

Case Report

Pullout Button Suture for the Treatment of Type IV Avulsion of the Flexor Digitorum Profundus Tendon: Case Report

Suriya Luenam MD*,
Arkaphat Kosiyatrakul MD*, Sunya Prachaporn MD*

* Orthopedic surgeon, Department of Orthopaedics, Phramongkutklo Hospital and College of Medicine, Bangkok, Thailand

A variety of surgical treatment methods for an avulsion of the flexor digitorum profundus (FDP) from its insertion and simultaneous fracture of the volar base of the distal phalanx, the so-called type IV FDP avulsion had been reported. The need to simultaneously reattach the FDP tendon and fixate the avulsed bony fragment makes the treatment of this injury challenging. The authors described a surgical technique of repair using a pullout suture tied over an external dorsal button without the need for retained hardware.

Keywords: Avulsion, Flexor digitorum profundus, Type IV, Pullout button suture

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Four types of avulsion injury of the insertion of FDP have been described⁽¹⁻³⁾. Type I is an avulsion with the tendon retracted into the palm. In type II avulsion, the tendon retracts to the level of the proximal interphalangeal (PIP) joint. In type III injury, the tendon is not retracted beyond the A4 pulley. Type IV is the avulsion of the insertion of FDP simultaneous with avulsion fracture of the volar base of the distal phalanx.

Type IV FDP avulsion is an uncommon injury with a wide variety of the proposed treatments⁽³⁻¹³⁾. The authors reported a surgical technique of repair with pullout button suture to secure the fragment and tendon simultaneously.

Case Report

A 45-year-old man was seen in our clinic one day after he had sustained a blow to the tip of the right ring finger while fixing a water pump drive belt. He had the severe pain and inability to actively flex the affected finger immediately after the injury.

Clinical exam revealed swelling and ecchymosis involving of the digital pulp and the volar aspect of the digit to the level of the proximal phalanx

region. He was unable to actively flex the DIP joint. The PIP joint was in a slightly flex position with limited active range of motion from 10 to 45 degrees.

Roentgenograms revealed a fracture of the volar base of distal phalanx with 5 x 6 mm in size involved 20% of the articular surface. There was the dorsal subluxation of the remaindering distal phalanx. A small fleck of bone was seen on the palmar aspect of the base of middle phalanx (Fig. 1).

Surgical exploration through a volar zigzag incision revealed an avulsion fracture of volar plate from the distal phalanx. The FDP was avulsed and retracted to the level of the chiasma of flexor digitorum sublimis. After the avulsed volar plate fragment was directly reduced, two parallel Keith needles were drilled 2.5 mm apart through the fragment into the remainder of distal phalanx to maintain the reduction. The DIP joint congruity and intraarticular reduction were assessed using fluoroscopic guidance (Fig. 2A). The needles were removed and the fragment was turned down to expose a fracture surface of the remainder of distal phalanx. The authors drilled two of Keith needles entering from each preceding hole and pointing toward mid portion of the nail. The authors advanced the needles until penetrating the nail plate and left them in place. Two additional 4-0 Prolene sutures were placed into adjacent soft tissue to augment the tendon repair (Fig. 2B). A button made from a 10 cc plastic syringe was shaped to fit the contour of the plate such that

Correspondence to:

Luenam S, Orthopaedic surgeon, Department of Orthopaedics, Phramongkutklo Hospital and College of Medicine, Bangkok 10400, Thailand.

Phone: 0-2246-0066 ext. 93459

E-mail: luenam_suriya@yahoo.com



Fig. 1 Preoperative radiograph of right ring finger (lateral view) showed a fracture of the volar base of distal phalanx (large arrow) and a small fleck of bone on the palmar aspect of the base of middle phalanx (small arrow) with dorsal subluxation of the DIP joint

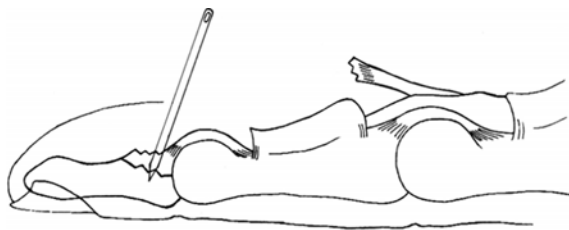


Fig. 2A After the avulsed volar plate fragment was directly reduced, two parallel Keith needles were drilled through the fragment into the remainder of distal phalanx and then removed

there was no overhang of the button on the surrounding skin. Two small holes were drilled in the button aligned with the projected path of the Keith needles. The retracted FDP stump was exposed through the

membranous portion of the flexor sheath, including partial release of the A3 pulley. A 2-0 nylon core suture was woven through the tendon stump with modified Kessler technique.

Each strand of the core suture was passed beneath the A4 pulley, through the needle hole of the fragment and through each eyelet of the Keith needle, respectively (Fig. 2C). The needles were pulled through the nail to deliver both suture strands. The core suture was used to advance the tendon stump beneath the A4 pulley and the tendon sheath to approximate the fracture fragment and the FDP insertion at the distal phalanx (Fig. 2D). The additional 4-0 Prolene sutures were placed on the tendon end but not tied. Each core suture strand was passed through the corresponding button hole, pulled snugly and tied over under the fluoroscopic guidance while the finger was held in flexed

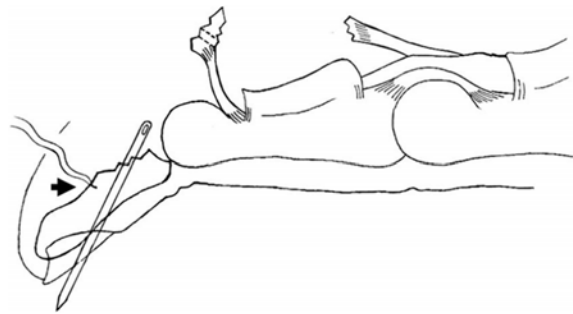


Fig. 2B The avulsed volar plate fragment was turned down to expose a fracture surface of the remainder of distal phalanx. Two of Keith needles were drilled from each preceding hole and pointing toward mid portion of the nail. Two additional 4-0 Prolene sutures were placed into adjacent soft tissue to augment the tendon repair (arrow)

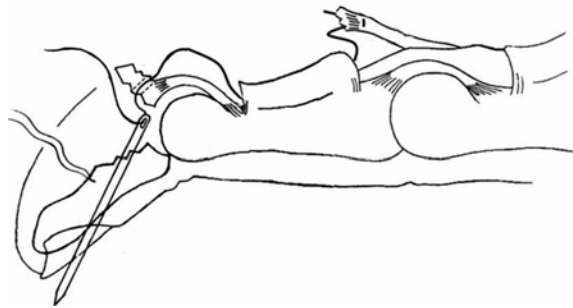


Fig. 2C A 2-0 nylon core suture was woven through the tendon stump with modified Kessler technique. Each strand of the core suture was passed beneath the A4 pulley, through the needle hole of the fragment and through each eyelet of Keith needle, respectively

position. The prepared additional sutures were then tied to strengthen the repair (Fig. 2E).

Postoperatively, an extension blocking short arm splint was applied with the wrist at 30 degree flexion, metacarpophalangeal joint at 70 degree flexion and the DIP and PIP joints near extension. The Duran controlled passive flexion exercise program was initiated immediately after the surgery. The external splint was discontinued at 4 weeks. The external button with pull out suture was removed at 6 weeks postoperatively. The immediate postoperative x-ray showed good reduction of both bony fragments and articular surface of the distal phalanx without subluxation of the DIP joint (Fig. 3). There was no further displacement on the serial follow-up radiographs taken at 2 and 6 months. The patient developed mild nail plate deformity which disappeared in one month after the authors removed the button. The patient was allowed to return to work with gradually increasing the use of the affected hand

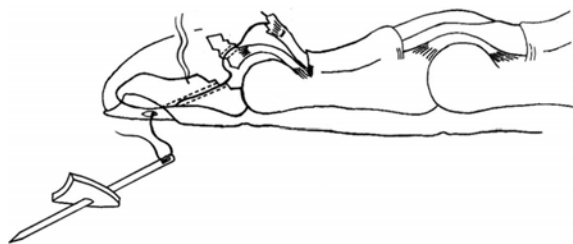


Fig. 2D The needles were pulled through the nail and button to deliver both suture strands

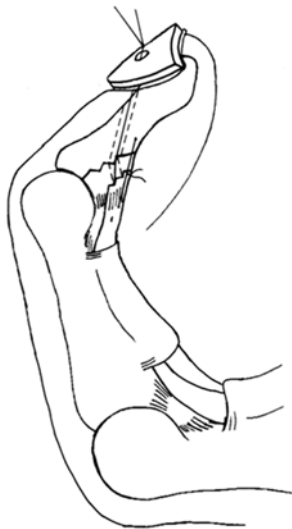


Fig. 2E Each core suture strand was pulled snugly and tied over while the finger was held in flexed position. The prepared additional sutures were then tied to strengthen the repair

at 8 weeks postoperatively. He was able to return to full unrestricted activities at 3 months and had the excellent function with the active range of motion of the DIP joint from 0 to 70 degrees and PIP joint from 0 to 110 degrees (Fig. 4). The digit was pain free and caused no functional limitation.

Discussion

Type IV FDP avulsion is uncommon. There were only 21 cases from the previous literature⁽³⁻¹³⁾. There is no consensus regarding the surgical treatment techniques⁽³⁻¹³⁾. Recently, the authors encountered a patient with type IV FDP injury and obtained the excellent functional outcomes from a surgical technique



Fig. 3 Postoperative radiograph demonstrated both bony fragments (large and small arrows) and articular surface of the distal phalanx was healing in a good alignment without subluxation of the DIP joint



Fig. 4 The patient had the excellent function with the active range of motion of the DIP joint from 0 to 70 degrees postoperatively

using pullout button suture to secure the fragment and tendon simultaneously.

Rigid fixation of both the fracture and the tendon insertion is very important for the early motion program. Various methods of fracture fixation have been reported including use of a cortical screw^(5,7,13), K-wires^(3,7,10,12), pullout wires^(4-6,11) and miniplate fixation⁽⁸⁾. However, there was no comparative biomechanically study of these fixation methods in type IV FDP injury. Although fixation with the cortical screw and miniplate yielded good outcomes in 4 case reports^(5,7,8,13), the authors raised valid concerns regarding the diminished bony surface area available for tendon healing, the development of the stress riser in the distal phalanx and the potential for retained and prominent hardware which may require subsequent removal. K-wire fixation across the remainder of distal phalanx and fragment lacks the potential for fracture site compression and may not be rigid enough for early motion rehabilitation. Many reports recommended the axial^(7,10,12) or dorsal blocking⁽³⁾ K-wire fixation across the DIP joint to increase stability and prevent dorsal subluxation of the distal phalanx, however, this prevents early joint mobilization and postoperative physiotherapy. Ehlert et al reported the excellent result after the treatment of type IV injury using pullout wire fixation to hold the fragment and separate pullout suture to secure the tendon⁽⁶⁾. Two previously reported cases treated with pullout fixation holding the fragment and the tendon insertion simultaneously demonstrated the unsatisfactory outcomes^(7,9). It is uncertain whether these cases will represent a poor result of this method for this uncommon condition. Langa and Posner attempted to secure the fragment and tendon simultaneously with a single pullout wire⁽⁹⁾. However, the immediate postoperative x-ray showed the suboptimal reduction of the fracture with dorsal subluxation of the DIP joint. The final range of DIP motion was relatively poor due to the articular incongruity of the distal phalanx. Henry et al reported a type IV injury case with fixation failure of the single pullout suture⁽⁷⁾. This may relate to the improper placement of the button fixation which appeared on the postoperative x-ray.

The authors have described the surgical technique to secure the fragment and tendon simultaneously using pullout button suture. This technique is relatively simple and may be useful in a small fracture fragment type IV FDP injury which is not amenable for the screw fixation because of the size mismatch. The button should be placed over the nail

plate which will generate the even load distribution on the undersurface creating the shearing resistant to reinforce the stability of fixation as well as avoid the risk of soft tissue injury from the pressure effect. In order to prevent the further displacement and improve the stability, the authors had passed the core suture right through the fragment and remainder distal phalanx. K-wire fixation across the DIP joint was not performed in order to start the early motion rehabilitation protocol.

Potential conflicts of interest

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การรักษาการกระชากขาดของเส้นเอ็น flexor digitorum profundus ชนิดที่สี่ด้วย pullout button suture: รายงานผู้ป่วย

สุรียา ลือนาม, อรรถพัทธ์ โกสิยตระกูล, ศัญญา ประชาพร

การผ่าตัดรักษา การกระชากขาดของเส้นเอ็น flexor digitorum profundus จากจุดเกาะร่วมกับฐานกระดูกปลายนิ้วด้านฝ่ามือหักหรือ type 4 FDP avulsion มีด้วยกันหลายวิธี แต่เนื่องจากต้องยึดเส้นเอ็นเข้ากับกระดูกที่หักทำให้การรักษาทำได้ยาก คณะผู้ประพันธ์ได้รายงานขั้นตอนวิธีการรักษาการบาดเจ็บชนิดนี้ด้วย pullout button suture