RESEARCH PAPER

Biotape Synthetic Graft for Ligament Reconstruction in Chronic Distal Radioulnar Instability: A Case Report

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Abstract

Instability of the distal radioulnar joint (DRUJ) may result in chronic ulnar-sided wrist pain, limited forearm rotation, and impaired hand function. Synthetic augmentation materials have emerged as potential alternatives that provide immediate biomechanical stability while avoiding donor-site complications.

Female, 61-year-old with chronic ulnar-sided wrist pain and restricted pronation–supination due to fall. Physical examination indicating distal radioulnar joint instability. Radiographic demonstrated widening of the DRUJ space and ligamentous disruption. Surgical reconstruction was performed using a synthetic Biotape graft placed through anatomically oriented bone tunnels in the distal radius and ulna and followed by physical rehabilitation. At 6 weeks follow-up, pain was improved and wrist stability restored. Radiographic evaluation confirmed maintained joint congruity without recurrent subluxation.

Synthetic graft augmentation has been reported to provide biomechanical stability comparable to native ligament function in experimental models. While clinical evidence is limited, this report suggests that biotape synthetic graft can became alternative for managing chronic DRUJ instability, particularly in patients with compromised autograft options.

Keywords: Distal radioulnar joint instability; ligament reconstruction; synthetic graft; biotape

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Introduction

The distal radioulnar joint (DRUJ) plays a critical role in forearm pronation and supination as well as rotational stability of the wrist. Disruption of this articulation can lead to chronic pain, limited range of motion, and reduced grip strength, significantly impairing upper-extremity function. The primary stabilizing structure of the DRUJ is the triangular fibrocartilage complex (TFCC), particularly the dorsal and volar radioulnar ligaments that maintain congruency between the distal radius and ulna during forearm rotation (Standring, 2021; Wolfe *et al*., 2017; Dmour *et al*., 2024)..

DRUJ instability commonly occurs following traumatic events such as fall on an outstretched hand (FOOSH), rotational injuries, or as a complication of distal radius fractures. In many cases, disruption of the TFCC results in abnormal translational movement of the distal ulna relative to the radius. Patients typically present with ulnar-sided wrist pain, mechanical clicking, decreased grip strength, and limitation in pronation–supination movements (Qazi *et al*., 2021; Rodríguez-Merchán *et al*., 2022; Huang *et al*., 2025).

Initial management may involve conservative measures including immobilization and rehabilitation. However, persistent instability or chronic TFCC disruption often requires surgical intervention to restore the anatomical ligamentous structures and joint biomechanics. Several surgical techniques have been described, including TFCC repair and anatomic ligament reconstruction using tendon autografts such as palmaris longus or

hamstring grafts. The Adams–Berger reconstruction technique remains one of the most widely accepted methods for treating chronic DRUJ instability (Adams & Berger, 2002; Gillis *et al*., 2019; Spies *et al*., 2020).

Despite favorable outcomes, autograft reconstruction carries certain disadvantages, including donor-site morbidity, limited graft availability, and variable tendon quality, especially in elderly patients. These limitations have encouraged the development of alternative methods using synthetic augmentation materials designed to replicate ligament function while providing high initial mechanical strength (Yammine & Erić, 2020.

Synthetic graft materials such as suture tapes or high-strength synthetic fibers have been increasingly utilized in ligament reconstruction procedures in orthopaedic surgery. These materials offer consistent mechanical properties, immediate stabilization, and avoidance of donor-site complications. Biomechanical studies have demonstrated that suture-based constructs may achieve stability comparable to native ligament structures in DRUJ stabilization models (Bachmaier *et al*., 2018; Mackenzie *et al*., 2022)

In this report, we describe a case of chronic DRUJ instability treated with ligament reconstruction using a Biotape synthetic graft. The objective of this case report is to present the surgical technique, postoperative outcomes, and potential advantages of synthetic graft augmentation in restoring distal radioulnar joint stability.

Case Report

A 61-year-old woman presented with persistent pain in the right wrist for three months following a fall in which the hand was used to break the fall. The patient reported increasing pain on the ulnar side of the wrist, particularly during forearm rotation and when lifting objects. Functional activities such as gripping and household tasks were significantly limited.

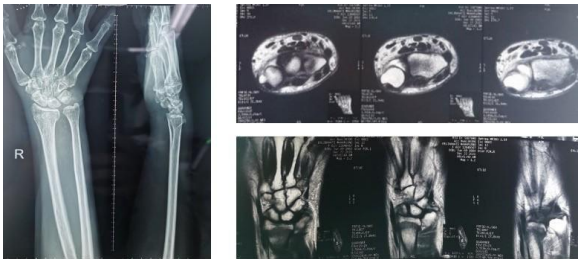

Figure 1. Radiographic and magnetic resonance imaging findings demonstrated widening of the joint space and ligamentous disruption of the distal radioulnar joint (DRUJ).

Physical examination revealed localized tenderness over the distal ulna and visible prominence of the ulnar head. Range of motion testing demonstrated limited pronation and supination of the forearm due to pain and mechanical instability. Special tests for DRUJ instability were positive, including the ballottement test and piano key sign, indicating abnormal translational movement of the distal ulna relative to the radius. Radiographic examination showed widening of the distal radioulnar joint space. Magnetic resonance imaging further demonstrated ligamentous disruption consistent with TFCC injury and DRUJ instability. Given the persistence of symptoms despite conservative treatment, surgical reconstruction of the distal radioulnar ligaments was indicated.

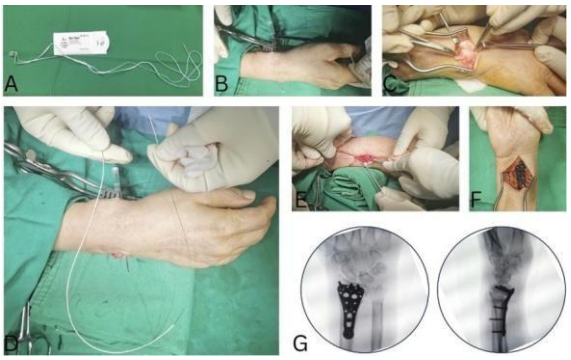

Figure 2. (A) Synthetic biotape graft. (B) Creation of a bone canal for the biotape fixation pathway. (C) Surgical approach to expose the ulnar head. (D) The biotape is inserted into the canal with the assistance of an Abbocath. (E) The biotape after fixation in the prepared canal. (F) Clinical photograph following plate fixation of the distal radius. (G) Postoperative radiographic evaluation demonstrating plate fixation of the distal radius and reconstruction of the distal radioulnar joint (DRUJ).

The procedure was performed under regional anesthesia. A surgical approach was made to expose the distal ulna and radius. Bone tunnels were created in the distal radius and ulna to replicate the anatomical orientation of the dorsal and volar radioulnar ligaments. A synthetic Biotape graft was passed through the bone tunnels using a guiding abbocath. The graft was tensioned with the forearm positioned in neutral rotation to reproduce physiological ligament tension throughout pronation and supination movements. Fixation was achieved using plate fixation at the distal radius and a suture anchor at the ulna to secure the graft.

Intraoperative assessment demonstrated improved joint stability with no abnormal translational movement during forearm rotation. Postoperative management consisted of temporary immobilization followed by progressive rehabilitation. Early therapy focused on protected range-of-motion exercises, gradually advancing to strengthening and functional activity training. At six weeks follow-up, the patient reported significant pain reduction and improved forearm rotation. Clinical examination revealed stable DRUJ mechanics without evidence of recurrent instability. Follow-up imaging confirmed maintained joint congruity and absence of subluxation.

Figure 3. Postoperative clinical evaluation demonstrating forearm supination–pronation and finger joint flexion–extension.

Discussion

Chronic instability of the distal radioulnar joint remains a challenging condition in hand surgery due to its complex biomechanics and the essential role of the TFCC in stabilizing the joint. Restoration of anatomical ligament function is crucial for maintaining forearm rotation and preventing degenerative joint changes (Dmour et al., 2024; Harbrecht et al., 2025)

The Adams–Berger reconstruction technique has long been considered the standard surgical method for managing chronic DRUJ instability. This technique reconstructs both dorsal and volar radioulnar ligaments using a tendon autograft passed through bone tunnels in the distal radius and ulna Several clinical studies have reported favourable outcomes with improved joint stability and pain reduction following this procedure (Gillis et al., 2019; Spies et al., 2020; Adams & Berger, 2002).

However, autograft reconstruction may present several disadvantages. Harvesting tendon grafts can result in donor-site morbidity, additional operative time, and postoperative pain. Furthermore, the quality of autograft tissue may be compromised in elderly patients or individuals with degenerative tendon changes. Recent biomechanical studies have explored the use of synthetic graft materials for ligament reconstruction. Graf *et al.* (2025) demonstrated in a cadaveric model that suture-based constructs can provide mechanical stabilization of the DRUJ comparable to native ligament structures. Similarly, biomechanical analyses comparing graft preparation techniques for DRUJ reconstruction have shown that synthetic augmentation may improve initial construct stability and reduce elongation during cyclic loading. In other orthopaedic applications, suture tape augmentation has been successfully used in ligament repair procedures such as anterior cruciate ligament and ankle ligament reconstructions. These materials provide high tensile strength and allow early mobilization while supporting biological healing of surrounding tissues (Yammine & Erić, 2020; Graf et al., 2024; Mackenzie et al., 2022).

In the present case, the use of a Biotape synthetic graft allowed anatomical reconstruction of the distal radioulnar ligaments without the need for tendon harvesting. The graft provided immediate mechanical stability and maintained joint congruity during postoperative follow-up. Another potential advantage of synthetic graft reconstruction is the ability to standardize graft properties. Unlike autografts, which vary in size and strength depending on patient anatomy, synthetic materials provide predictable mechanical characteristics (Graf et al., 2024; Zheng et al., 2023).

Nevertheless, several limitations must be considered. Long-term clinical outcomes of synthetic graft use in DRUJ reconstruction remain poorly documented. Potential complications such as graft wear, foreign body reaction, or late mechanical failure require further investigation through larger clinical studies. This case demonstrates that synthetic graft augmentation using Biotape may provide an effective alternative technique for DRUJ ligament reconstruction, particularly in patients in whom autograft options are limited. Further prospective studies with larger patient populations and long-term follow-up are necessary to evaluate the durability, functional outcomes, and complication rates associated with this technique.

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