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TECHNIQUE

Extensor Tenodesis for Plexic Hands With C7 to T1 or C8, T1 Root Avulsions: A New Technique

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ABSTRACT

In C7 to T1 or C8, T1 root avulsion palsies, restoration of finger active extension is not possible. Only tenodesis may restore hand opening in active wrist flexion. Many techniques have been described to restore this motion. In routine techniques, extensor tendons are fixed on radius or sutured on dorsal retinaculum. However, in these procedures, progressive tendon lengthening or ruptures may occur and salvage procedure may be difficult to perform. Therefore, we proposed a new extensor tenodesis technique. The extensor digitorum communis tendons are sutured on the paralyzed flexor digitorum superficialis tendons through interosseous membrane. This procedure allows performing a strong tendon to tendon suture more resistant than radius or retinaculum fixation. As other tenodesis techniques, wrist flexion has to be active to obtain hand opening.

Keywords: extensor tenodesis, plexic hand, tendon transfers

HISTORICAL PERSPECTIVE

Plexic hand in case of C7 to T1 or C8, T1 root avulsions, is a rare entity. Motor nerve surgery is not possible in these cases. However, palliative surgery remains a challenge and may greatly improve these patients. In these cases, finger flexion and extension and intrinsic function are paralyzed. However, wrist extension is present most of the time. Only few muscles are available for palliative surgery. Extensor carpi radialis longus (ECRL) is used for finger flexion with anastomosis on flexor digitorum profundus (FDP) tendon. Brachioradialis (BR) tendon is used for thumb flexion with anastomosis on flexor pollicis longus (FPL) tendon. Intrinsic function is reanimated in a second-stage operation with passive capsulorraphy techniques or equivalent.[1] However, no muscles are available to restore active finger extension. Therefore, extensor tenodesis may improve finger extension during active wrist flexion to improve hand function.[2,3] Many tenodesis have been described.[2–8] However, fixation of tendon to bone is not perfect. As a matter of fact, healing of tendon is not complete, and tendon ruptures are not rare.[2] Moreover, tendon lengthening is frequent in these techniques whatever the fixations are. Therefore, we present a new extensor tenodesis to avoid these complications.

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INDICATIONS/CONTRAINDICATIONS

The decision to proceed with this extensor tenodesis is based upon a combination of factors. Finger flexion and extension has to be paralyzed, active wrist flexion and extension have to be present, and no other tendons are available to restore active finger extension. This clinical situation is present in brachial plexus palsies with C7 to T1 or C8, T1 root avulsions (anatomical variations), or in tetraplegia group 5.[9] In these cases, extensor tenodesis allows hand opening in wrist active flexion. Flexion finger transfers and extension tenodesis may be performed during the same stage operation. However, intrinsic function may be restored in a second procedure with a sensory nerve neurotization in case of C8, T1 root avulsions.[10]

TECHNIQUE

The patient is brought to the operating room where a general anesthetic is administered. The wrist and hand is then placed prone on the operating table. The extremity is exsanguinated, and a tourniquet is inflated to above 100 mm Hg above systolic blood pressure.

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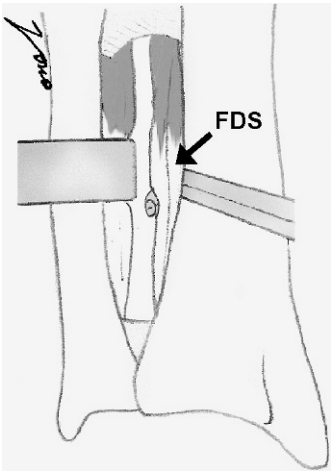

FIGURE 1. After interosseous membrane is excised, the FDS tendons are located and pull out the anterior compartment to perform suture with the EDC tendons. During tendon traction, care must be taken of median nerve. The EDC tendons are not represented to simplify the illustration.

Through a volar radial approach, the BR, ECRL, FDP, FDS, and FPL tendons and median nerve are identified. The BR tendon is detached from the radius and dissected from surrounding fascia proximally until at least 2.5 to 3 cm of passive excursion from the resting position can be obtained. Care must be taken to avoid damage to the radial nerve. The BR tendon is passed under the radial pedicle to reach the FPL tendon. Then, BR is sutured to the FPL with a strong Pulvertaft suture. Tension must be sufficient so that the thumb reach the long finger in 20-degree passive extension. The modified Makin procedure may be added to this transfer to improve thumb opposition: the FPL tendon is translocated through an interphalangeal arthrodesis.[11] The thumb interphalangeal joint is open through a dorsal approach. The FPL tendon is pulled through the joint and placed in a dorsal position. Then, the interphalangeal joint arthrodesis is performed with 2 Kirschner wires.

The ECRL tendon is released and detached through the volar radial approach. The ECRL tendon is passed around the lateral side of the radius under the radial pedicle to reach the FPD tendons. The FDP tendons are sutured side-to-side together. Care must be taken to obtain a complete closure of index and long fingers and slightly less of the ring and small fingers when tension is applied. The ECRL is then sutured to the FDP tendons with a strong Pulvertaft procedure. In wrist extension, fingers have to be semiflexed.

Then, a dorsal longitudinal approach to the wrist is used. The dorsal retinaculum is opened longitudinally to reach the fourth extensor compartment. Extensors tendon are retracted to expose the interosseous membrane. A window of interosseous membrane is divided to reach the anterior compartment of forearm. Lateral insertions of the interosseous membrane are detached from the ulna and radius, just above the radioulnar joint. The length of the window is about 6 cm. Hemostasis of anterior interosseous artery is performed. Then, the FDS tendons are pull through the interosseous membrane from the anterior compartment to perform the tenodesis (Fig. 1). During traction on the FDS tendons, care is taken of median nerve. The EDC tendons are then sutured side-to-side to the FDS tendons with nonabsorbable sutures (Fig. 2). Tendons are tensed to have metacarpophalangeal (MP) joints in extension when wrist is in neutral position. When sutured are performed, tenodesis effect may be tested during the procedure: MP joint extension occurs in 30 degrees of passive wrist flexion. The dorsal extensor retinaculum is then closed. Suction drain is placed to avoid hematomas, and skin is closed with polypropylene sutures.

The wrist is immobilized during 3 weeks in neutral position with MP joint in extension in a short-arm splint.

■ COMPLICATIONS

Early complications after this technique may include wound infection, hematoma, and nerve injury (median nerve). Therefore, median nerve and the FDS tendons are isolated during the volar approach.

■ REHABILITATION

After the cast removal, full active wrist flexion leading to passive finger extension is started. Moreover, active fingers flexion and thumb motion is initiated. Strengthening and heavy lifting are not begun before 12 weeks.

■ RESULTS

Three male patients who had C8, T1 root avulsion palsy underwent this procedure. The average age was 26 years (range, 22–28 years). In all patients, wrist extension and flexion were preserved. Finger flexion, thumb opposition,

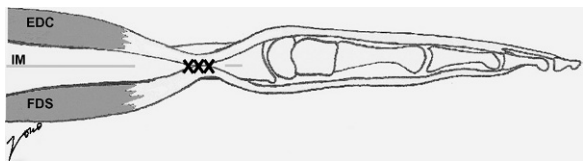

FIGURE 2. The EDC tendons are sutured on the FDS tendons through the interosseous membrane with nonabsorbable sutures. The ulna has not been represented to show the interosseous space.

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and intrinsic function were paralyzed. In all patients, ECRL has been transferred on FDP, BR was transferred on FPL associated with a modified Makin procedure.[11,12] Intrinsic function was restored in suturing FDS on A1 pulley with 30-degree flexion of MP joint. Extensor tenodesis was performed as described before. With an average follow-up of 25 months (range, 23–27 months), all patients recovered active finger flexion. Hand opening or passive finger extension was complete in 30-degree wrist flexion. No complications have been noted.

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