surgery with improvement of joints movement, the second surgery of flexor tendon reconstruction was planned. First stage tendon reconstruction was initiated by Bruner incision to repair FDS and FDP tendon. During surgery, total tear of FDS and A2 pulley injury was found with bowstringing and loss of flexion at FDP. Moreover, after having good exposure on tendon and pulleys, pulley repair and tunnel was created by inserting silicon rod to prevent collapse of the tunnel. Digital nerve was also released from fibrotic tissues (**Figure 1**). After surgery, hand therapy was focusing on passive flexion ROM exercise and active extension ROM exercise while also maintaining the position with dorsal splint.

Figure 1. Clinical Findings On First Clinical Attendance Found with Hypersensitivity on Index Finger and Passive PIP Joint 0°/30°, Passive DIP Joint 0°/20° and No Active Movement on Both PIP and DIP Joint



As for the physiotherapy, patient was treated with infrared ultrasound underwater due to the hypersensitivity at the scar area and desensitization with soft materials continued with scar massage, tendon gliding and hand function exercises.
On the second stage (the last procedure), exposure of the distal and proximal tip of the silicon rod was done and replaced by palmaris longus graft. The replacement was done by treading the tunnel from the previous surgery (**Figure 2**). Primary closure was done after ensuring stability of the the tendon and movement on flexion and extension. During post-operative care, the hand was neutrally positioned with Kleinert splint to enhance tendon movement until 3 weeks. At this moment, tendon gliding and tight scar was found with good improvement and flexibility Place and hold tenodesis exercise and active extension was also started 4 weeks after the surgery with more aggressive physiotherapy and physical rehabilitation. After 8 weeks, extension splint was applied to prevent flexion contracture. Active and passive assisted therapy in outpatient clinical visit was continued every 2 times per week in conjunction with independent exercise by the patient at home.

Figure 2. Clinical Findings after First Surgery Found with Improvement On Passive PIP Joint Movement Of 30°/10° and DIP Joint Movement of 0°/30°





At 12 months follow-up after surgery, patient was able to flexed at most of nearly 90° at the MCP joint, 90° at the PIP joint, and 80° at the DIP joint. A 10° DIP joint flexion contracture was present (**Figure 3**). On the grip test examination, patient was able to grip at mean of 18.2kg grip strength compared to the other side at mean of 23.5kg grip strength. Patient can gradually returned to all activities.

Figure 3. Intra-operative image exposing of both flexor digitorum profundus and flexor digitorum superficialis tendons loss of flexion and bowstringing.

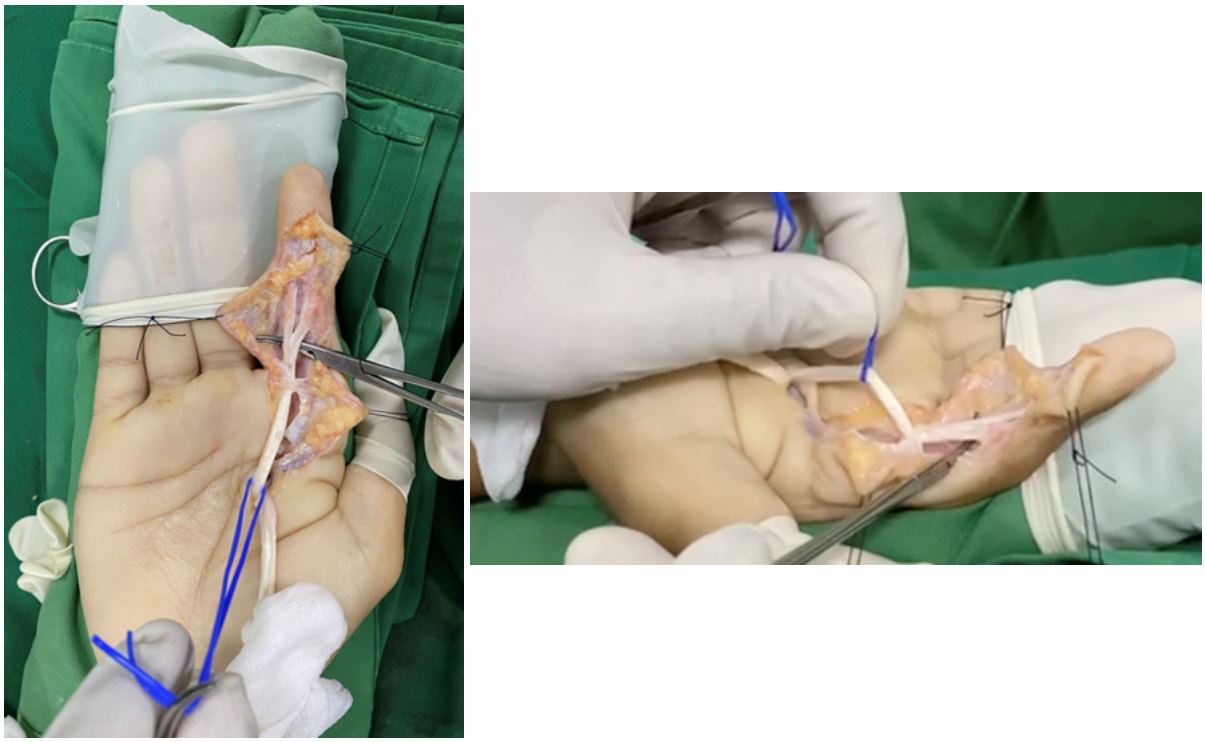


Figure 4. Replacement of Silicon Rod and Graft Insertion and Fixation through pulley's tunnel with minimal incision.

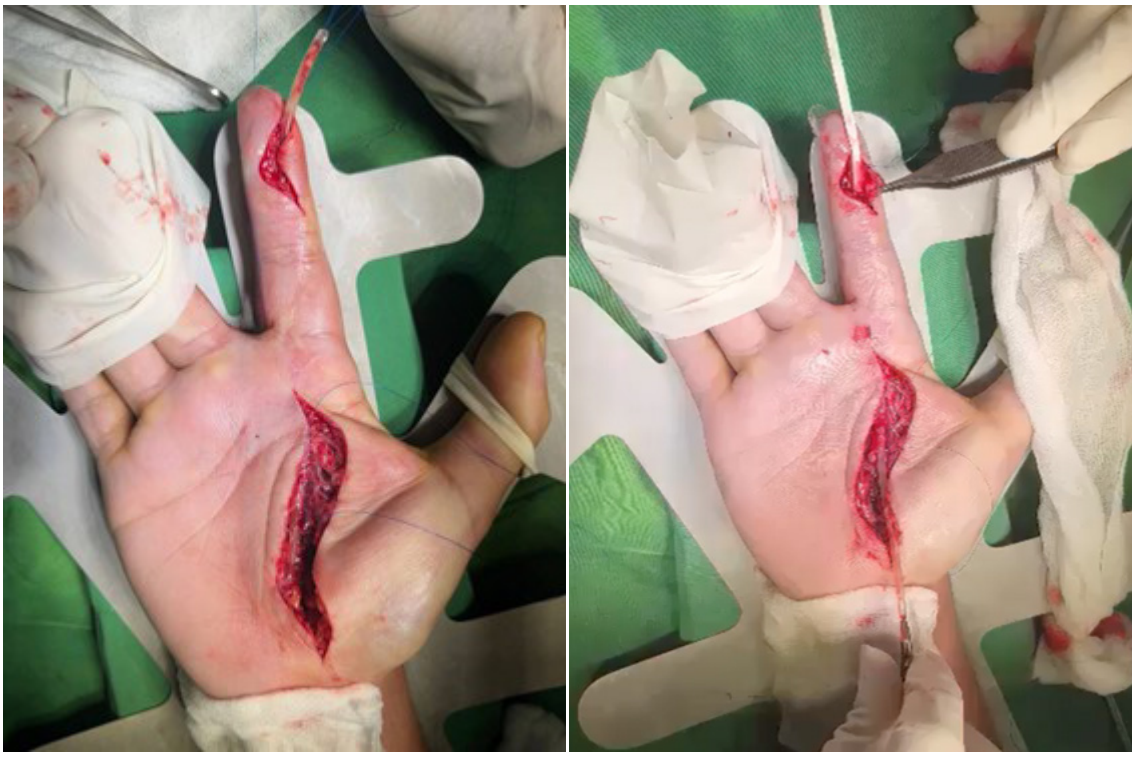


Figure 5. Clinical Outcome at 12 months after 2 Stages of Flexor Tendon Reconstruction Surgery.



DISCUSSION

This case involves a neglected rupture of the FDS and flexor digitorum profundus (FDP) tendons for six months, which was subsequently treated with a two-stage reconstruction using Bruner's incision, with physiotherapy starting three days postoperatively. At the three-week follow-up, there was an improvement in passive PIP joint movement to 30°/10° and DIP joint movement to 0°/30°. Research by Abdul et al. indicated that patients with FDS and FDP ruptures who received reconstructive therapy and rehabilitation promptly after the first stage of surgery benefited from aggressive physiotherapy programs, which helped in overcoming stiffness and achieving maximum passive range of motion.[6] This is also supported

by research conducted by Evans R.B, et al who said exercises that involve wrist tenodesis can enhance the movement of tendons in the finger sheath and higher up. Performing the 'active hold' exercise for the FDS in the injured finger may reduce the impact of adhesions caused by ruptured vincula due to retraction of the profundus tendon, bleeding into the flexor sheath, and surgical trauma during FDP retrieval.[8]

Following surgery, hand therapy focused on passive flexion range of motion (ROM) exercises and active extension ROM exercises, along with maintaining the position using a dorsal splint. Evans R.B. et al.'s study also observed that the early controlled mobilization with Kleinert elastic band technique was used for 3 to 4 weeks. Thereafter, the hand was protected by a dorsal hood splint is placed with the wrist in a relaxed position of 20–30 degrees of flexion to reduce the viscoelastic resistance from the opposing extensor muscles. The metacarpophalangeal (MP) joints are set at 30 degrees of flexion to alleviate tension from the lumbrical muscles on the profundus tendon, facilitating passive positioning of the digits into a modified hook fist position exercise. This approach aims to increase the differential movement of the flexor digitorum profundus (FDP) and flexor digitorum superficialis (FDS) tendons, while also ensuring a safer position for the active tension component of the exercise regimen.[8]

At the 12-month follow-up, the patient exhibited significant improvement, with nearly 90° flexion at the MCP joint, 90° at the PIP joint and 80° at the DIP joint. A residual 10° flexion contracture at the DIP joint was noted. Grip strength tests showed a mean of 18.2 kg in the affected hand compared to 23.5 kg in the unaffected hand, resulting in a grip strength of approximately 77% measured in kilograms. The patient was able to gradually resume all activities, demonstrating a successful surgical outcome and rehabilitation process. Abdul et al.'s study also noted that the average power grip strength reached 80% compared to the unaffected side after 18 months of follow-up.[6] For instance, Tang et al. reported that early motion protocols, combined with proper orthotic support, significantly reduce complications such as joint stiffness and adhesion formation.[9]

Early rehabilitation in the first six to eight weeks post-surgery focuses on protecting the tendon repair.[10] Interventions during this early postoperative period can include patient education, prescription or fabrication of orthoses, exercise regimens, wound care (application of dressings or topical applications), swelling management (e.g., compression therapy, elevation, or cryotherapy), scar management (e.g., massage treatments, topical applications, desensitization programs), and electrotherapy modalities (e.g., neuromuscular electrical stimulation).[11] "Place and hold" regimens involve manually flexing the injured digit using either the patient's uninjured hand or another person (e.g., a physical therapist); the patient then tries to hold the flexed position using the muscle strength of the injured flexor tendon. Bending and straightening the fingers using the patient's own muscle strength without assistance is essential to examine high-quality clinical evidence to determine the effectiveness and safety of rehabilitation interventions for managing flexor tendon injuries of the hand, identifying those most effective in restoring digital motion and function while minimizing the risk of complications and adverse events.[7] Gadallah A, et a study also noted that complete recovery of tendon function necessitates compulsory postoperative physical therapy. Early initiation of physiotherapy is strongly advised to improve tensile strength and reduce the formation of adhesions. Additionally, meticulous postoperative physiotherapy can effectively manage the formation of granulation tissue, preventing any negative impact on tendon gliding.[12] Furthermore, Yang et al. demonstrated that patients who adhere to a structured rehabilitation program, including place-and-hold exercises and active extension, show better recovery trajectories. Their findings corroborate the need for a multidisciplinary approach involving surgeons, physiotherapists, and occupational therapists to optimize patient outcomes.[13]

LIMITATION

Despite the successful outcome in this case, several limitations exist. This report focuses on a single patient, limiting the generalizability of the findings. The patient's adherence to postoperative rehabilitation and individual factors, such as overall health, might have influenced the results. The absence of a control group makes it difficult to attribute improvements solely to the surgical and rehabilitation interventions. Additionally, the long-term sustainability of the functional gains and the potential for recurrence of complications were not extensively addressed. Future studies with larger, controlled cohorts and long-term follow-ups are needed to validate the efficacy and generalizability of this approach.

CONCLUSION

This case report demonstrates the successful treatment of a neglected flexor tendon rupture using a two-stage reconstruction approach. Early and aggressive physiotherapy significantly contributed to the patient's recovery, resulting in improved hand function and grip strength. While the findings are promising, they are based on a single patient and lack a control group. Future studies with larger cohorts and long-term follow-ups are needed to validate these results and refine treatment strategies for flexor tendon injuries.

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