

Technique for Reconstruction of Midcarpal Instability Associated with Lunotriquetral Coalition

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Summary: Carpal coalition is a rare congenital presentation of 2 or more fused carpal bones due to a failure of apoptotic segmentation during development. The most common subtype is lunotriquetral coalition (LTC). Most cases are asymptomatic and found incidentally on imaging; however, a few symptomatic cases requiring treatment have been reported. Surgical intervention of arthrodesis and proximal row carpectomy in adults have been reported where conservative management of splinting, physiotherapy, anti-inflammatory medication, or steroid injections have failed. We report a unique case of Minnaar type 2 LTC in a 20-year-old man with a 6-year history of daily right wrist pain and symptomatic wrist instability whose previous conservative therapies failed. Midcarpal instability and volar intercalated segment instability—volar flexion of the lunate—were present. A novel technique using the palmaris longus tendon to reconstruct the triquetrohamate, triquetrocipitate, and dorsal radiolunate ligaments was performed. The graft was secured dorsally to the hamate, triquetrum, and capitate. An additional graft from the lunate to distal radius acted as a biomechanical checkrein. There were no complications. Temporary Kirschner wires were removed 2 months postoperatively, followed by occupational hand therapy. At 1-year follow-up, the patient no longer reported pain or lunotriquetral tenderness. Midcarpal instability and volar intercalated segment instability resolved. Postoperative right wrist flexion and extension were 40 and 75 degrees, respectively. We discuss the successful outcome of this novel technique as an alternative to arthrodesis in the surgical management of LTC. (*Plast Reconstr Surg Glob Open* 2022;10:e4430; doi: 10.1097/GOX.0000000000004430; Published online 7 July 2022.)

INTRODUCTION

Lunotriquetral coalition is a rare, congenital fusion of the lunate and triquetrum that results from a failure of apoptosis during embryological development.¹⁻⁴ Rarely, pain can present which is thought to be related to the inadequate cartilage resulting in degenerative osteoarthritis.¹⁻³ The largest known surgical case series of symptomatic LTC was nine adults who underwent arthrodesis, proximal row carpectomy, or no operation.² The current surgical options of arthrodesis or proximal row carpectomy are not ideal in pediatric/adolescent patients. Soft-tissue reconstruction has not been described in LTC; however, it

is a treatment option in midcarpal instability or VISI.^{5,6} We report a successful case employing a novel reconstructive technique using palmaris longus tendon graft to reconstruct an attenuated triquetrohamate ligament and supporting ligaments, as an alternative to arthrodesis, in a patient with LTC.

CASE DESCRIPTION

A 20-year-old right-hand-dominant man without previous injury or trauma presented with a 6-year history of right, ulnar-sided wrist pain. Examination of the right wrist showed gross instability of the midcarpal joint with a palpable clunk, tenderness at the triquetrohamate and lunocapitate articulations, and palmar subluxation of the distal carpal row. X-ray and computed tomography imaging demonstrated LTC. Magnetic resonance imaging showed an osseous component with inflammatory bone marrow edema and attenuation of the dorsal wrist capsule. Conservative measures consisting of midcarpal steroid injection followed by 1 month of immobilization failed to provide relief. Ligament reconstruction with dorsal capsulorrhaphy and anterior interosseous nerve/

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posterior interosseous nerve neurectomy was planned to avoid a motion-compromising partial fusion procedure. Intraoperative visualization showed fusion of the lunate and triquetrum and gross instability of the midcarpal joint. The mechanism of the proximal and distal carpal rows was such that axial loading of the wrist caused the distal carpal row to load the palmar aspect of the LTC, subsequently causing the coalition to fall into VISI (Fig. 1). Furthermore, the LTC caused the lunate and triquetrum to move as one fixed block, disrupting the normal helical articulation between the triquetrum and hamate, which normally prevents VISI deformity (Fig. 2). Two Kirschner (K) wires were used to hold reduction of normal carpal alignment. A palmaris tendon autograft was harvested in standard fashion utilizing step-cuts and twisted with Arthrex (Naples, Fla.) suture tape. While the tendon graft acts as a biological construct that will incorporate into the bone, the suture tape is intended to prevent the graft from stretching over time. Drill holes were prepared in the hamate, capitate, and triquetrum, lunate, and distal radius. The tendon graft was secured to the hamate, capitate, and triquetrum with a 3.5-mm Bio-Tenodesis (Arthrex) swivel lock. Another tendon graft was secured from the lunate to the dorsal distal radius to function as a biomechanical checkrein (Fig. 3). Postoperative X-ray confirmed normal alignment without evidence of recurrent midcarpal instability (Fig. 4). The K-wires were buried, and a short-arm splint was applied. At 2-week follow-up, the patient reported less pain and intact sensation with no hardware/incision complications, and the splint

was changed to a cast. Two months after the initial operation, another operation was performed to remove the K-wires, followed by occupational hand therapy strengthening/stretching exercises. Six months postoperatively, the patient was cleared to return to all activities without restrictions. At 1-year follow-up, he no longer reported pain nor clunking, however he had mild discomfort at the palmaris harvest site. On examination, there was no midcarpal instability or tenderness at the lunotriquetral interval. Mild tenderness was present at the radiocarpal articulation. Measurements were right grip strength 65 lbs; left grip 75 lbs; pinch 19 lbs bilaterally; right wrist flexion 40 degrees; extension 75 degrees.

DISCUSSION

This is a unique case of LTC associated with midcarpal instability in a 20-year-old whose symptoms started at age 14, which to the authors' knowledge, has not yet been reported in the literature. A study found the mean age of LTC diagnosis in the pediatric population was 13.³ Reconstruction was the preferred choice for this patient as arthrodesis would have resulted in joint-limiting motion. Results of arthrodesis in adult LTC patients show a limited range of motion with complications of nonunion up to 57%, impingement, and reoperation.^{2,5,6} A new arthrodesis technique to reduce nonunion rates was reported in four patients using distal radius cancellous



Fig. 1. Preoperative X-ray demonstrating palmar subluxation of the distal carpal row over the proximal carpal row and lunotriquetral coalition.

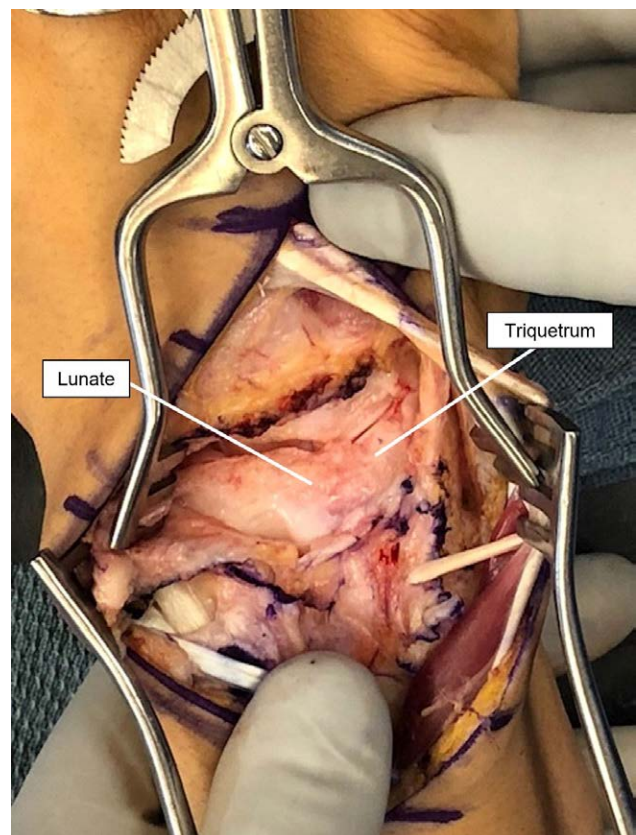


Fig. 2. Intraoperative photograph demonstrating palmar flexion of the LTC with axial loading of the wrist.

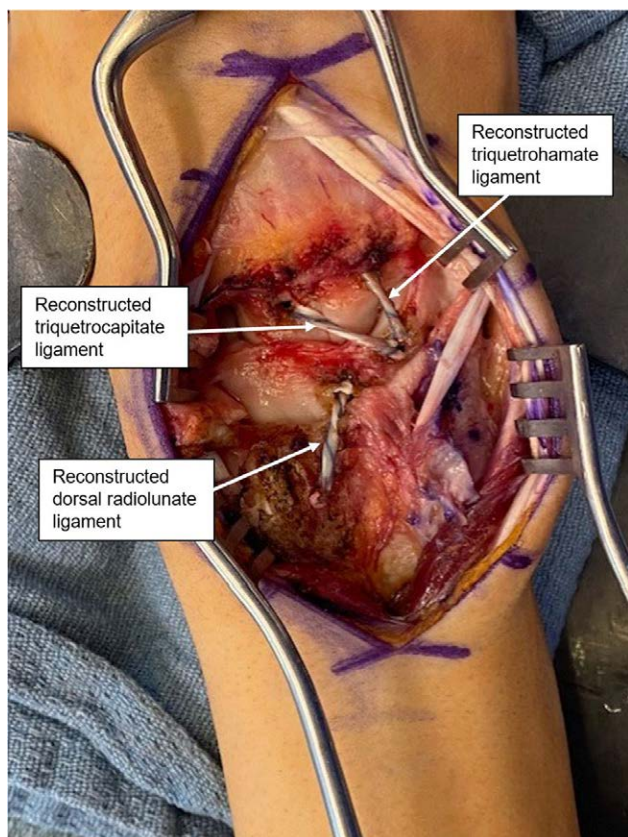


Fig. 3. Intraoperative photograph demonstrating the novel reconstruction utilizing Arthrex 3.5-mm swivel lock Bio-Tenodesis screws, suture tape, and palmaris longus tendon graft to reconstruction the triquetrohamate and triquetrocapitate ligaments. The dorsal radiolunate ligament was also reconstructed to act as a biomechanical checkrein to prevent palmar flexion of the LTC.

bone graft and threadless compression screws; however, none had VISI or midcarpal instability.⁴ Due to the rarity of LTC and limited reports of surgical intervention, other chronic wrist pain treatments provide potential surgical alternatives. Techniques like three-ligament tenodesis, dorsal capsulodesis, and thermal shrinkage exist and ligament repair using extensor carpi ulnaris or flexor carpi ulnaris are well studied. However, using the extensor carpi radialis has the potential of tethering the radiocarpal joint.⁵⁻⁸ There are two reports in the literature using palmaris tendon autograft for midcarpal instability or LT ligament repair.^{8,9} Harper and Iorio et al⁸ treated LT instability in two patients (ages 18 and 29) by passing the palmaris tendon through bone tunnels bored in the triquetrum and lunate. Chaudhry et al⁹ studied six patients (ages 24 to 42) with midcarpal instability using a technique in which the palmaris graft was secured in a zigzag configuration to the dorsal triquetrum and lunate. Both mention unique considerations for appropriately setting graft tension: overtaut can cause pin pull-out and friction/irritation from increased contact points, whereas excess slack allows laxity and instability to recur.^{8,9}

In our patient, LTC and midcarpal instability resulting in VISI were unique considerations, requiring



Fig. 4. Postoperative X-ray demonstrating normal carpal alignment with no evidence of recurrent midcarpal instability.

adjunctive K-wires and placement of a radiolunate checkrein. VISI is reproducible when sectioning the palmar and proximal component of the LT, or when the LT ligament and other stabilizers are injured.^{5,7} The volar component of the LT ligament is the strongest segment with a yield strength of 300 N.⁵ Last, anterior interosseous nerve/posterior interosseous nerve neurectomy has been shown to improve pain relief, grip, and functional outcome measured on the Disabilities of the Arm, Shoulder, and Hand.¹⁰ Disabilities of the Arm, Shoulder, and Hand was not measured in our patient.

SUMMARY

We report a successful outcome of a novel reconstructive technique using palmaris tendon graft followed by hand therapy for lunotriquetral coalition associated with midcarpal instability and a VISI deformity in a 20-year-old whose conservative therapy failed.

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