A Novel Technique for the Treatment of Jersey Fingers

Transosseous repair of FDP has been long utilized, tying the sutures over a polyethylene button at the nail plate, which is associated with significant complications.

Avoiding use of a button decreases these complications, eliminating damage to the nailbed and eliminating external sutures, thus decreasing infection risk.

Keith needles can be utilized to pass the sutures from volar to dorsal, and can be inserted using a wire drive; their position can be checked fluoroscopically prior to suture passage.

This technique can be used in conjunction with skeletal fixation of associated fractures.

This technique can be utilized in pediatric patients, placing the sutures distal to the physis.

The avulsion-type injury of the flexor digitorum profundus (FDP) from its insertion on the distal phalanx is relatively common. FDP avulsions are seen in athletes and nonathletes, and are the result of the sudden hyperextension of the distal interphalangeal joint during active flexion. These injuries usually occur while grasping the jersey of an opposing player and are thus commonly referred to as “jersey finger.” Initially described in 1977 by Leddy and Packer, FDP avulsions are classified on the basis of the proximal extent of the retraction of the FDP and the presence or absence of a bony avulsion fracture fragment. Type I injuries are defined by tendon retraction to the level of the palm, where it is tethered by the lumbricals. At this level, the vinculum longus profundus (VLP) and vinculum brevis profundus (VBP) are ruptured, resulting in the substantial loss of intrinsic and extrinsic vascular supply to the tendon. In type II injuries, which are the most common type of FDP avulsions, the FDP tendon retracts to the level of the proximal interphalangeal (PIP) joint. Although the VBP is disrupted in this scenario, the VLP remains preserved because it arises at the level of the volar plate of the PIP joint. Type III lesions involve tendon avulsions with an associated bony fragment that is typically sufficiently large to not pass...
through the flexor sheath, thus limiting retraction to the level of the A4 pulley. Both vincula remain intact, given that the VBP originates at the distal portion of the middle phalanx. The Leddy and Packer classification was later expanded to include type IV and V injury patterns, which are less common than other injury patterns. Similar to type III injuries, type IV injuries involve a bony avulsion; however, the FDP subsequently ruptures from this fragment and the tendon subsequently retracts into the finger or palm. Type V injuries are more complex than other injury types because they involve a concomitant distal phalanx fracture with the FDP avulsion. Al-Qattan subclassified type V injuries into extra-articular (type Va) and intra-articular (type Vb) distal phalanx fractures on the basis of the distinct management of these 2 entities.

Numerous techniques have been proposed and described for the repair of FDP avulsion injuries. The pullout suture-dorsal button combination is the most widely described technique and was initially described by Bunnell. Unfortunately, this technique is accompanied by numerous potential postoperative complications. Nail plate deformity is the most commonly described complication. Other complications include local wound irritation, pain, button snagging, and repair failure. Additionally, the presence of external sutures creates a potential route of ingress for bacterial infection.

Bone suture anchor techniques were later utilized to repair FDP avulsions in an attempt to decrease complications associated with the external suture-button construct. The use of a transosseous suture without external button fixation has also been proposed. Sood and Elliot described a technique where the suture is passed through a hole, drilled transversely through the tuft of the distal phalanx, and affixed to the other limb. In 1999, Schultz and colleagues described a technique where transosseous tunnels are placed in the distal phalanx in a dorsal-to-volar direction. The suture is then passed through and tied on the dorsal surface. In this article, we propose a transosseous suture technique that may provide advantages over previously described methods.

**Surgical Technique**

**Types I, II, and III**

A Bruner incision is performed on the volar aspect of the affected finger, and full thickness flaps are elevated off the flexor sheath. The avulsed FDP tendon is retrieved in the usual fashion, and its insertion is identified. A 2-0 braided polyester suture is run in a Krakow fashion along the distal aspect of the FDP tendon and passed along its normal course under the A4 pulley. Using a K-wire driver, 2 Keith needles are then driven through the base of the distal phalanx. The needles exit dorsally proximal to the germinal matrix. Once the appropriate positioning of the Keith needles is confirmed through fluoroscopic imaging, a dorsal counterincision is made, and the skin flaps are bluntly elevated. Each limb of the 2-0 suture is passed individually through 1 of the Keith needles, and the FDP tendon is inspected to ensure that it can be brought distally to its insertion with good tendon-to-bone contact. The finger is brought into flexion, and the sutures are securely tied dorsally over the distal phalanx and the extensor tendon. The incisions are closed, and a dorsal blocking splint is applied with the wrist and fingers in flexion.

**Types IV and V**

In cases of type IV or V injury, a screw or plate construct is first used to allow for the successful reduction and fixation of the fracture. Once completed, the tendon avulsion is addressed in the same fashion as previously described, with the repair being performed atop the affixed fragment.
Discussion

The avulsion of the FDP tendon from its insertion (zone I) on the distal phalanx is commonly called “jersey finger” and is a well-described injury that occurs most commonly in the ring finger. These injuries can be difficult to treat and are associated with a complication rate of as high as 60%. Bunnell’s initial description of a suture passed through the fingernail and then tied over a polypropylene button has been associated with multiple complications. Kang and colleagues reported abnormal nail growth, nail fold necrosis, fingertip deformity, stiffness, infection, and amputation, 43% of all complications were directly related to the button. As an alternative to the button, sutures may be tied directly over the nail plate itself via 2 separate holes. While this technique eliminates the complications directly associated with the button, the potential for infection remains. Additionally, increased direct pressure is placed on the nail plate and nail bed, thus potentially increasing the risk of nail deformity.

In 1994, Hallock initially described the use of bone anchors as an “internal fixation” alternative and cited the “expense of the apparatus” as the major drawback of this technique. McCallister and colleagues compared the clinical outcome of suture anchor fixation with that of the button-over-nail technique. Although they ultimately demonstrated that the clinical outcomes of the 2 techniques are not significantly different, they noted that suture anchor fixation is associated with decreased infection rate (7% vs 0%) and time to return to work. Poor bone mineral density and low cortical thickness are correlated with anchor pull-out, thus limiting its universal use. Furthermore, the universal use of many commonly available anchors is limited given that they are too large to be accommodated within many phalanges, particularly in women and in the small and ring fingers. The use of microanchors rather than mini anchors not only decreases this risk but also decreases construct strength, thus necessitating the use of 2 anchors to restore adequate fixation strength. Anchor use is associated with specific risks, including the dorsal migration of the anchor, the osteolysis of the surrounding bone, as well as the perforation of the dorsal cortex and the possible extrusion of the anchor through the phalanx and into the nail bed. Additionally, in the wake of a changing healthcare system, the cost of suture anchors, as initially noted by Hallock, must be considered. This consideration is particularly relevant to the use of a 2 microanchor construct, which has been advocated given its biomechanical advantage.

Transosseous tendon repair is a cost-effective option that obviates many complications commonly observed with other fixation methods. By keeping the suture within the body, the complications inherent in external sutures and buttons are eliminated, including the loss of fixation as a result of button or suture damage and facilitating hand hygiene maintenance. The rate of infection is also reduced. Moreover, the risk of nail deformities is decreased because the suture is not passed through the nail bed and nail plate in the described technique. Occasionally, some patients do note irritation from the dorsal suture knot under the thin skin proximal to the germinal matrix. This can be easily addressed in the clinic by removing the knot under local anesthesia following sufficient tendon healing. Additionally, the described technique can be used safely in pediatric patients with open physes because the needles can be placed to prevent violating the physis. This technique can be performed in conjunction with the skeletal fixation of type III, IV, and V jersey fingers. In our experience, the transosseous suture repair is more secure than the limited screw fixation, which can be accomplished in many type III jersey fingers, and in at least 1 case, has maintained flexor function when the skeletal fixation of the jersey finger has failed.

All internal fixation techniques have been described previously by Sood and Elliot and, later, by Schultz and colleagues. In contrast to Sood and Elliott’s technique, which requires the creation of transverse tunnels, a volar-to-dorsal tunnel is technically easy to create and creates a direct repair to tendon insertion. Our technique is similar to that of Schultz and colleagues but has the following differences and potential improvements:
1. Keith needles are passed in a volar-to-dorsal fashion, thus allowing for the direct visualization of the transosseous tunnel origin, minimizing the size of the transosseous tunnels, and allowing for the anatomic reduction of the tendon.

2. Fluoroscopy is used to confirm wire placement prior to skin incision, thus enabling precise placement and potentially allowing the needles to be placed so as to avoid physeal injury in pediatric jersey fingers.

3. By using Keith needles, sutures can be passed with the same instrument that created the tunnel, thus simplifying surgical technique.

4. A Krakow suture technique is used. This technique results in less gapping and higher load-to-failure than other suturing techniques.22

5. A 2-0 braided suture is used, therefore strengthening repair.

*This paper will be judged for the Resident Writer’s Award.*

**Key Info**

**Figures/Tables**

Figures / Tables:

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Figure 1. (A) A Bruner incision completed with full-thickness flaps elevated off of the flexor sheath. The avulsed flexor digitorum profundus (FDP) tendon was located at the level of the proximal interphalangeal joint (type II) and retrieved. (B) A 2-0 braided polyester suture is placed in a Krackow technique into the distal FDP tendon and passed under the A4 pulley (asterisk). (C) Final position of the FDP tendon once secured dorsally over a bone bridge.

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Figure 2. Intraoperative fluoroscopic imaging of Keith needle placement. Ideally, the 2 needles are passed from the volar-distal to dorsal-proximal direction, thus allowing for the anatomic reduction of the flexor digitorum profundus tendon to its insertion while avoiding the violation of the germinal matrix.
Figure 3. Dorsal counterincision at 2-week follow-up.
Figure 4. (A) Preoperative and (B) postoperative radiographs of a type IV injury, in which the distal phalanx fracture was reduced and subsequently stabilized with a screw. The flexor digitorum profundus tendon avulsion was then repaired with transosseous sutures through the stabilized distal phalanx base.
References


5. Al-Qattan MM. Type 5 avulsion of the insertion of the flexor digitorum profundus tendon.

*Figure 5*. Lateral radiographs demonstrating (A) early failure/pull-out of screw fixation for a type III injury (B) with subsequent union. Despite the screw pull-out, the transosseous sutures maintained FDP function.


Multimedia

Product Guide

Product Guide

- STRATAFIX™ Symmetric PDS™ Plus Knotless Tissue Control Device
- STRATAFIX™ Spiral Knotless Tissue Control Device
- BioComposite SwiveLock Anchor
- BioComposite SwiveLock C, with White/Black TigerTape™ Loop

Citation

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