The juncturae tendinum flap: An alternative method for the reconstruction of extensor tendon defects

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ABSTRACT
Extensor tendon injuries are common conditions because these tendons are located in less protected anatomical locations compared to flexor tendons. Extensor tendons are linked on the dorsum of the hand by cross-connexions, called juncturae tendinums, or intertendinous connexions. Several methods for extensor tendon reconstruction have been reported in the literature. To the best of our knowledge, tendon reconstruction incorporating the juncturae tendinum has not been previously reported. Here we describe the use of the juncturae tendinum flap for the reconstruction of extensor tendon defects on the dorsum of the hand. A simple, one stage, minimally invasive procedure is reported that preserves the option of performing other potentially necessary reconstruction methods for repairing tendon defects.

Key words: Tendon defect, extensor tendon, juncturae tendinum flap, reconstruction

Introduction
Extensor tendons are located on the surface of bones and beneath the skin at the level of the metacarpal bones where they are vulnerable to injury [1,2]. Blunt or sharp penetrating traumas and industrial accidents are the most common causes of tendon injury [3]. Eight zones of extensor tendons have been described in the literature [1,2]. One of the zones, called the metacarpal zone (zone 6), has fibrous cross-connexions between the extensor tendons of the 2nd-5th fingers on the dorsum of the hand, called intertendinous connections or juncturae tendinums (JT’s) [1,2,4,5]. The known functions of JT’s include limiting independent extension of the ulnar’s three digits, spacing of the EDC (extensor digitorum communis) tendons, admeasuring of the force between common extensor tendons, coordination of extension, stabilization of the metacarpophalangeal joints, inhibiting running away of the proximal end of tendon from the injury zone and aiding in the restriction of independent movement between the flexor and extensor tendons [2,3,5-10]. Von Schroeder et al. classified and defined the patterns of JT’s based on three morphologic types: Type 1 JT’s are situated in a transverse or oblique direction and have filamentous regions; type 2 JT’s consist of well-defined and much thicker connecting bands; and type 3 JT’s consist of tendon slips from the extensor tendons, which are divided into 2 subtypes, depending on their shape (y or r sub-types) [2,4,5]. The r subtype is the more oblique form, while the y subtype of the type 3 JT’s is the tendon slip form [4,5]. Pinar et al. reported that fibrous tissue fibers were organized into thin and loose bundles in type...
1, but which were thicker in types 2 and 3. In recent studies, the most common JT s found are type 1 located in the second intermetacarpal space, type 2 located in the third intermetacarpal space and type 3 located in the fourth intermetacarpal space [4-6]. Type 3 juncturae have been reported as being the thickest and longest juncturae [4,5]. During repair of extensor tendon defects or strained tendons with tendon grafts, a number of techniques have been described, including tendon transfers, two-stage tendon reconstructions, free tendon flap transfers, local tendon flaps and turnover tendon lengthening [3,7,11].

Here we report an easy and useful method for repairing zone 6 extensor tendon defects that are adjacent to the JT. A suggested method is for reconstruction of the dorsal hand tendon defects using a JT flap.

**Surgical Technique**

The preferred technique can be perform under general anesthesia with tourniquet control. At the beginning of the procedure, the JT must be separated from its proximal or distal connections due to the defective injured tendon area. After separation of the JT flap, the next step is rotation of the flap onto the defective tendon area. A minimal back-cut incision can be carefully executed at the base of the JT flap if necessary. The tendon suture technique depends on the surgeon’s experience, but we suggest using mattress and epiten- dinous nonabsorbable sutures (Figure 1).

**Case Report**

A 19 year old male patient was admitted to our clinic with a sharp injury on the dorsum of his hand. Extension of his ring finger could not be observed upon physical examination. Under general anesthesia using tourniquet control, the operation was performed. During the operation, an approximately 2 cm defective tendon region was identified on the ring finger just around the JT while the fingers and hand were extended (Figure 2). The tendon defect was repaired with a proximal-based JT flap, which was separated from the JT’s distal connection from the 5th finger. The distal end of the JT was rotated and moved to the defective area of the extensor tendon at the proximal end of the injured ring finger tendon (Figure 3). The proximal end of the tendon was slit, while the distal end of the JT was threaded.
Intraoperative view of the reconstructed tendon defect.

Figure 4. Intraoperative view of the reconstructed tendon defect.

into the slit tendon area using 4/0 and 5/0 nonabsorbable sutures. The distal end of the injured tendon was then reinforced with 5/0 nonabsorbable suture after minimal cut-back of the JT incision at the base of the JT connection with the ring finger (Figure 4). The operation was completed and an extensor splint executed. The patient used splint therapy for three weeks followed by two months of hand therapy consisting of a range of motion exercises. The finger was regarded as regaining a full range of motion if after nine weeks from surgery the patient had no complaints. After a one year follow-up visit there were neither any ailments nor abnormal movements reported.

Discussion

There have been several reports about extensor tendons but relatively few clinical and anatomical studies concerning the JT [4-6,11]. Because of the presence of JT, total or partial injuries of the extensor tendons on the dorsum of the hand may not result in a loss of extension of the 2nd-5th fingers, which are proximal to the JT [1,2,5]. Pinar et al. and Palatty et al. reported for adults the sequential maximum lengths of the JT for type 1 (8.73 ± 1.98 and 9.2 ± 3.2), type 2 (11.55 ± 3.42 and 10.1 ± 1.7), type 3 (12.22 ± 2.39 and 12.3 ± 1.3), and type 3y (15.22 ± 3.29 and 15.3 ± 2.4) (all in millimeters) [5,6]. JT are used for dorsal aponeurosis repairs [4,5]. JT can be useful for identification during extensor tendon repair [4,5]. Jeon et al. reported two cases of snapping of the JT, resulting in separation from the ring finger, which was then sutured to the small finger after radial sagittal band rupture without any postoperative annoyance [11]. Yong et al. used JT for correction of extensor tendon displacement [12]. Keen and Fuglevand reported that JT probably play only a minor role in distributing force across the fingers during natural activities of the hand [8]. In our method, we used the JT as a flap for reconstruction of an extensor tendon defect on the dorsum of the hand. Compared to other reconstruction methods for repairing extensor tendon defects, the JT flap does not sacrifice another tendon and does not require extra incisions for application of tendon grafts. In addition, the JT flap does not weaken the donor tendon, as the tendon lengthening technique requires neither a second operation nor an extra incision in the donor area as a two-stage tendon repair. The JT flap procedure also does not use other tendons or require extra incisions and requires a much shorter operation time as compared to the free tendon flap technique. One of the limitations of our method is that the JT flap is useful for repairing adjacent tendon defects on the dorsum of the hand that are smaller than 2 cm. We suggest using our JT flap technique in zone 6 extensor tendon defects, as based upon reported surgical results in the literature. JT have been used for other surgical reasons without any reports of postoperative morbidity [11,12]. Nonetheless, one stage proximal- or distal-based JT flap repairs do not require another incision in the donor area, nor does the technique sacrifice a donor tendon for use in tendon transfering or grafting.

Conclusion

In conclusion, we recommend employing our JT flap technique for the reconstruction of small extensor tendon defects on the dorsum of the hand. Using the JT flap is not accompanied by any significant morbid-
ity related to the donor area and facilitates a one stage repair procedure that preserves the potential option of performing other tendon reconstruction methods without weakening the common extensor tendons. To the best of our knowledge, this is the first report in the literature that describes the use of a JT flap technique for repairing damaged extensor tendons.

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