Modified brachioradialis wrap for stabilizing the distal radioulnar joint: case report

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Abstract Distal radioulnar joint (DRUJ) stability requires competent static and dynamic soft tissues. Multiple DRUJ techniques have been described in the literature. Our method is a novel modification of the Gupta method of DRUJ stabilization used in a revision reconstruction on a patient with a total wrist arthroplasty. A brachioradialis graft is harvested and tunneled through Parona's space volar to the pronator quadratus and through the muscle body. The tendon is then brought dorsal between the radius and ulna to the dorsal side of the distal ulna and sutured to the floor of the 5th extensor compartment, as well as to the surrounding extensor reticulum ulnar to the 6th compartment with nonabsorbable sutures. Our modification of the method described by Gupta prevents ulnar subluxation of the extensor carpal ulnaris (ECU), allows the tendon graft construct to more adequately resist volar translation of the radius, and thus acts like a leash to pull the radius dorsally to the stationary ulna. This modification gives the graft a better force vector to resist the volar translation of the distal radius. We are able to present successful 30-month follow-up of this procedure.

Keywords Brachioradialis wrap · DRUJ instability · DRUJ stabilization

Introduction

The bony anatomy of the distal radioulnar joint provides very little inherent stability. The shallow sigmoid notch of the radius does not constrain the ulnar head. Capsular tissue, ligaments, and muscles provide most of the stability. The triangular fibrocartilage complex (TFCC) is composed of dorsal and volar ligaments that provide the basis of the soft tissue support [6, 7]. Left untreated, chronic instability and subsequent DRUJ arthritis can have a significant impact on hand and wrist function. In cases of acute trauma, primary methods of repair have been described to repair the TFCC and capsule. In chronic instability, the extent of injury requires a more advanced technique to restore joint stability.

Multiple techniques have been published describing DRUJ stabilization [1–5]. Many of them use bone tunnels to anchor tendon grafts used to reconstruct damaged ligaments. In patients who do not have normal bony anatomy (i.e., total wrist and/or ulnar head arthroplasty), further challenges exist for reconstructing a stable and functional DRUJ. In our clinical case, the presence of a total wrist arthroplasty and ulnar head replacement as well as failed previous reconstructions required a novel modification of the Gupta method of DRUJ stabilization to better control the pathophysiology [4].

Case Report

Our patient is a 56-year-old right-hand dominant female referred to our institution for management of her left wrist chronic DRUJ instability. This patient had a left total wrist and ulnar head arthroplasty performed at an outside institution for end-stage osteoarthritis refractive to conservative treatment. Postoperatively, she experienced recurrent dislocations requiring multiple closed reductions and had been in a cast for several months. On physical exam, she had gross DRUJ

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Fig. 1 Preoperative XR of left wrist with total wrist arthroplasty and ulnar head replacement. AP, oblique, and lateral views show a dislocated DRUJ. Implant appears radiographically stable

instability and absent finger extension to her index, long, ring, and small fingers. Her neurovascular exam was unremarkable. Preoperative X-ray upon presentation demonstrates a dislocated ulnar head replacement that was well fixed as was the wrist arthroplasty (Fig. 1). Intraoperatively, the patient was

noted to have extensive synovitis and black particulate staining due to polyethylene wear and subsequent metal on metal impingement from her total wrist arthroplasty. Her extensor tendons were ruptured over a long segment and her extensor retinaculum was attenuated. It was postulated that metallosis

Fig. 2 Artist rendering of surgical incisions needed for harvesting the brachioradialis tendon. Two 4-cm incisions: a distal radially based volar incision and a proximal volar incision at the musculotendinous junction

of the brachioradialis is created. A dorsal incision based over the 5th extensor compartment is used to complete the stabilization procedure

Fig. 3 Artist rendering of completed DRUJ stabilization. The tendon is then wrapped around the dorsal side of the distal ulna and sutured to the floor of the 5th extensor compartment, as well as to the surrounding extensor reticulum with nonabsorbable sutures

lead to capsular destruction with subsequent attenuation of the DRUJ leading to dislocation and destruction of her extensor mechanism.

The patient then underwent a DRUJ stabilization procedure using the palmaris longus tendon and extensor tendon tenodesis of the lesser finger stumps to each other, and then a flexor carpi radialis transfer this construct. For this procedure, a harvested palmaris longus tendon was used and anchored at the distal radius on the volar aspect of the wrist, and then the two tails were passed through the interosseous

membrane dorsally. The wrist was put in neutral rotation and one tail of the graft was sewn in to the ECU tendon sheath and then brought distally along the retinaculum while a second tail was brought more distally and feed through the fifth extensor retinaculum and secured side-to-side with 4–0 Fiber Wire to the sixth compartment extensor retinaculum.

Over the subsequent 18 months, the patient began to have recurrent instability of her DRUJ again. Revision surgery was recommended and a modification of previously described DRUJ stabilization procedures was used [1, 2, 5]. A more robust stabilization of the DRUJ was desired given the failure of the previous reconstruction, therefore, a modification of the procedure described by Gupta was used. This allowed the stout BR tendon to be used as graft while leaving its insertion intact on the distal radius as a solid anchor. This modification involves a different configuration of the graft, which we believe provides better stabilization against DRUJ instability.

Fig. 4 Intraoperative photograph showing completed DRUJ stabilization and revision dorsal exposure

Surgical Technique

The majority of the surgical procedure follows a technique reported by Gupta [4]. As previously described, harvesting the brachioradialis tendon requires two 4-cm incisions: a distal radially based volar incision and a proximal volar incision at the musculotendinous junction of the brachioradialis (Fig. 2). Through the distal incision, the BR is identified proximal to the first dorsal compartment. The proximal incision allows access to the musculotendinous junction of the BR. Care must be taken as the radial sensory nerve runs just deep to the BR muscle belly emerging dorsal to the musculotendinous junction and tendon proper. Once the muscle and tendon are separated, the freed tendon is tunneled through the distal incision and is freed to be used during the wrap procedure. The distal

Fig. 5 **a** AP and **b** lateral radiographs at 30-month follow-up. Radiographs show a well-fixed implant and reduced DRUJ

insertion of the BR is left attached to the radius and is crucial for anchoring the construct.

The DRUJ is then accessed through a standard exposure on the dorsal ulna side of the wrist over the 5th extensor compartment. This incision can be made as lengthy as needed for adequate exposure (Fig. 2). The extensor digiti minimi in the 5th compartment is mobilized and retracted to allow access to the dorsal wrist capsule. The free end of the BR graft is tunneled through Parona's space volar to the pronator quadratus and through the muscle body. The tendon is then passed from volar to dorsal through the floor of the 5th extensor compartment. The tendon is then wrapped around the dorsal side of the distal ulna. The tendon is sutured, with the forearm in supination, to the floor of the 5th extensor

compartment, as well as to the surrounding extensor reticulum ulnar to the 6th compartment with nonabsorbable sutures (Figs. 3 and 4). Intraoperatively, stability of the joint can be tested in pronation and supination and subsequent adjustments made to the tension of the graft. Provisional sutures that were placed are assessed and replaced as needed to maintain stability. The sigmoid notch was also recontoured with a burr, although a limitation of this was due to the wrist arthroplasty.

Postoperatively, the patient was immobilized in a sugar tong splint in neutral rotation for 6 weeks. At 6 weeks, gentle pronation and supination exercises were started. At 6-month follow-up, the patient was noted to have a stable DRUJ and a functional arc of motion of 30° of pronation and supination, respectively. At 30-month follow-up, the patient underwent

Fig. 6 Clinical photographs showing operative extremity (*left*) with near equal pronation (**a**) and supination (**b**) to contralateral (*right*) upper extremity

physical exam and radiographic follow-up. Radiographic evaluation was unremarkable (Fig. 5a, b). On exam, the patient was noted to have near-equal pronation and supination on her surgical extremity (left) compared (approximately 70°) with the contralateral upper extremity and the patient reports no instability of her DRUJ (Fig. 6a, b).

Discussion

The ulna is a stationary axis about which the radius is free to move, and with injury to the DRUJ soft tissue constraints, the radius may translate volarly, away from the radius and subsequently permit ulnar head dislocation. Our modification of the method described by Gupta allows the tendon graft construct to more adequately resist volar translation of the radius, thus acting like a leash to pull the radius dorsally to the stationary ulna. This modification gives the graft a better (more anteroposterior) force vector to resist the volar translation of the distal radius. It also stabilizes the ECU to the dorsal ulnar aspect of the ulna and prevents subluxation ulnarly, which aids in preventing the ulnar head from escaping dorsally.

Conflict of interest Patrick G. Marinello, M.D. declares that he has no conflict of interest.

Sebastian Peers, M.D. declares that he has no conflict of interest.

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Statement of human rights and animal rights All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5). Informed consent was obtained from all patients for being included in the study.

Statement of informed consent Informed consent was obtained from all individual participants included in the study in accordance with institutional policy for using electronic medical records.

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