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Case Report

The Combination of Fractional Tendon Lengthening and the Wide Awake, Local Anesthesia, No Tourniquet Technique for Secondary Tendon Reconstruction

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Key words: Case report Flexor tendon Flexor tendon re-repair Fractional tendon lengthening WALANT Rupture is a major concern after primary flexor tendon repair. The predominant treatment for rupture of the primary repair is immediate surgical exploration and repeat repair. However, repeat repair is challenging, including achieving ideal tension in the flexor mechanism. Further, immediate repeat repair is associated with poor outcomes, particularly in the small finger. As such, there is a need to improve both the technique and outcomes of repeat repair of primary flexor tendon rupture. We present a case of primary flexor tendon repair rupture treated with a novel combination of fractional tendon lengthening and the wide awake, local anesthesia, no tourniquet technique. A combination of these techniques has multiple benefits. An intraoperative, dynamic assessment of the digits enables immediate optimization of the repair. Further, these techniques allow for better intraoperative patient education and communication, increasing the likelihood of adherence to postoperative therapy and better overall outcomes.

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Restoration of previously normal function after a flexor tendon injury is difficult. A major concern is repair rupture.¹ Immediate rerepair of the rupture often yields the best results.^{1,2} However, re-

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repair comes with multiple challenges, including making the repair too tight, which hinders the digit extension and may impact patient quality of life. One method to relieve the excess tension is a z-plasty lengthening of the flexor tendon; however, there is little literature on its use in the hand/wrist.³ Additionally, re-repair has been associated with poor outcomes in the little finger, further highlighting the need to improve overall treatment.^{12,4} We present the combination of fractional tendon lengthening (FTL) and the wide awake, local anesthesia, no tourniquet (WALANT) technique to achieve ideal tension and successful re-repair of primary flexor tendon rupture.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Case Report

A 24-year-old man presented with a right-hand laceration due to a table saw injury (Fig. 1A). The patient was unable to actively

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Figure 1. A 24-year-old man sustained a right-hand laceration in the proximal zone 2/distal zone 3 due to a table saw injury and presented to us after visiting the emergency room. **A** The injury severed the FDP and FDS tendons of the right hand, which were repaired surgically. The 10-week postoperative follow-up confirmed a successful repair with full active **B** extension and **C** flexion.

flex the small finger distal and proximal interphalangeal joints. Surgical exploration under WALANT conditions revealed lacerated flexor digitorum profundus (FDP) and flexor digitorum superficialis (FDS) tendons. Moreover, there were nerve lacerations, which were repaired with a cadaveric allograft. The lacerated tendons were repaired using a 6-strand M-Tang configuration with 4-0 sutures (Supramid) followed by 6-0 Prolene epitendinous sutures (Ethicon) circumferentially. The A1 pulley was released to improve tendon gliding without impedance. Intraoperatively, the patient demonstrated full range of motion (ROM) without tendon gapping (Video 1 [available on the Journal's website at www.jhsgo.org]). The patient was enrolled into the St. Johns early active ROM protocol. At the 3-week follow-up, he had the independent function of his small finger FDP and FDS tendons. At the 10-week follow-up, he confirmed a successful repair (Fig. 1B, C; Video 2 [available on the *Iournal's* website at www.ihsgo.org]).

At 11 weeks after surgery, the patient presented for the reevaluation of the right small finger after feeling a popping sensation when opening a car door. The patient explained that he had not been complying with his restrictions and was participating in heavy manual labor shortly after the repair. On examination, the patient was unable to actively flex the distal and proximal interphalangeal joints of the right small finger as at his initial presentation (Video 3 [available on the *Journal's* website at www.jhsgo. org]).

Using the WALANT technique, a surgical exploration under local anesthesia revealed an intact FDS tendon but a ruptured FDP tendon (Fig. 2). The FDP tendon edges were debrided and repaired by the 6-strand M-Tang technique using 3-0 core sutures (Supramid) and 6-0 Prolene epitendinous sutures (Ethicon). Intraoperatively, immediately after the repair, the patient was unable to achieve full active extension of the small finger, suggesting that the repair was too tight (Fig. 3; Video 4 [available on the Journal's website at www.jhsgo.org]). Fractional lengthening of the musculotendinous junction of the FDP and FDS tendons to the small finger was undertaken to relieve this tension (Fig. 4). The palmaris tendon was also harvested and used as an augmentation to the FDP repair. Specifically, the palmaris tendon was used as a spiral wrap around the primary coaptation site and sutured to the FDP repair. Immediately after FTL, the patient demonstrated a full active ROM of the small finger with no evidence of tendon gapping or unsmooth gliding (Fig. 5; Video 5 [available on the Journal's website at www. ihsgo.org]). His 16-week follow-up confirmed a successful re-repair with a full active ROM in the right little finger (Fig. 6; Video 6 [available on the *Journal's* website at www.jhsgo.org]). Twelve months after the re-repair, the patient was fully satisfied with the reconstruction. He returned to all preinjury activities, including



Figure 2. The patient presented with a rupture of the primary repair at postoperative 11 weeks. Specifically, the FDP, but not the FDS tendon, was ruptured.

heavy manual labor. The total active motion was 266°, with a full ROM at the metacarpophalangeal joint and 2° loss of motion at the distal and proximal interphalangeal joints.

Discussion

We present our experience with FTL and WALANT technique as a method to achieve successful re-repair of primary flexor tendon rupture. Fractional tendon lengthening consists of making multiple small tenotomies at the musculotendinous junction of tendons within the forearm to restore the balance between the flexor and extensor muscles. The technique has been used with good results to treat hand/wrist flexion contracture.^{3,5,6} Recently, Ayhan et al⁷ described the use of FTL in the initial repair of flexor tendon injury. However, as far as the authors are aware, there is no literature on the use of FTL to treat the rupture of primary flexor tendon repair.

The WALANT technique has been successfully used in various hand procedures, including flexor tendon repair.⁸ There are multiple reported benefits of the technique.

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Figure 3. Re-repair of the FDP tendon was undertaken with the WALANT technique. A An intraoperative assessment revealed that the patient was able to achieve full active flexion in the right little finger. B However, the repair was too tight, as demonstrated by an inability to achieve full active extension.



Figure 4. A schematic diagram demonstrating the FTL technique. **A** The repair was initially too tight. **B** However, fractional lengthening at the musculotendinous junctions of the FDP and FDS to the small finger restored correct tension and allowed for a full active extension.

Studies have found that the WALANT technique allows for greater efficiency and reduced costs.⁹ Further, the technique allows for active, intraoperative assessment of the hand/fingers, potentially reducing postoperative complications such as rupture or tenolysis.¹⁰ The physician can also demonstrate appropriate ROM and emphasize the importance of adherence to postoperative therapy protocols to the awake patient during the procedure.¹⁰

We describe a previously unreported combination of FTL and WALANT technique to achieve successful re-repair after rupture of primary flexor tendon repair. These 2 techniques, in combination, allowed for a successful surgery, despite the difficulties associated with flexor tendon re-repair, especially in the little finger.^{1,2,4} The WALANT technique allowed us to evaluate the repair quality and active movement in the hand intraoperatively via a dynamic, active assessment. As a result, the initial tightness of the re-repair was immediately identified and resolved intraoperatively via FTL. Without the WALANT technique and intraoperative assessment, the repair tension would likely have gone unnoticed, required a later follow-up procedure, or led to permanent morbidity and a suboptimal outcome. The combination of FTL and WALANT technique demonstrates the potential to improve outcomes of re-repair of primary flexor tendon ruptures; nevertheless, further studies on this topic are needed.

Further, the WALANT technique enabled us to better educate the patient on his limitations after the re-repair. Patient noncompliance has been cited as a major cause of primary flexor tendon repair rupture, and better patient education is vital to re-repair success.² Although the importance of postoperative therapy and adherence to limitations were explained during the patient's first procedure, they were potentially not sufficiently emphasized. As a result, the patient engaged in heavy-labor activities shortly after the repair, which may have led to the rupture. The WALANT technique allowed our patient to be awake during the salvage procedure, enabling the surgeon to fully emphasize the expected limitations after surgery and the reasoning behind them, improving patient understanding and compliance.

We have also successfully used FTL and WALANT technique with digit widget dynamic external fixation and tenolysis for 2 additional patients with flexion contracture after primary tendon repair. Both patients demonstrated considerable improvements in active extension, overall total active ROM, and functional capacity, allowing a return to higher-level activities. This further highlights the strength of this technique in secondary tendon reconstruction.

In this study, we chose to use the palmaris tendon as augmentation to repair the re-ruptured FDP tendon. It should be noted that the palmaris tendon can also be used as an interposition graft to address the initial tension issue during digit extension. However, we chose not to pursue this technique because we found that FTL under WALANT conditions can be used to fine-tune and achieve the exact balance in the flexion-extension mechanism more easily.

The WALANT technique and FTL demonstrate potential as a combined technique. However, certain factors must be considered before using them. An appropriate patient population is required; patient anxiety about being awake during the procedure can be a

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Figure 5. Fractional lengthening of the musculotendinous junction of the FDP and FDS tendons to the small finger restored ideal tension in the flexor mechanism, as demonstrated intraoperatively by full active A flexion and B extension.



Figure 6. The 16-week follow-up after the re-repair demonstrated a successful repair with full active A extension and B flexion in the right little finger.

contraindication for the WALANT technique. Additionally, location should be considered when attempting FTL. Undergoing FTL proximal to any lumbrical origin poses a risk of the quadriga effect.

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