Distal Radio-Ulnar Joint Instability

Literature Review

And

Case Studies

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Assessment and Management of Distal Radio-Ulnar Joint Dysfunction: Literature Review and Two Case Presentations

Introduction

There is very little written in the physical therapy literature about dysfunction at the distal radio-ulnar joint, though it can become involved as a result of various traumas or in the rheumatic diseases. This is the most difficult area of the wrist to evaluate radiographically, so clinical assessment is important in diagnosis. This article describes the basic anatomy of the distal radio-ulnar joint (DRUJ), the common mechanisms of injury, and exam techniques. Two cases are reported to discuss the role of physical therapy in both conservative care and in the post-operative rehabilitation.

Anatomy of the Distal Radio-Ulnar Joint

The distal radius presents a concave surface called the sigmoid cavity to the convex surface of the ulna. The ulna's distinctive styloid process is not an articulating structure, but it does provide some bony support to the DRUJ in full supination. The ulna is separated from the wrist by the triangular fibrocartilage complex (TFCC)[1]. The TFCC consists of the articular disc, the meniscus homologue, the palmar and dorsal distal radioulnar ligaments, the sheath of the extensor carpi ulnaris (ECU), and the ulnar capsule. The ulnotriquetral ligament and the ulnolunate ligament are also components of the TFCC. The ulnar capsule, the sheath of ECU, and the ulnotriquetral ligament all attach to the styloid process. [2] The primary function of ECU is providing stability to the DRUJ as it goes from pronation to supination.[3] The pronator quadratus attaches to both the distal radius and the distal ulna. The pronator quadratus and the TFCC are the primary stabilizers of the DRUJ. The palmar radio-ulnar ligament provides stability in full

pronation, and the dorsal portion provides stability during full supination. There remains some controversy over the specific roles of these ligaments, based on the existence of different fiber orientation patterns between their deep and superficial layers. The tendon of extensor carpi ulnaris lies within a groove in the distal ulna. The tendon of extensor minimi digiti lies further laterally.[4] The interosseous membrane may also offer some stability.

There is a delicate balance at the DRUJ between mobility and stability. Any disruption of this balance can lead to instability, incongruity, impingement, or arthritis.[5] This balance can be disrupted by trauma or by chronic inflammatory processes.

Mechanisms of Injury

Instability develops at the DRUJ due to trauma or due to inflammatory processes in the overlying soft tissues. Historically, the injury is described by the position of the ulna in relation to the radius. In fact, the ulna remains as the stable unit, and it is the radius that translates either anteriorly or posteriorly. This misleading description is likely to continue. The reader needs to remember that a dorsal DRUJ dislocation, resulting in dorsal positioning of the ulnar head, indicates that the radiocarpal unit has moved anteriorly. The converse would be true for a volar dislocation[2]

Traumatic injuries

Direct injuries to the DRUJ are inclusive of dorsal dislocations, and palmar dislocations. Dorsal dislocation, which occurs with forced hyperpronation, is the most common presentation of instability. Palmar dislocation occurs with forced hypersupination. Or, the DRUJ may be affected indirectly by trauma anywhere within the forearm complex. For example, a history of a distal radius fracture is a common cause

of incongruity at the DRUJ. Goldberg reports that the DRUJ is affected in 60% of patients with forearm fractures.[6] The interosseous membrane can be torn as a result of a Galleazzi fracture or a radial head fracture.[5]

Rheumatic Diseases

Rheumatoid arthritis typically involves the wrist. One manifestation of the inflammation is synovitis of the joint capsule. This inflammatory process leads to erosion of the styloid process. Since the ulnar capsule, the tendon of ECU, and the ulnotriquetral ligament all attach to the styloid process, this erosion renders these stabilizing structures ineffective. In addition, tenosynovitis of the tendons as they cross the joint is exacerbated by the jagged edge of the eroding styloid process, sometimes causing rupture of the extensor carpi ulnaris tendon (ECU).[7]

Clinical Exam

The clinical exam is very important and it begins with a thorough history. The mechanism of injury and medical history will suggest DRUJ involvement.

In terms of mechanical injuries, hyperpronation injuries are a more common cause than hypersupination injuries, but forceful radial deviation can also be a cause. This injury might occur in rodeo, where the hand remains fixed, and the body is thrown over the hand. If the injury is recent, ecchymosis and soft tissue swelling will be evident. Sports which predispose one to TFCC injuries are tennis and golf, where impact with the ball occurs when the wrist is in ulnar deviation.[9] Gymnasts who begin weight bearing on the wrists at an early age can experience premature closure of the epiphyseal plate in the radius, causing incongruity at the DRUJ. This leads to early degenerative changes at the joint.[10]

If the cause is rheumatoid arthritis, the swelling may be more diffuse. If the ECU is subluxed, which can occur with forceful radial deviation, it will roll volarly as the

forearm moves from pronation to supination. Extensor tenosynovitis begins as a painless soft tissue mass on the dorsum of the wrist. The sheath will thicken, and may fill with "rice bodies". Rice bodies are the end results of synovial proliferation and degeneration. They are semi-firm exudate that contain collagen, cell debris, fibronectin, and fibrin, and they float in the synovial fluid.[11] If untreated, the synovium proliferates and invades the tendon, thereby weakening it and causing a rupture. Rupture may also be caused in rheumatoid arthritis by abrasion of the ECU tendon by the eroding distal ulna. The supportive TFCC structures attach to the distal ulna. The distal ulna also supports the ECU by positioning the tendon in a groove. The ECU is primarily responsible for DRUJ stability during pronation.

In cases of instability, further visual inspection may reveal the distal ulnar positioned either dorsally or volarly with respect to the radius. The distal ulna will be ballottable. Range will improve when the clinician reduces the ulnar head during supination or pronation.

Figure 1. To test for distal radio-ulnar joint instability, position the wrist in supination, stabilize the distal radius, and depress the distal ulna. Ballottability of the ulna would indicate instability.

With impingement at the DRUJ, ROM will be limited in extension, pronosupination, and in ulnar deviation. In this case, if the clinician radially deviates the wrist, the impingement is relieved, and range will improve into extension. Raskin reports that chronic incongruity can lead to ebernation, chondrolysis, and arthritic degeneration.[5]

The patient with dysfunction at the DRUJ will report pain with activities involving pronation and supination, such as turning doorknobs or opening jars. Grip strength will be diminished, as the ulnar side of the hand provides a good deal of strength. Pinch strength may not be diminished. A sensory exam includes paresthesias or frank sensory loss, and positive Tinel, and Phalen's signs. [5]

Signs of DRUJ Instability

- Ballottable distal ulna
- Ulnar styloid is positioned more volarly
- Painful pronation or supination
- Painful flexion in ulnar deviation
- Range of wrist flexion or extension increases when the wrist is held in radial deviation
- Decreased grip strength

Role of radiographic studies

Diagnosis by radiograph is difficult, because wrist rotation can yield a false negative result in regard to instability at the DRUJ. It would, however, be effective in assessing the status of the styloid process. To assess the TFCC, computed tomography (CT scan) is considered to be more accurate, but proper positioning of the wrist is important in this test also. Arthrograms are quite accurate.[4] Fulcher believes that arthroscopy is the gold standard of diagnosis.[9]

Case Studies

Case #1

Post-Surgical Management of
Distal Radio-Ulnar Joint Arthroplasty with Synovectomy

Our patient is a 46-year-old black male who has been employed for 18 years as a painter/sandblaster. About 18 months ago, he developed insidious onset of right, master wrist pain. An MRI demonstrated a tear of the triangular fibrocartilage complex (TFCC), causing instability at the distal radioulnar joint (DRUJ).[8] He underwent an arthroplasty and partial synovectomy and presented for therapy 5 weeks post-operatively.

Patient interview: Past medical history was unremarkable except for high cholesterol. He reported that the wrist pain impaired his function. He had difficulty turning the key to start the car and to open his door. It was also painful to turn a doorknob or lift his coffee cup. He rated the pain as a 1 or 2/10 at rest, and an 8/10 with activity (Verbal analog scale, zero = no pain, and 10 = most severe pain).

Evaluation: There was mild edema. The wrist measured 19 cm, versus 18 cm on the uninvolved side. Sensation was intact. Gross grasp measured 45 # on the right, versus 85# on the left

Active range of motion (ROM) was within functional limits (WFL) except for:

Supination	25°
Pronation	75°
Radial deviation	15°
Ulnar deviation	10°
Wrist extension	35˚
Wrist flexion	55º

Assessment: Patient was 5 weeks post DRUJ revision/arthroplasty of the right master wrist. The incision was well healed, and the scar was fairly mobile, and without hypersensitivity. Wrist ROM was limited most markedly in supination. Strength as

measured by static grip is 50% of the left hand. Endurance is poor. He had significant pain that limited his ability to perform ADLs and his ability to perform his work-related responsibilities.

Short-term goals:

- Improve forearm supination from 25° to 50°
- Improve wrist extension from 35° to 55°
- Improve grip strength from 45# to 55#
- Decrease edema
- Decrease pain with activity to 4/10

Long- term goals:

- Restore optimal ROM and functional use of right master hand
- Decrease pain to 1/10 with activity
- Increase grip strength to 75#
- Increase ROM to full

Treatment plan:

- Phonophoresis or iontophoresis with dexamethasone to DRUJ
- Moist heat prior to stretching, and ice after exercise or activity
- Passive and active ROM exercises to the wrist, forearm, and fingers
- Begin strengthening exercises at 6 weeks post-op
- Wear cock-up splint
- Scar management strategies

Progress: After 5 weeks of two visits per week, gains in ROM and strength were noted, but pain persisted. Gross grasp has increased to 70#. Edema was still noted over the dosal ulnar aspect of the wrist. Active ROM had improved to:

	Initial	Final
Supination	25°	50˚
Pronation	75°	70˚
Radial deviation	15°	
Ulnar deviation	10°	
Wrist extension	35˚	70˚
Wrist flexion	55º	65˚

The patient was discharged at that time, and then waited 2 weeks for a re-check with the hand surgeon. Over that time, he equalized gross grasp strength in both hands at 80#. He lost 20° of pronation, which then measured 50°, and lost 5° in both flexion and extension, which are now at 60º and 65º respectively. Supination increased to 60°. Pain continued to be significant during his activities.

He attended 5 therapy sessions over the next 4 weeks. There was little change in his ROM or pain. He was discharged with a home exercise program and advised to use ice for pain management. He was unable to return to work as a painter/sandblaster, and was pursuing job training opportunities through his employer.

Discussion: This case exemplifies the difficulty of managing the wrist after a tear of the TFCC. The therapeutic intervention includes edema and scar management, increasing mobility, and strengthening the existing supporting structures around the wrist.

Case Study #2

Conservative Care of Extensor Carpi Digitorum Communits (EDC)

Our patient is an 85-year old man with a one-year history of pain and swelling on the ulnar, dorsal aspect of the right master wrist. The hand has also developed weakness that impairs his ability to hold or manipulate objects.

Patient interview: Past medical history includes bilateral carpal tunnel release (1984 & 1985), osteoarthritis, total hip replacement (1990), and medically controlled hypertension. He takes two Advil per day for wrist pain.

He is married, and spends winters in Florida and summers in Connecticut. He enjoys gardening year-round. He has difficulty rising from a chair, buttoning and fastening clothing, holding a plate or a glass, and lifting any heavy objects. Wrist pain now limits

his activities of daily living. He reports a pain level of zero at rest (Verbal analog scale, zero = no pain, and 10 = most severe pain), and a level of 4 with light activity. Pain level increases to a 7 or 8 if lifting heavy objects.

Evaluation: Inspection reveals a large nodule of synovitis on the dorsal radial aspect of the hand along the extensor carpi ulnaris (ECU). The mass is soft and mildly tender. Patient reports sensory impairment on the dorsum of all fingers. Wrist circumference is 20.7 cm. There is marked intrinsic atrophy, especially of the thenar web space. Grip strength is 5 pounds. Attempts to grip tightly cause the wrist to collapse into flexion. Range of motion (ROM) is impaired:

Wrist flexion	45˚
Wrist extension	35˚
Radial deviation	10˚
Ulnar deviation	25˚

Proximal Interphalangeal Joint (PIP) Flexion

I	II	III	IV	V
Limited in extension	-20˚	-25˚	-30˚	-25˚

Short-term goals:

- Improve wrist ROM 10˚ in flexion and extension
- Improve wrist strength and stability so that grip strength improves to 10 pounds.

Long term goals:

- Improve self-care function, such as buttoning and handling kitchenware
- Return to gardening

- Resume home exercise program, including weights for upper extremities, for his generalized osteoarthritis

Treatment Plan:

- Iontophoresis/phonophoresis with dexamethasone to decrease the inflammation in the ECU tendon
- Gentle joint mobilizations of the wrist and PIPs to improve functional ROM
- Strengthen wrist extensors to improve distal radio-ulnar joint (DRUJ) stability
- Joint protection and ADL training for increased independence. Lift objects with the wrist held in neutral, rather than in supination. Use wrist cuffs for shoulder exercise rather than hand held weights.
- Palliative modalities for pain management

Progress: After 3 weeks (6 visits) of intervention, the wrist circumference had decreased one-half centimeter. He reported a decrease in pain level to 3 with light activity and 6 with heavier activity. ROM increased to 50˚ flexion, and 35˚ extension. Grip strength was unchanged at 5 pounds. He reported difficulty with ADLs such as carrying a bag of groceries, lifting a milk jug, or using pruning clippers. He saw the physician at this time, and received an order to continue with the course of therapy.

After a second course of three weeks (6 visits) of therapy, he reported a pain level of 4 with activity. He was able to button a little easier. He felt more confident when carrying a plate. He was able to use a 5-pound hand-held weight for shoulder exercises. Gross grasp remained at 5 pounds, versus 15 pounds on the non-master hand. Wrist circumference was only slightly diminished, measuring 20.2 cm. ROM improved significantly

	Initial	Final
Wrist flexion	45˚	45˚
Wrist extension	35˚	45˚
Radial deviation	10˚	20˚
Ulnar deviation	25˚	25˚

Discussion: This patient provided a typical onset of DRUJ instability with an etiology of degenerative arthritis. He had difficulty holding objects with a supinated forearm. He had difficulty weight bearing on the wrist, making it difficult to rise from a chair, and it was difficult to lift everyday objects like plates and glasses. The intervention was two-pronged. The iontophoresis with dexamethasone decreased the swelling and inflammation, while the mobilization and strengthening exercises provided functional mobility and strength. Instructions in joint protection strategies reduced the stress on the joint, promoting healing and preventing further forces on the weak tissues.

Both cases exemplify the level of difficulty in successfully managing DRUJ instability. Although both conservative care and surgical intervention alleviated the symptoms of these patients, neither was able to resume their former activity level. Intervention helped in the areas of ROM and strength. Pain persisted at decreased levels, but continued to impair function.

The therapist needs to recognize that inflammation of the tissues surrounding this joint can lead to instability and significant loss of function. Early intervention would be most effective. Especially in the instance of rheumatoid arthritis, controlling the inflammation of the ECU will allow the supportive tissues to stay intact. Later intervention, as described in these cases, focuses on reducing the inflammation and strengthening the remaining supporting structures.

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