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Case Series

Use of palmaris longus graft in chronic distal radio-ulnar joint instability in complex tear of triangular fibro-cartilage complex

Malay P. Gandhi, Nilkumar R. Patel*, Rushit M. Shah, Vatsal J. Mehta, Malkesh D. Shah

Department of Orthopaedics, Smt. BK Shah Medical Institute and Research Centres, Sumandeep Vidyapeeth Deemed to be University, Waghodia, Vadodara, Gujarat, India

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***Correspondence:**
Dr. Nilkumar R. Patel,
E-mail: neelpatel0803@gmail.com

ABSTRACT

Chronic distal radio-ulnar instability often results from complex tear of triangular fibro-cartilage complex (TFCC), which serve as a critical stabilizer for wrist. This injury frequently arises due to repetitive trauma or acute injury, leading to significant pain, functional impairment, and diereses grip strength. Chronic dislocation of the distal radio ulnar joint has traditionally been managed through intricate osteotomies and reconstructive procedures, often resulting in stubborn stiffness and diminished functionality. It is advantageous to employ a fixation method that not only restores wrist biomechanics but is also aesthetically pleasing for the affected individual. Here, we introduce a new technique for use of palmaris longus graft with fixation button stabilizing chronic distal radio-ulnar joint instability. The advantage of this surgery is decries the duration of the surgery, and start early range of movements of wrist with significant improvement in pain using the vas score. None of the patients had complications. The use of palmaris longus graft is believed to an innovative, safe, reliable and efficient method for of distal radio-ulnar joint (DRUJ) instability.

Keywords: Palmaris longus, DRUJ, TFCC, Fixation buttons

INTRODUCTION

The distal radio-ulnar joint (DRUJ) frequently sustains injury following wrist trauma, either in isolation or in conjunction with distal radius fractures and triangular fibro cartilage complex (TFCC) tears. For symptomatic patients, restoring the dorsal or volar radio-ulnar ligament is essential to regain DRUJ motion. The preferred tendon source for ligament reconstruction, as per the Adams and Berger technique from 2002, is the palmaris longus (PL).

While the PL tendon is suitable as a graft due to its length, diameter, and availability, it is also one of the most variable muscles in the human body. Variations such as absence of the PL, bi-tendinous configurations, multiple muscle bellies, palmaris prefunds, reverse Palmaris, and Palmaris brevis are commonly observed in cadaveric studies. Absence of the PL has been reported at rates ranging from 1.5% to 63.9%, diagnosed through clinical observation, intraoperative discovery, or cadaver dissection. In this report, we describe a case involving a young man with chronic DRUJ dislocation treated through PL tendon ligament reconstruction. Intraoperatively, we encountered an anomalous tendon, prompting several modifications to the Adams technique for DRUJ reconstruction. The patient provided consent for the publication of this report, and our work adheres to the CARE guidelines.

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CASE SERIES

The study was carried among 10 patients diagnosed with distal radio ulnar joint instability due to distal forearm pathology in those who underwent suspension fixation with button plates for DRUJ dislocation and we take palmaris longus grafts and fixation was done. We take 6 months follow up and evaluating with wrist Mayo score and took for post-operative complications. The evaluation time point was 6 months after the operation.

Diagnostic criteria, inclusion criteria, and exclusion criteria

Diagnostic criteria

Patients in the study had acute or chronic DRUJ instability, including traumatic DRUJ dislocations or Colles fractures, Smith fractures, Galazzi fractures combined with DRUJ dislocation, chronic inflammation involving the DRUJ. The symptoms and signs of DRUJ dislocation included positive "ulnar fossa sign," "piano key sign," and positive forearm rotation test1, 2, 15.

The diagnosis of DRUJ was made by combining the positive and lateral X-ray films. Computed tomography (CT) or magnetic resonance imaging (MRI) could be used to confirm the diagnosis

Inclusion criteria

The inclusion criteria were: patients 18 to 50 years old who were diagnosed with DRUJ dislocation; patients who underwent DRUJ construction; and all the follow-up data for physical examination, radiography, MRI, functional activity of the wrist joint, grip strength of the wrist joint, Mayo Wrist score before and 6 months after the operation had been collected.

Exclusion criteria

The exclusion criteria were: patients who disagreed with the surgical plan, were unwilling to participate in experimental research, or did not cooperate with the treatment; patients with complications such as serious cardiovascular and cerebrovascular diseases, and liver, kidney or hematopoietic system diseases; and patients with multiple trauma (injury severity score [ISS] >16), with fever or skin allergies, with mental illness or Alzheimer's disease or with severe open fractures, and pregnant women were excluded.

General data

From June 2022 to December 2022, ten (10) patients diagnosed with DRUJ instability by radiography, MRI scan, and physical examination were admitted to our hospital. This study was approved by the ethics committee of our hospital. The patients included six men and four women; follow-up was performed in all twenty patients. The follow-up for 6 months (Table 1).

Table 1: General data of the patients.

S. no.	Sex	Age (years)	Disease course (months)	Follow-up period (months)	Accompanying Condition	Surgical Plan
1	Male	23	1	3	Distal end of radius and ulna fracture	Open reduction and internal fixation + suspension fixation
2	Male	26	6	5	Distal end of radius and ulna fracture	Open reduction and internal fixation + suspension fixation
3	Male	38	5	6	Distal ulna fracture	Ulna osteotomy +suspension fixation
4	Female	30	8	3	None	suspension fixation
5	Female	45	10	3	Ulna fracture	Ulna osteotomy +suspension fixation
6	Male	25	12	5	Distal end of radius and ulna fracture	Open reduction and internal fixation + suspension fixation
7	Male	30	3	6	Galeazzi fracture	Open reduction and internal fixation + suspension fixation
8	Male	32	6	6	None	suspension fixation
9	Female	35	8	4	Distal end of radius fracture	Open reduction and internal fixation + suspension fixation
10	Female	45	9	3	Ulna fracture	Ulna osteotomy +suspension fixation

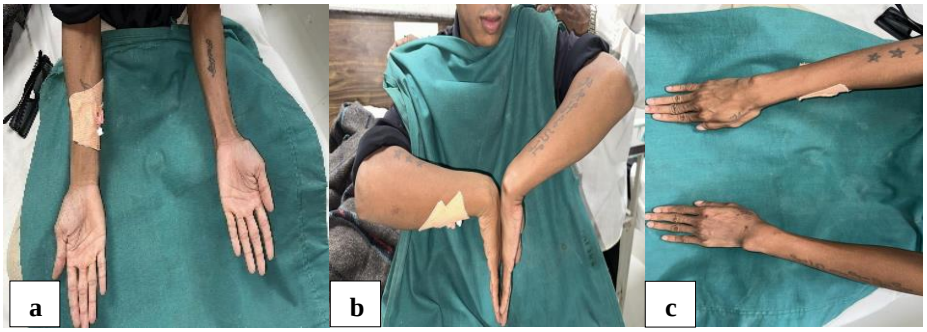

Figure 1: Pre op movements (a) supination, (b) palmar flexion, and (c) pronation.

Treatment management of primary disease

All procedures were performed by the same experienced chief physician. The patients were placed in the supine position. After the successful induction of brachial plexus anesthesia, the operative field of the upper arm was routinely disinfected and draped. A tourniquet was placed on the arm proximally to the operation field. The management of one patient was complicated: the patient had Galeazzi fracture and invading the DRUJ, as well as a long ulna. The open reduction internal fixation and ulnar osteotomy and plate and internal screw fixation were performed. Two patients with long ulnas underwent ulnar osteotomy and plate and internal screw fixation. Three patients with traumatic dislocation of the DRUJ underwent internal fixation with plates and screws. After completing the treatment of the primary diseases, the DRUJ was reconstructed by suspension fixation with button plates surgical technique A dorso-ulnar incision is made over the DRUJ. The extensor retinaculum is opened to expose the 5th compartment. The extensor digiti minimi (EDM) tendon is retracted radially. An inverted L-shaped capsular incision is made to expose the DRUJ, with the smaller limb of the L-shaped being made just proximally to the TFCC. The TFCC remnant is debrided to expose the fovea. An interosseous tunnel is created from the fovea to the ulnar side of the ulnar styloid. The 4th dorsal compartment is elevated subperiosteally to reflect the dorsal margin of the sigmoid notch and lunate fossa of the distal radius. A 3.5 mm drill hole is made in the lunate fossa approximately 5 mm radial to the radial edge of DRUJ and 5 mm to the radio-carpal joint to avoid breaching the sigmoid notch. Volarly, the radial tunnel is made on the ulnar column of the distal radius approximately 5 mm radial to the sigmoid notch and 5 mm proximal to the radiocarpal joint. The PL graft is passed through this radial tunnel with a suture retriever from dorsal to volar. Both limbs of the PL graft are then passed to the ulna interosseous tunnel with one end pulled longer than the other. A second ulnar tunnel is made proximally to pass the longer limb. Both limbs are fixed with Pulvertaft's weave technique after appropriate graft tensioning in the neutral wrist and compressed DRUJ. Finally, the graft is tightened and stabilized with an endobutton. The average duration of surgery was one and half hours and average follow up was 24±6 weeks. Suture removal was done at 2 weeks. Wrist mobilization started after 5 weeks. None of the patients showed any complications. Functional scoring of wrist joints before and 6 months after operation using Garland-Wesley wrist score was 13.500±2.66 preoperatively, the Garland–Werley wrist score was 2.83±1.33 postoperatively at 6 months after surgery, at 6 months after surgery, the Garland–Werley wrist score (p=0.000).

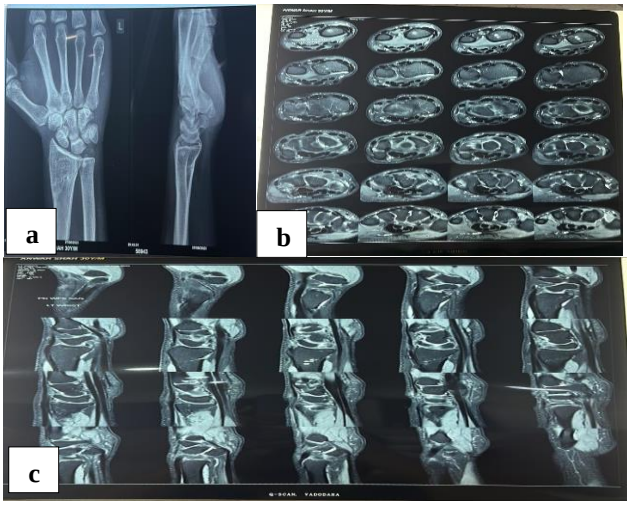

Figure 2 (a-c): Pre op X-rays and MRI with report.

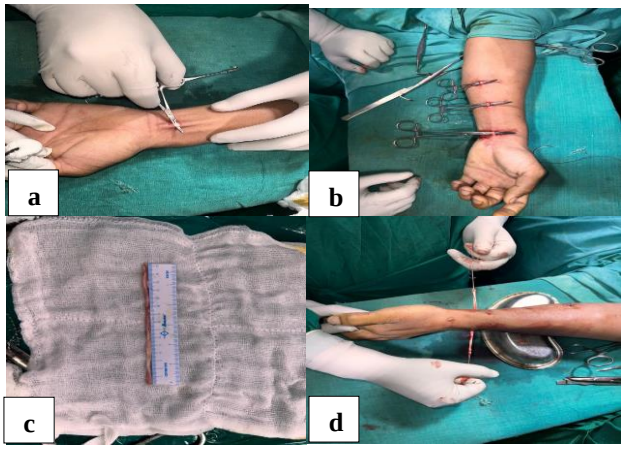

Figure 3: Intra op photos (a and b) harvesting palmaris longus graft, (c) length of palmaris longus graft, and (d) palmaris longus graft attach to the adjustable endobuttone lope.

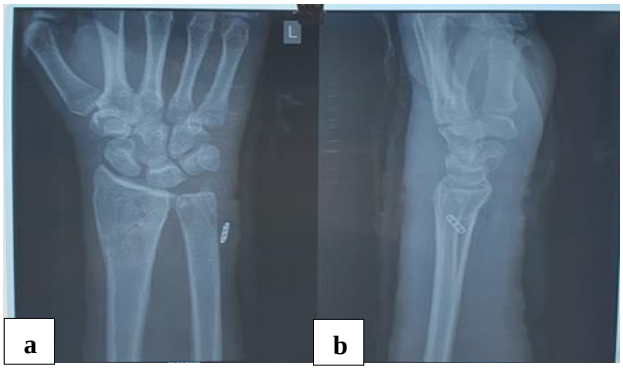

Figure 4 (a and b): Post op X-ray.

Figure 5: (a) Dorsiflexion, (b) pronation, (c) supination, and (d) follow up X-ray.

DISCUSSION

DRUJ dislocation can result from both traumatic and pathological causes.[1] Trauma or chronic inflammation affects the bony structures and soft tissues of the DRUJ, leading to instability or dislocation.[2] Common signs of DRUJ dislocation include the "ulnar fovea sign," the "piano key sign," the "positive forearm rotation test," the "positive squeeze test," and ulnar impact syndrome.[3] Research indicates that pain at the ulnar fovea is a sensitive indicator of TFCC injury, with a sensitivity of 95.2%. Biomechanical studies have confirmed a link between ulnar impact syndrome and DRUJ instability.[4] Diagnosis typically relies on positive physical signs and anteroposterior radiographic views, with contralateral wrist radiographs used for comparison when necessary. CT and MRI are also viable diagnostic tools for DRUJ.[5] Additionally, wrist arthroscopy serves as an effective surgical treatment option and is considered the gold standard for diagnosing DRUJ injuries under direct vision, particularly for TFCC injuries.[6,7]

Acute DRUJ instability can be managed with external fixation using a plaster cast, alongside TFCC repair. Improper treatment of DRUJ dislocation can lead to wrist pain and limit forearm rotation.[8,9] Successful conservative treatments have been reported, with Wassink achieving favorable outcomes through manual reduction and plaster cast fixation in patients experiencing repeated traumatic DRUJ dislocations.[10,11] For chronically unstable or dislocated DRUJ that has not yet degenerated, soft tissue reconstruction is often the preferred treatment option. Biomechanical studies indicate that physiological changes occur in the motion trajectories of the joint following reconstruction, aside from articular capsule shortening.[12] Ulnar tendon suspension fixation may result in poor stability and is primarily utilized for treating ulnar instability.[13] While the shortening of the extensor support band and joint capsule has minimal effects on DRUJ motion trajectories, they are often employed to restore mild instabilities or used in conjunction with other soft tissue reconstructions.[14] A retrospective study by El-Haj et al reported satisfactory outcomes during a short-term follow-up (16 months) for treating dorsal instability of the DRUJ by shortening the dorsal wrist support band.[15]

The Adams and Berger procedure is a well-known technique for DRUJ ligament reconstruction; however, it is complex.[16] This procedure necessitates incising the support band and joint capsule for intra-capsular operation and involves drilling a tunnel in the ulnar joint fossa to allow tendon passage. This approach may affect the blood supply to the TFCC and risk direct damage to its anatomy.[17,18] Consequently, both postoperative bone and joint tissue repair can be adversely affected. Moreover, this anatomical reconstruction method does not accurately replicate the anatomical and biomechanical properties of the deep and superficial structures of the DRUJ ligament, potentially impacting surgical outcomes and increasing complication rates.[19]

In this study, the suspension fixation method utilizing a button plate for DRUJ reconstruction was identified as straightforward for surgeons.[20] It facilitates early functional exercises and promotes satisfactory postoperative recovery. Extra-articular fixation of the DRUJ (e.g., Kirschner wire fixation) has a reduced impact on the TFCC but may hinder postoperative rehabilitation exercises, increasing the risk of postoperative forearm stiffness. This technique carries potential complications, including Kirschner wire breakage and secondary fractures.[21]

The suspension manipulation technique is minimally invasive and easy to perform. Even in the event of fixation failure, alternative options remain. Drake and Kam et al have utilized a suture button device to restore DRUJ stability.[22] For patients experiencing DRUJ instability, de Vries conducted biomechanical experiments demonstrating that the suture button device could be used to reconstruct the distal interosseous membrane, thereby treating DRUJ instability. In cases of DRUJ instability and dislocation resulting from TFCC injury, Shuchai Xu, a co-author of this study, implemented an improved suspension device to enhance DRUJ stability, achieving satisfactory

clinical outcomes.[23] Xu's technique is simple, minimally traumatic, reproducible, and advantageous for early postoperative rehabilitation, presenting new avenues for future DRUJ stability reconstruction without necessitating intra-articular or extra-articular ligament reconstruction. This procedure preserves adjacent joint structures and supports early functional exercises, resulting in satisfactory postoperative recovery.[24,25]

Drilling a tunnel with a 2-mm Kirschner wire minimizes the diameter of the bone tunnel, thereby reducing the risk of fractures associated with oversized tunnels during ligament reconstruction. Additionally, this approach minimizes regional injury to the TFCC attachment site and provides a stable environment conducive to healing. Compared to free tendon transplantation, this technique has a minimal impact on the donor site and maintains tendon vitality and tension.

For patients with DRUJ instability or dislocation due to significant traumatic injury of the donor ligament from pathological factors, the suspension technique allows for stable fixation while significantly reducing surgical trauma. Furthermore, suspension fixation enables patients to initiate early forearm rotation exercises, preventing internal fixation fractures or joint stiffness associated with rigid fixation methods, such as Kirschner wire fixation.

CONCLUSION

The respective procedure for DRUJ ligament reconstruction is the Adam and Berger procedure, but operation is complicated and time consuming. The palmaris longus tendon is a dispensable donor graft that is greatly utilized in various reconstructive surgeries. However, the variety of the muscle belly and the tendon is hardly identified in preoperative clinical and radiological examination. It is also rarely reported other than in cadaveric studies. Thus, physicians should be aware of the PL tendon varieties when considering them as donor grafts, and other sources of grafts or allografts should be kept in mind. Otherwise, modifications to the standard technique can be made. This study describes a new method for the surgical reconstruction of the DRUJ through suspension fixation with a button plate. Postoperative follow up showed a good position of the DRUJ with no significant dislocation or subluxation. This procedure is simple and less traumatic for the reconstruction of DRUJ stability, without the need to perform intra-articular or extra-articular reconstruction of the ligament. This procedure does not damage the adjacent structures of the joint and can support early functional exercise and achieve satisfactory postoperative functional recovery. Thus, the suspension fixation technique is an effective and novel approach for DRUJ reconstruction.

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