

Technique of Dynamic Flexor Digitorum Superficialis Transfer to Lateral Bands for Proximal Interphalangeal Joint Deformity Correction in Severe Dupuytren Disease

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Pseudo-boutonniere deformity is an uncommon complication from long-standing proximal interphalangeal (PIP) joint contracture in Dupuytren disease. Prolonged flexion contracture of the PIP joint can lead to central slip attenuation and resultant imbalances in the extensor mechanism. We present a technique of flexor digitorum superficialis (FDS) tendon transfer to the lateral bands to correct pseudo-boutonniere deformity at the time of palmar fasciectomy for the treatment of Dupuytren disease. The FDS tendon is transferred from volar to dorsal through the lumbrical canal and sutured into the dorsally mobilized lateral bands. This technique presents an approach to the repair of pseudo-boutonniere deformity in Dupuytren disease. (*J Hand Surg Am.* 2018;43(2):192.e1-e6. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)

Key words Dupuytren disease, boutonniere deformity, tendon transfer.



DUPUYTREN DISEASE IS A PATHOLOGICAL process involving fibromatosis of the fascia of the palm and digits. The resultant pathoanatomical changes in the hand lead to contracture. Dupuytren disease is a common complaint evaluated by hand surgeons and its prevalence increases with age. A variety of secondary pathologies from long-standing primary Dupuytren contractures can develop including mallet deformities, sagittal band rupture, and boutonniere deformity.

In Dupuytren disease, the secondary pathologies must be addressed in addition to the cords causing the primary contracture. Proximal interphalangeal (PIP) joint flexion contractures in Dupuytren disease are caused by spiral and central cords and less commonly by lateral cord contraction.¹ Prolonged flexion contracture of the PIP joint can lead to central slip attenuation, incompetence of the distal interphalangeal (DIP) joint volar plate, and volar subluxation of the lateral bands. This imbalance in the extensor mechanism leads to a boutonniere-type, or pseudo-boutonniere, deformity.^{2,3} Treatment of boutonniere deformity is very difficult and a variety of nonsurgical and surgical techniques have been described. A dorsal orthosis of the PIP joint can be attempted in patients with reducible boutonniere deformity. Surgical options are designed to lengthen the extensor tendon, free the lateral slips and reduce their volar migration, or reconstruct the central slip.⁴ The Fowler tenotomy lengthens the extensor mechanism, bringing the extension forces more proximally toward

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the PIP joint.⁴ Release of the lateral bands is achieved by dividing the transverse retinacular ligaments. Central slip reconstruction can be accomplished via direct end-to-end central slip tendon repair, lateral band transposition, or free tendon graft with the palmaris longus.⁴

We present a technique of flexor digitorum superficialis (FDS) tendon transfer to the lateral bands to correct pseudo-boutonniere deformity at the time of palmar fasciectomy for the treatment of Dupuytren disease.

INDICATIONS

We reserve this procedure for patients with severe, finger-in-palm flexion deformity, with boutonniere deformity occurring after palmar fasciectomy.

CONTRAINDICATIONS

Patients without evidence of central slip attenuation are not recommended for this procedure because it can lead to intrinsic overtightening.

SURGICAL ANATOMY

The digital fascial anatomy is complex in both the healthy and the diseased Dupuytren digit. In the healthy hand, the superficial palmar fascia extends distally as pretendinous bands toward each finger. At the superficial transverse palmar ligament, spiral bands extend from the central band bifurcation medially and laterally to the flexor tendon sheath and insert with the natatory ligament. The digital neurovascular bundle is enveloped by the dorsal Cleland ligaments and the volar Grayson ligament. In Dupuytren disease, alignment of extracellular collagen fibers is responsible for the contracture of the nodules and cords. Three of the most common cords that develop in Dupuytren disease include the central, lateral, and spiral cords.¹ These cords are implicated in the formation of flexion contractures in the metacarpophalangeal and PIP joints.¹

The extensor digitorum communis (EDC) originates from the common extensor tendon in the forearm and inserts on each digit. The central slip is the proximal insertion point for the EDC on the dorsal surface of the proximal middle phalanx. Two slips of the EDC extend medially and laterally to the central slip ramifying with the intrinsic tendons of the lumbricals and interossei muscles to form the lateral bands. The lateral bands converge dorsally to insert at the proximal aspect of the distal phalanx. The transverse retinacular ligament connects

the lateral bands to the flexor sheath over the middle phalanx, preventing dorsal subluxation of the lateral bands during extension. The triangular ligament stabilizes the lateral bands distally, preventing volar subluxation during flexion. With attenuation of the central slip, the lateral bands are able to migrate toward the volar surface resulting in a boutonniere deformity. The boutonniere deformity is characterized by PIP joint flexion and DIP joint extension.

On the volar surface, tendons from the FDS divide distal to the A1 pulley and extend medially and laterally to the flexor digitorum profundus. They insert as individual slips on the volar surface of the proximal middle phalanx. The tendons of the flexor digitorum profundus extend distally and now superficially to the FDS to insert at the base of the distal phalanx.

SURGICAL TECHNIQUE

Bruner incisions are marked out over the involved digits. In this case, the ring and little fingers are involved (Figs. 1, 2). Skin is incised, and cords are exposed in a proximal-to-distal manner. Care is taken to identify the neurovascular bundles on either side of the involved fingers. The pathological tissue is excised (Fig. 3). The PIP joint is then carefully examined. Should an intrinsic joint contracture be identified, a volar release is performed. The A3 pulley is opened, the flexor tendons are retracted, and the volar plate and checkrein ligaments are exposed and then divided proximally. An oblique incision is next made over the involved PIP joint. The transverse retinacular ligament is released and the lateral bands are exposed and sutured together with a 3-0 Ethibond into a more dorsal position relative to where they have subluxated (Figs. 4, 5). A pursestring technique may also be used for the realignment, suturing from one lateral band into the central tendon, then into the opposite side lateral band, and then back across in a similar manner, in horizontal mattress fashion. Attention is then turned back to the volar incisions, and the slips of the FDS are transected and transferred to the dorsum of the finger through the lumbrical canal (Figs. 6–8). Both slips of the FDS are then sutured to the lateral bands with a 3-0 Ethibond (Fig. 9). Wounds are then copiously irrigated. Hemostasis is achieved using electrocautery and thrombin spray. Skin is closed in a simple interrupted manner using 4-0 nylon suture. Sterile dressings are applied, and then an extension orthosis is applied to the involved fingers.



FIGURE 1: Severe Dupuytren contracture of the ring and little fingers. Note the boutonniere deformity of the little finger.

POSTOPERATIVE MANAGEMENT

The patient is placed in an extension orthosis for the operated digits for 7 to 10 days. The patient then sees a hand therapist for a night orthosis and protected active range of motion. Passive range of motion begins at 6 weeks, with strengthening to begin at 7 to 8 weeks after surgery.

PEARLS AND PITFALLS

It is important to carefully transfer the ulnar and radial slips of the FDS to the dorsal surface. Proper identification and dissection through the lumbrical canal radially will ensure free passage of the FDS slips without resistance. During insertion of the FDS slips into the lateral bands, tensioning of the extensor components must be closely monitored. Flexion and extension at the PIP joint should be evaluated during surgery. Appropriate tensioning of the PIP joint should allow nearly complete extension at rest and 60° of passive flexion.⁵ Excessive tension on the lateral bands must be avoided. Postoperative hand rehabilitation is critical following this dynamic tendon transfer to promote function and limit recurrent contracture and must not be discontinued prematurely.



FIGURE 2: Bruner incisions are marked out over the involved fingers.

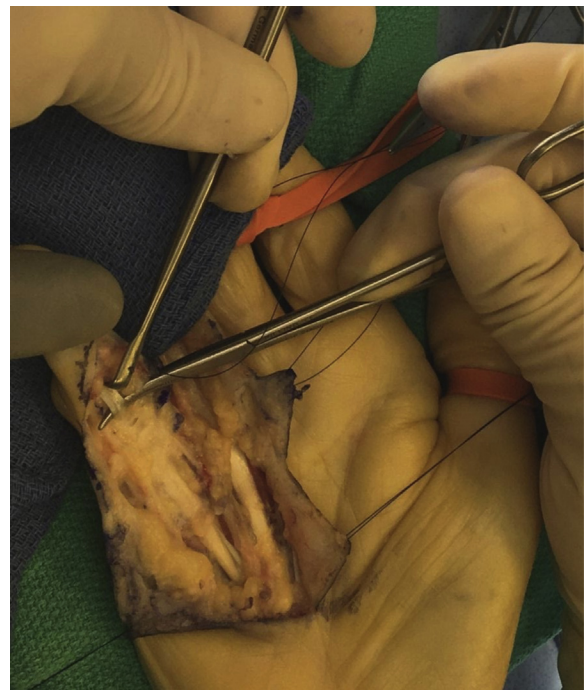


FIGURE 3: The Dupuytren cords have been excised. The PIP joint is examined and a volar release is performed, if necessary. The FDS is identified at its insertion on the middle phalanx.

COMPLICATIONS

Overtightening of the intrinsic is the greatest risk of this procedure, which can lead to secondary inability to flex the finger at the DIP joint. Similarly, overtightening of the lateral bands during dorsal mobilization can cause loss of PIP and DIP joint flexion. Other risks include damage to neurovascular structures, infection, failure to reduce the boutonniere deformity, and recurrence.

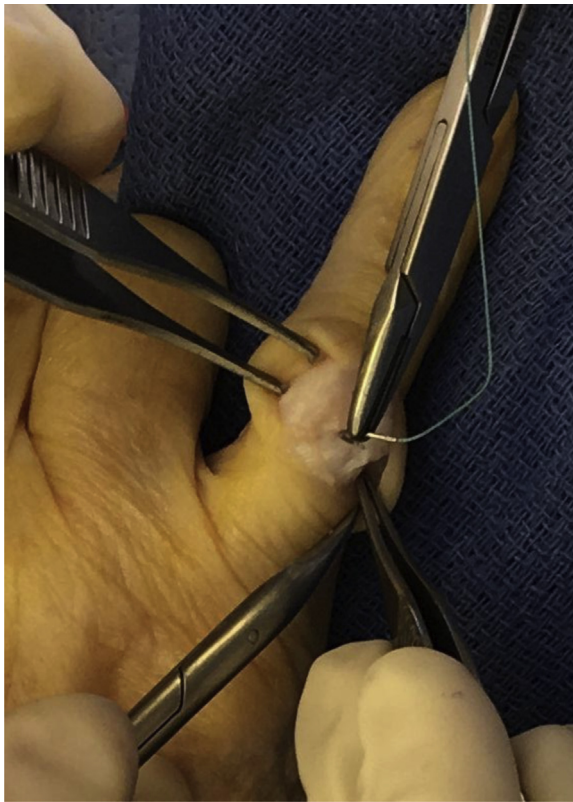


FIGURE 4: A separate dorsal incision is made over the little finger. The transverse retinacular ligament is released, the lateral bands are exposed, and they are sutured together with a 3-0 Ethibond into a more dorsal position relative to where they had subluxated volarly.

CASE ILLUSTRATION

The patient is a 79-year-old Caucasian man who presented with Dupuytren disease of the ring and little fingers of the left hand. He had an 80° flexion contracture of the PIP joint of the small finger and a 40° PIP joint contracture of the ring finger with the wrist flexed. He underwent palmar fasciectomy for both fingers as well as volar PIP joint release. After release, extension to 10° at the PIP joint was possible for the ring finger and 15° for the little finger. He also underwent dorsal PIP extensor realignment with pursestring technique for each finger. Finally, the FDS was released and transferred through the lumbrical canal to the dorsum of the PIP joint of the little finger. The patient underwent a 10-day period of immobilization after surgery, and then began therapy. The patient's result at 4 months, which was his final follow-up, was a 30° flexion contracture of the PIP joint of the little finger and a 15° contracture at the ring finger PIP joint.

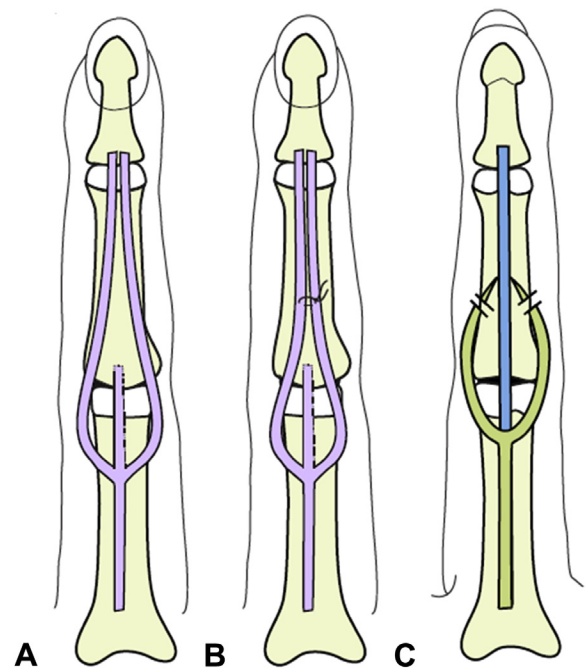


FIGURE 5: **A** Dorsal surface of digit illustrates the extensor digitorum communis (EDC) including the central slip and lateral bands. **B** Lateral bands of the EDC are mobilized dorsally and sutured together. **C** Volar surface of finger illustrates the flexor digitorum superficialis (FDS) and the flexor digitorum profundus. The FDS tendon divides into 2 slips that insert on the middle phalanx. Transection of the FDS slips is performed at their insertion.

DISCUSSION

Utilizing a dynamic FDS tendon transfer, reconstruction of the extensor mechanism restores the function of the central slip and balances the flexion forces about the PIP joint. The dorsally anchored FDS slips produce an extension force across the PIP joint in the absence of the native central slip. Thus, repositioning the FDS dorsally removes a deforming force across the PIP joint while providing a dynamic extensor force at the same joint. Dorsal mobilization of the lateral bands reduces the flexion forces across the PIP joint from volar subluxation of the lateral bands in chronic PIP joint contracture.^{5,6}

There are limited reports describing the management of pseudo-boutonniere deformity following Dupuytren disease. Hentz and Desai³ recommend treatment of pseudo-boutonniere deformity using a technique by which the lateral bands are fenestrated with a scalpel and the DIP joint is fixed in 15° to 20° of flexion with a small Kirschner wire.³ Doyle⁵ also described a fractional lengthening technique of the FDS tendon as a means to diminish the flexion force across the PIP joint in boutonniere deformity. Flexor digitorum

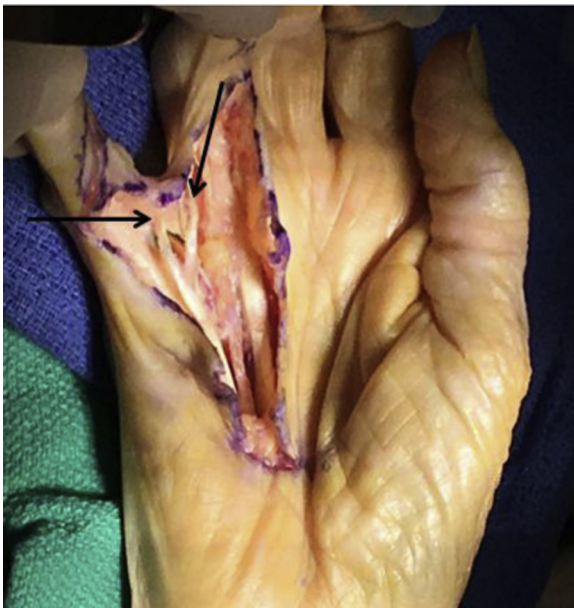


FIGURE 6: Both slips of the FDS have been cut as indicated by both arrows.

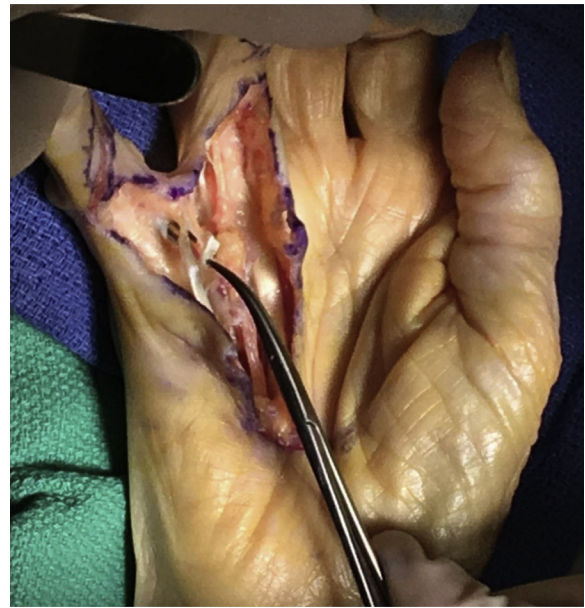


FIGURE 8: The slips of the FDS are pulled dorsally through the lumbrical canal.

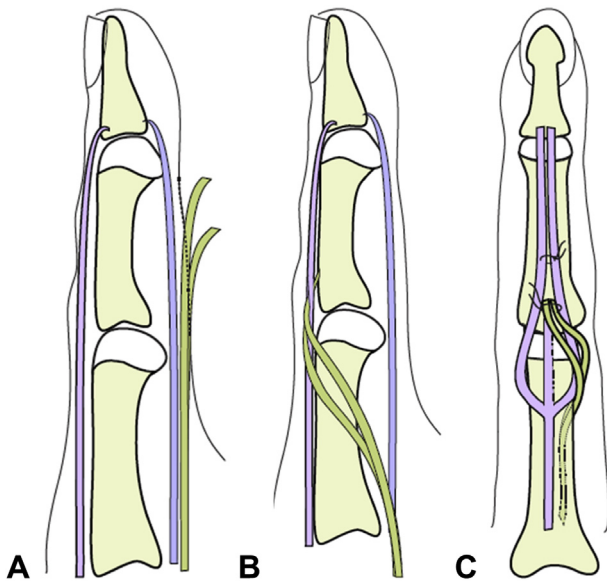


FIGURE 7: **A** Lateral view of the digit shows the flexor digitorum profundus, EDC, and the 2 cut slips of the FDS. **B** Lateral view of the digit shows the FDS tendon transfer from the volar to the dorsal surface. **C** Dorsal surface of digit demonstrates FDS tendon transfer sutured to the lateral bands.

superficialis tendon transfers for the treatment of boutonniere deformity have been previously described by Stack,⁷ Ahmad and Pickford,⁸ and Zancolli.⁹ In Stack's original paper,⁷ the FDS tendon was cut proximally in the palm and divided into 2 slips preserving their distal insertion. A tenodesis was performed between one slip of the FDS tendon and the flexor sheath



FIGURE 9: The slips of the FDS are sutured to the lateral bands.

and the second slip was passed via an intraosseous tunnel through the middle phalanx to the dorsal surface to reconstruct the extensor mechanism. This tendon from the FDS was threaded subcutaneously to the

dorsum of the metacarpal bone and a tenodesis was performed on the extensor tendon.⁷ Ahmad and Pickford⁸ performed only a tenotomy on the ulnar slip of the FDS at the level of the distal palmar crease. Maintaining its distal insertion, the ulnar slip of the FDS was delivered to the dorsum via an intraosseous tunnel through the middle phalanx and secured over the proximal phalanx to the extensor tendon.⁸ This technique has the advantage of repairing the extensor central slip while maintaining the function of the FDS tendon with the radial slip. Lastly, Zancolli⁹ reported a technique by Ardao comparable with ours using a proximally based FDS pedicle transferred dorsally through the extensor apparatus and fixed to the base of the middle phalanx, in an effort to reconstruct a central tendon with a gap. An analogous surgical technique to our FDS tendon transfer is also described in patients with flexible hammer toe deformity secondary to flexor digitorum longus (FDL) tendon contracture. In the Girdlestone or Taylor procedure, the 2 slips of FDL tendon are transferred subcutaneously to the dorsum of the proximal phalanx and sutured to the extensor mechanism.¹⁰ This FDL tendon transfer is performed with the goal that the FDL will assume the function of the foot intrinsic muscles.¹⁰

Pseudo-boutonniere deformity is an uncommon complication of prolonged PIP joint contracture in Dupuytren disease. Treatment options are limited for this deformity. The FDS dynamic tendon transfer serves as 1 option for the repair of pseudo-boutonniere deformity and reconstitution of the extensor mechanism. We feel that a dynamic transfer is advantageous compared with distally based static transfers because the dynamic transfer both removes a deforming force and restores the extension force.

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