

Suspension Arthroplasty Combined with Ligament Reconstruction of the Thumb Carpometacarpal Joint to Salvage Two Failed Arthroplasties: A Case Report

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What to Learn from this Article?

The ECRL tendon can be a ligamentous source for reconstruction of thumb CMC joint after removal of the trapezium.

Abstract

Introduction: Thumb basal joint arthroplasty with removal of the entire trapezium is often followed by proximal subsidence and impingement of the thumb metacarpal to the scaphoid, which is a common cause of post-operative thumb pain. Treatment of this impingement is a challenge among surgeons. We performed suspension arthroplasty combined with intercarpal ligament reconstruction using a strip of the extensor carpi radialis longus (ECRL) tendon on a patient suffering from pain caused by this type of the impingement and obtained a successful outcome.

Case Report: We treated a 52-year-old female pianist who complained of pain in her left thumb carpometacarpal (CMC) joint. She had undergone two previous ligament reconstruction and tendon interposition arthroplasty procedures on the joint, for which strips of the flexor carpi radialis tendon and the abductor pollicis longus tendon were used in the first and second operations, respectively. The pre-operative X-ray demonstrated proximal subsidence and impingement of the first metacarpal on the scaphoid. We performed suspension arthroplasty combined with intercarpal ligament reconstruction using a strip of the ECRL tendon to create the trapezial space. 3 years after surgery, despite the 3 mm subsidence of the thumb compared with immediately after surgery, her thumb pinch and grip strength had improved, and the thumb basal pain was relieved.

Conclusion: This case shows that suspension arthroplasty with intermetacarpal ligament reconstruction using an ECRL strip can be applied in revision surgery for impingement of the first metacarpal with the scaphoid following thumb CMC joint arthroplasty after removal of the entire trapezium. This is the first report to describe the treatment of first metacarpal impingement after CMC joint arthroplasty using suspension arthroplasty combined with intercarpal ligament reconstruction.

Keywords: Thumb carpometacarpal joint arthritis, ligament reconstruction and tendon interposition, impingement.

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Author's Photo Gallery



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Introduction

There are several operative procedures for treating patients with thumb carpometacarpal (CMC) joint arthritis whose symptoms are not relieved by conservative treatment. These include simple excision of the trapezium [1]; ligament reconstruction and tendon interposition (LRTI) arthroplasty of the joint [2, 3]; suspension arthroplasty using part of the flexor carpi radialis (FCR) tendon [4, 5], abductor pollicis longus (APL) tendon [6], extensor carpi radialis longus (ECRL) tendon [7], or a suture button [8]; and trapezial prosthesis replacement [9, 10]. LRTI arthroplasty is the most frequently performed operation for a painful thumb CMC joint in the United States [11]. One of the most common complications of LRTI arthroplasty is subsidence of the first metacarpal, which sometimes induces pain in the base of the thumb [12].

We treated a female pianist who had recurrence of pain in the base of the thumb after twice undergoing LRTI arthroplasty. The FCR and APL tendon strips had been used in the first and second arthroplasty, respectively. Because the patient strongly desired to preserve motion of the CMC joint, we performed a suspension arthroplasty combined with ligament reconstruction between the first and second metacarpals using the distally based ECRL tendon strip. 3 years after surgery, subsidence of the first metacarpal was minimal, and the patient was satisfied with the operation. This is the first report to describe a salvage operation to treat impingement of the first metacarpal on the scaphoid after an LRTI operation using a novel operative procedure comprising suspension of the first metacarpal and reconstruction of the intermetacarpal ligament using an ECRL tendon strip.

Case Report

A 52-year-old female pianist developed arthritis of the left thumb CMC joint. After receiving conservative treatment for 6 months, she underwent LRTI arthroplasty using the FCR tendon after resection of the entire trapezium. 3 weeks of immobilization of the thumb in a spica cast was followed by range-of-motion exercises of the joint. She felt recurrence of pain in the base of the thumb 4 months after surgery, and a plain X-ray revealed that the first metacarpal had subsided and begun to touch the distal scaphoid. 8 months after the first LRTI procedure, she had the second LRTI surgery using a strip of the APL tendon. 6 months after that surgery, the thumb had moved proximally and was impinging on the scaphoid tubercle (Fig. 1a), and the patient again complained of joint pain. She was referred to our hospital 14 months after the first operation. She complained of tenderness in the base of the thumb and a deformity of the thumb demonstrating hyperextension of the metacarpophalangeal (MP) joint associated with flexion of the interphalangeal joint. Tinel's sign was negative around the thumb. A xylocaine injection into the junction between the proximal first metacarpal and the scaphoid relieved the pain. She strongly desired to preserve motion of the CMC joint because she wanted to continue playing the piano. We performed the operation detailed below.

Surgery

A 4-cm curved incision was created along the lateral margin of the first metacarpal and the proximal margin of the scaphoid tubercle. At the ulnar end of the skin incision, the half of the FCR tendon that had been used in the second operation was identified and exposed. The APL tendons, some of which had been used in the first operation, were exposed at

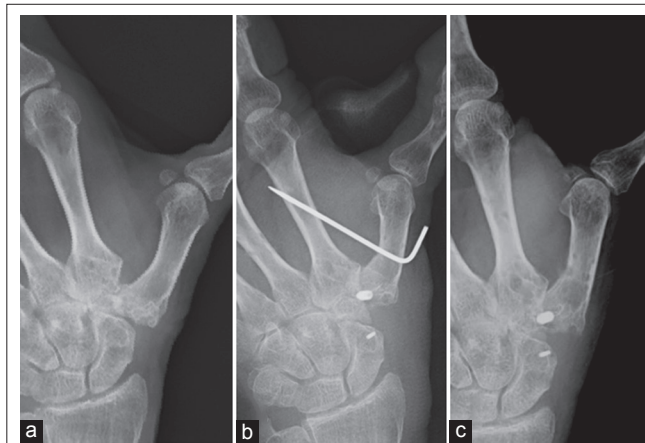


Figure 1: Plain X-ray images taken during the patient's first visit to our clinic (a), just after the suspension arthroplasty and ligament reconstruction operation (b), and 3 years after the operation (c).

the radial end of the wound. The proximal base of the first metacarpal was in contact with the distal articular surface of the scaphoid. Removal of the soft tissue between the scaphoid and the first metacarpal base allowed the first metacarpal to be moved distally to a position that restored the normal joint junction between the first and second metacarpals. In that position, the proximal articular surface of the second metacarpal was seen through the trapezial void.

Through multiple intermittent skin incisions over the ECRL, the ECRL tendon was exposed, and a 15 cm-long distal-based half strip of the ECRL tendon was harvested. A bone tunnel from the proximal dorsal cortex of the second metacarpal to the second CMC joint surface created during the previous operation was filled with scar tissue. A pilot pin was inserted through the tunnel, and the scar tissue was removed using a 3.2 mm drill bit (TJ screw system; Nakashima Medical Co. Ltd, Nagoya, Japan). Because of malposition of the bone tunnel made at the base of the first metacarpal in the previous operation, using the pilot pin and a 3.2 mm drill bit, we created a new bone tunnel from the first metacarpal just distal to the APL insertion to the most ulnar portion of the first CMC joint surface.

The strip of ECRL tendon was passed through the bone tunnel into the second metacarpal base. The strip taken from the second CMC joint surface was inserted into the bone tunnel created in the first metacarpal base from the CMC joint surface and pulled out from its exit just distal to the APL insertion. The first metacarpal was distracted distally to level the joint lines between the first and second metacarpals. An interference screw (TJ screw; diameter, 3.5 mm; length, 7 mm) and a small piece of bone taken from the distal dorsal radius were inserted into the bone tunnel exit of the first metacarpal just distal to the APL insertion to fix the ECRL tendon strip. The distal ECRL tendon strip was subsequently passed three times around the FCR and APL in a figure-of-eight fashion to suspend the first metacarpal (Fig. 2). The end of the ECRL was passed dorsally and sutured to the ECRL remnant in an interlacing fashion (Fig. 3). A 1.5 mm K-wire was temporarily placed between the first and second metacarpals and removed 3 weeks after surgery (Fig. 1b).

Post-operative care and course of treatment

A thumb spica cast was applied for 3 weeks after surgery, and a CMC joint soft splint was worn for a further 5 weeks. After the 8 weeks, the

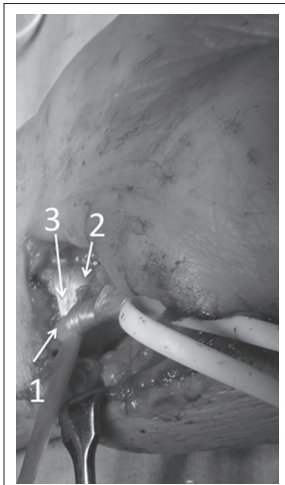


Figure 2: A photograph during the suspension arthroplasty and ligament reconstruction operation. After passing through the bone tunnels created in the base of the first and second metacarpals and being fixed to the first metacarpal with an interference screw, the extensor carpi radialis longus tendon strip was looped around the remaining flexor carpi radialis and abductor pollicis longus 3 times. (1) APL tendon, (2) FCR tendon, (3) transferred ECRL tendon strip.

patient was encouraged to move the thumb and was allowed to play the piano.

3 years after the final operation, the thumb subsidence was measured as 3 mm on a plain X-ray compared with that obtained immediately after surgery, but the subsidence had not progressed when assessed 6 months after surgery (Fig. 1c). The patient demonstrated 30° hyperextension of the MP joint of the thumb, which was slightly better than that before surgery. The palmar and horizontal abduction were both 65°, and she could adduct the thumb to touch the palmar and radial side of the palm. Her grip strength improved from 12 kg preoperatively to 25 kg postoperatively. The tip and side pinch strengths had recovered from 1.2 kg and 2.8 kg preoperatively to 3.2 kg and 5.8 kg postoperatively, respectively. The patient felt no pain or paresthesia, but she perceived a slight solid feeling in the base of the thumb. She could play the piano without pain and was satisfied with the outcomes 3 years after surgery. The visual analog scale pain score at that time was 0.

Discussion

There are several possible causes of recurrent pain in the thumb CMC joint after LRTI with removal of the entire trapezium, including scaphotrapezoid arthritis, proximal subsidence and impingement of the first metacarpal on the scaphoid, adhesion of the FCR or APL tendon, and neuropathy of the superficial branch of the radial nerve [13, 14]. Impingement of the first metacarpal on the scaphoid is one of the most common causes

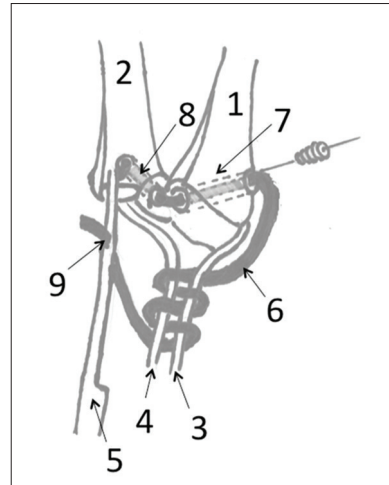


Figure 3: A schematic diagram of the operation performed on the patient. (1) First metacarpal, (2) second metacarpal, (3) remaining abductor pollicis longus tendon, (4) remaining flexor carpi radialis tendon, (5) extensor carpi radialis longus (ECRL) tendon, (6) transferred ECRL tendon, (7) bone tunnel at the base of the first metacarpal, (8) bone tunnel at the base of the second metacarpal, (9) interlacing suture of the transferred ECRL tendon strip with the remaining ECRL tendon.

of the post-operative pain. There are a variety of surgical options for the treatment of impingement of the first metacarpal on the scaphoid, such as fusion of the first and second metacarpals, artificial implant interposition in the trapezoid void [15, 16], suture-button arthroplasty [17], or another attempt at ligament reconstruction or suspension arthroplasty. Because intermetacarpal fusion causes severe restriction of thumb motion, this procedure is not indicated for pianists. Long-term outcomes of artificial implants or suture-button arthroplasty of the thumb basal joint have not been reported.

Considering that the patient desired to continue working as a pianist and that the first metacarpal had subsided proximally and impinged on the scaphoid twice, we had to perform an operation that would preserve a good range of motion of the thumb and prevent thumb proximal subsidence. We thus decided to use an operation involving suspension of the first metacarpal combined with reconstruction of the ligament between the first and second metacarpals. Ours is the first case study to report a successful outcome of suspension arthroplasty with intermetacarpal ligament reconstruction performed to salvage the thumb basal joint that had developed impingement of the first metacarpal on the scaphoid after LRTI.

Yang and Weiland reported that subsidence of the first metacarpal that had settled into the trapezoid void did not correlate with the symptoms or functions after thumb CMC arthroplasty [18]. Garcia-Elias and Tandioy-Delgado opposed this idea, and they proposed a surgical procedure to prevent subsidence of the first metacarpal that involved creating a rigid tendinous cylinder in the trapezoid void [12]. On checking the clinical record and the consecutive post-operative X-rays for this patient obtained at the previous hospital, we found on a plain X-ray that the thumb basal joint

pain recurred when the first metacarpal contacted the scaphoid following the proximal subsidence. The xylocaine injection into the scaphotrapezoidal space relieved her pain immediately. These findings suggest that subsidence of the first metacarpal and impingement on the scaphoid may have been the cause of the pain at the base of the thumb in this patient.

Our operation prevents thumb subsidence by combining two procedures: An intercarpal ligament reconstruction and suspension of the thumb metacarpal by approximation of the FCR and APL tendons. The suspension procedure and the intercarpal ligament reconstruction can be expected to operate complementarily to sustain the load of the proximal movement of the first metacarpal toward the trapezoidal void and to reduce the tensile strength of the ECRL tendon strip, which should decrease the risk of breaking the bone tunnels and loosening the tendon strip. The tendon strip passing the bases of the first and second metacarpals was fixed to the first metacarpal base using an interference screw. Even if the tendon strip was torn out or loosened between the first and second metacarpals or in the trapezoidal void, either or both of the ligament reconstruction and the suspension effect would remain effective. This technique can be applied to the initial operation for the management of thumb CMC joint arthritis

in young patients, except manual workers that apply repetitive axial loads to the thumb base.

Conclusion

Subsidence and impingement of the first metacarpal to the scaphoid caused the thumb pain in this patient. The suspension arthroplasty combined with the ligament reconstruction between the first and second metacarpals was strong enough to sustain the load of the proximal movement of the first metacarpal toward the trapezoidal void and prevented the proximal subsidence of the first metacarpal. This technique can be applied to the initial operation for the management of thumb CMC joint arthritis in young active patients.

Clinical Message

The suspension arthroplasty combined with the ligament reconstruction between the first and second metacarpals prevented the proximal subsidence of the first metacarpal in a patient with thumb CMC joint arthritis.

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