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CASE REPORT

Flexor pulley reconstruction using a transverse carpal ligament: a case report

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Abstract
Although various techniques exist for pulley reconstruction, none are useful for all patients. We performed flexor pulley reconstruction using a transverse carpal ligament which has the advantages of a useful gliding surface, sufficient width and thickness, anatomical similarity to the pulley, and adequate durability. Cosmetically, all the surgical scars are on the volar side while functionally, we can avoid invasion to both the flexion and extension sides.

Keywords Transverse carpal ligament · Pulley · Reconstruction

Introduction

Flexor pulley reconstruction is important to both prevent bowstringing of flexor tendons, preserve exercise ability, and maximize power. Many surgical techniques have been reported for pulley reconstruction but there is no single technique that fits every patient, making each repair strategy unique. Here, we present a case in which the transverse carpal ligament was used as a graft to restore digital flexion.

Case report

A 44-year-old female was referred to our hospital with flexion limitation in her left ring finger after having received three operations at a different hospital. She first received a tendon sheath incision for trigger finger 6 years prior, then a tendon sheath resection, flexor digitorum superficialis tendon resection, and tenolysis on the flexor digitorum profundus. Flexion contracture was improved but a limitation appeared because of bowstringing within the flexor tendon. A third operation, consisting of an A2 pulley reconstruction using the palmar longus (PL), was performed 2 years ago but, again, resulted in eventual limitations of flexion. During our evaluation, the metacarpophalangeal joint had an active range of motion (ROM) of full extension to 60° flexion while the proximal interphalangeal joint had an active ROM of full extension to 70° flexion. The distal interphalangeal joint, meanwhile, was limited to an active ROM of full extension to 45° flexion. Passive motions were full without joint contracture but a bowstring effect was seen in the finger (Fig. 1). This clinical finding, coupled with the previous surgical history, pointed to a rupture within the reconstructed A2 pulley and we effected a second reconstruction to restore flexion.

Our surgical approach, performed under axillary block and air tourniquet, was directed towards the previous surgical scar where we found that the original pulley had been excised from A1 to A4 (all) and the reconstructed pulley (PL for A2) was not ruptured but

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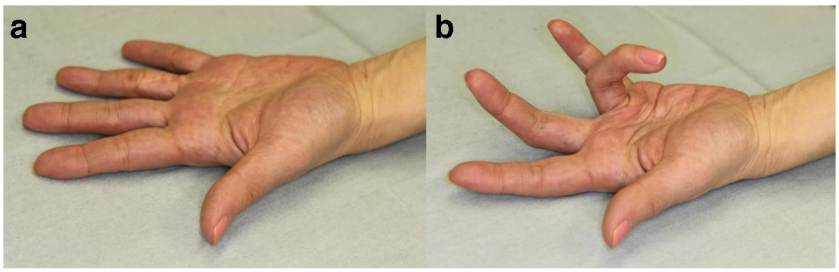

Fig. 1 **a** Passive motions were full without joint contracture. **b** Limitation of flexion was appeared because of bowstring of flexor tendon

simply loosened. We made an incision at the palm side of the wrist and harvested a 6 × 20 mm piece of the proximal side of the transverse carpal ligament without removing the loosened pulley. The pulley was tightened and sutured using 4–0 black nylon. After drilling the proximal phalanx, the transverse carpal ligament graft was fixed by soft wire to the peripheral side of the tightened pulley (Fig. 2). Conservative rehabilitation was carried out under the following restrictions: for 3 days after surgery, only passive exercise (under observation), and movement during dressing changes were allowed. From postoperative day 4, active flexion was permitted only with an extension-limiting splint. From the 8-week postoperative point, passive extension was allowed. Furthermore, we utilized a dynamic splint to limit PIP extension, decreasing this limitation at the 14-month postoperative mark. At the 29-month postoperative timepoint, we removed the soft wire under local anesthesia and she had regained full ROM and grip (Fig. 3).

Discussion

Various materials exist for pulley reconstruction, such as free tendon grafts, the flexor digitorum superficialis tendon, the extensor retinaculum, and volar plate. There are also reports on using a palmar fascia strip, free tendon sheath grafts, cadaveric fascia temporalis grafts, and artificial materials [1–3]. However, as the damage to the pulley is always variable, there is no consensus on which graft source is best. An ideal graft should be strong, durable, and carry a small frictional resistance so selection criteria should include a size that is properly long, wide, and thick while minimizing donor side morbidity.

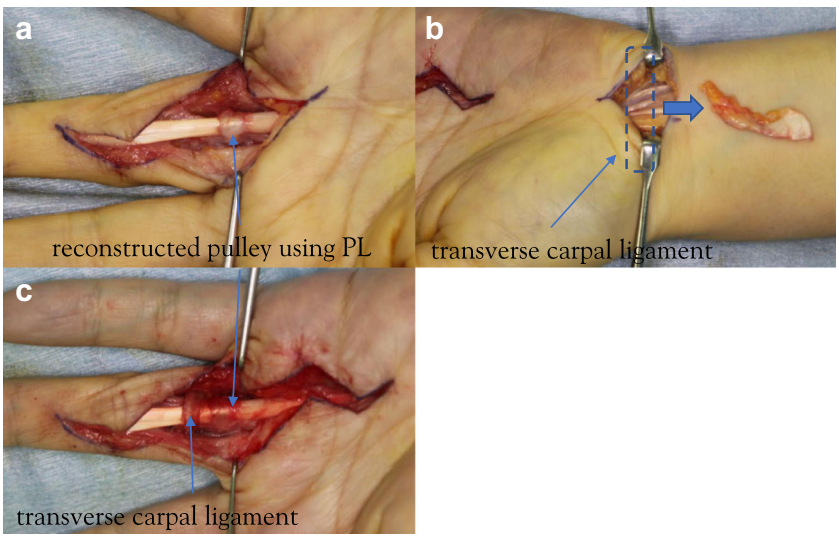

Fig. 2 **a** The reconstructed pulley was not raptured but it was simply loosened. **b** We harvested proximal side of transverse carpal ligament which size was 6 × 20 mm. **c** After drilling the proximal phalanx, transverse carpal ligament was fixed by soft wire. We did not remove the loosen pulley

Fig. 3 At 42 months postoperative, she had regained full ROM and grip

For these reasons, we consider reconstruction using the transverse carpal ligament as having similar advantages to use the extensor retinaculum (first reported by Lister [4] in 1979), namely that it has a useful gliding surface, is sufficiently wide and thin, is anatomically similar to the pulley, and has adequate durability. In particular, there are several reports on the low frictional resistance caused by gliding surfaces [5, 6].

The usefulness of the transverse carpal ligament lies in its additional advantages over the extensor retinaculum. Firstly, compared to the "extensor" retinaculum, it has a "flexor" tendon sheath structure that is anatomically similar to the pulley. Secondly, both the donor and recipient scars are on the palmar side so volar side scars can be avoided as a cosmetic advantage. Thirdly, we can avoid invasion of a healthy extensor mechanism as a functional advantage. On the other hand, wire fixing is necessary because of its short length (about 2 cm), but, even with the need for eventual removal, wire fixing has less impact on the extensor mechanism. As with carpal tunnel opening surgery, temporary grip strength reduction and pain may occur. However, as long as total resection is avoided, we anticipate long-term improvement as seen in the present case.

In our case, trauma from multiple surgeries, an excised flexor digitorum superficialis tendon, and pulley deficiency were serious enough to render partial reconstruction (such as free tendon sheath transplantation) inadequate. Reconstruction with the palmaris longus was also considered, but the left side had already been used in a previous surgery while a birth defect precluded use of the right side. Suggestions to take grafts from the lower legs and toes were rejected by the patient. As a result, a free tendon graft was not used in this case. However, given the results of this case, we think that pulley reconstruction should be organized similarly. Furthermore, as pulley injury often involves tendon injury and adhesion, free tendons should be preserved for tendon reconstruction while conservative rehabilitation will avoid reconstructive tendon sheath collapse.

To conclude, we think that, in terms of adhesion prevention, reconstruction from an intrasynovial source, such as the transverse carpal ligament, is ideal. As both hand surgeons and therapists hate invasion of a healthy extensor mechanism for flexor side treatment, the use of the transverse carpal ligament can be a useful therapeutic option.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval No ethical approval was necessary for this case report.

Patient consent Informed consent for publication was obtained from the patient in the case report.

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