

Use of the Volar Plate of the Distal Interphalangeal Joint as a Distally Based Flap in Flexor Tendon Surgery

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The usual treatment for flexor digitorum profundus (FDP) avulsions as well as FDP lacerations in the distal part of zone I is tendon reinsertion into bone. Although there are several different techniques of FDP tendon reinsertion into bone, they are generally complex and have a weak tensile strength. A technique for treating these injuries is to use the volar plate of the distal interphalangeal joint as a distally based flap for tendon repair. The current communication discusses the technique and its potential complications. Initial clinical experience is encouraging and the volar plate flap technique may take its place in flexor tendon surgery. (*J Hand Surg Am.* 2016;41(2):287–290. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)

Key words Hand, flexor tendon, volar plate, technique.



IN 2010, AL-QATTAN ET AL¹ INTRODUCED the concept of using the volar plate (VP) of the distal interphalangeal (DIP) joint to augment flexor tendon repair in zone I injuries. The concept was applied in 15 adult patients with clean-cut lacerations of the flexor digitorum profundus (FDP) in the distal part of zone I. In these patients the distal FDP stump was short and was not expected to hold the sutures well. The authors used figure-of-eight sutures for the repair. Proximally, the suture purchases 7 mm of the proximal FDP tendon. Distally, there was no attempt to separate the distal tendon stump from the underlying VP and the VP was not raised as a flap. Instead, the VP was purchased along with the short distal FDP stump (Fig. 1). Biomechanically, the authors showed that inclusion of the VP

in the distal tendon purchase significantly increased the tensile strength of the repair at time 0 (61.7 vs 107.9 N; $P < .05$).¹ In 2012, the authors reported on the same technique applied in children.²

More recently, it was recommended that the entire VP be raised as a distally based flap and used in flexor tendon repair.^{3,4} This new modification may be applied to FDP avulsions as well as FDP lacerations in the distal part of zone I; the modification introduces the concept of edge-to-edge repair between the FDP tendon and the VP (Fig. 2). This communication discusses the surgical technique of FDP-to-VP flap repair.

HISTOLOGIC AND ANATOMIC CONSIDERATIONS

Compared with the histology of the FDP tendon, the volar plate has thicker collagen bundles that stain darker with Masson trichrome stain.³ This thicker and more condensed structure of the VP will hold sutures better than the less condensed structure of the FDP tendon.

Anatomically, the VP of the DIP joint covers the joint and provides the main volar support of the joint, resisting hyperextension. The VP is attached proximally to the subcondylar fossa of the middle phalanx

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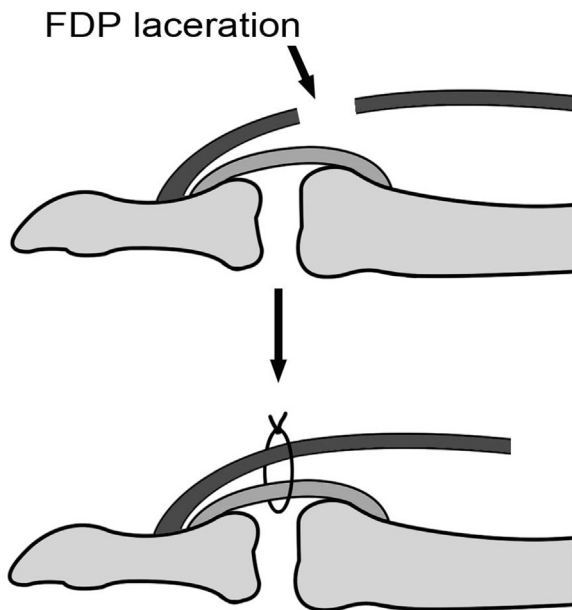


FIGURE 1: Original technique of augmenting FDP repair by including the VP without raising the VP as a distally based flap. There is tendon-to-tendon contact after the repair.

and distally to the base of distal phalanx just deep to the insertion of the FDP. Raising the volar plate as a distally based flap exposes the DIP joint; there is concern that this may affect DIP joint kinematics, leading to delayed DIP joint hyperextension.⁵ However, this was not noted clinically.³ The lack of instability of the DIP joint despite use of the VP is probably related to 2 factors. First, the intact collateral ligaments of the DIP joint provide some stability to the DIP joint. Second, the new FDP-to-VP flap repair provides new volar support to the DIP joint. However, the literature lacks detailed kinematic studies of the DIP joint after elevation of the VP as a distally based flap.

SURGICAL TECHNIQUE AND POSTOPERATIVE MOBILIZATION

Exposure is done via either a volar Z or a midlateral incision. Raising the volar plate as a distally based flap should be done with a knife rather than scissors. The volar plate is released completely from the middle phalanx. Laterally, the VP flap is released for 3 to 4 mm only, making sure not to disrupt the collateral ligaments of the DIP joint. This will expose the articular cartilage of the head of the middle phalanx as well as the DIP joint space. Care is taken not to injure the articular cartilages of the joint. The proximal cut end of the FDP tendon is then identified and repair to the VP flap is performed using 2 or 3 separate figure-of-eight sutures, as shown in Figure 2. I prefer to use polypropylene sutures. The size of sutures depends on the

age of the patient; 3-0 sutures are used in adults. In children, smaller sutures are used and care is taken not to injure the growth plate of the distal phalanx while going through the VP flap.

A dorsal plaster orthosis is applied at the end of surgery to hold the wrist in 30° flexion, the metacarpophalangeal joints in 30° flexion, and the interphalangeal joints fully extended. Active mobilization within the orthosis is started immediately after surgery. The patient is asked to extend the interphalangeal joints actively within the orthosis and then flex the fingers actively about one third of the way in the arc of flexion. Flexion is then completed passively by pushing the fingers into more flexion using the contralateral hand.

This technique is shown in the online video and in Figure 3 (Video 1 is available on the *Journal's* Web site at www.jhandsurg.org).

PEARLS AND PITFALLS

Raising the VP as a distally based flap should be done carefully to avoid injury to the articular cartilages, collateral ligaments of the DIP joint, and the growth plate of the distal phalanx in children. The VP is a thick structure and it is easier to use cutting rather than taper needles for tendon repair. The most suitable technique of repair is figure-of-eight sutures. It is difficult to apply epitendinous sutures; but one can apply them to the volar aspect of the repair.

COMPLICATIONS

The most common form of repair of FDP avulsions and FDP lacerations in the distal part of zone I is tendon reinsertion into bone. The classic Bunnell dorsal button technique⁶ is associated with known risks of infection, skin necrosis, and nail deformity. Tendon reinsertion into bone may also be done by using internally placed sutures⁷ or suture anchors⁴ but the procedure is more complex. Furthermore, the tensile strength of all techniques of tendon reinsertion into bone is relatively weak (around 40 N).^{8,9} Compared with these standard techniques, the VP flap technique has 2 main advantages: higher tensile strength¹ and simplicity of execution. However, the VP flap technique carries other potential complications such as a theoretical risk of DIP joint volar instability and accidental injury to the articular cartilage or growth plate while raising or suturing the VP flap. Another potential complication is a decrease in elasticity of the VP, leading to delayed flexion contracture at the DIP joint.⁵ Clinical experience with the VP flap is limited to case reports³ and lacks long-term follow-up. Furthermore, studies on joint kinematics after raising the VP flap are

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