CE

1.5 ANCC Contact Hours

Clinical Assessment and Diagnostics of Patients With Hand Disorders

A Case Study Approach

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Clinical assessment of the hand is important for diagnosing underlying hand disorders. Using a case study approach, the clinical assessment for three disorders of the hands is presented: trigger finger (stenosing tenosynovitis), carpal tunnel syndrome, and ulnar-sided wrist injury (styloid impingement). We assess the annular one pulley and finger range of motion for patients with trigger finger. To diagnose for carpal tunnel syndrome, assessment for Tinel's sign, Phalen's sign, abductor pollicis brevis muscle bulk, two-point discrimination, and obtaining a nerve conduction study are performed. Assessment for ulnar-sided wrist injury includes wrist range of motion, assessment of distal radial ulnar joint stability, provocation tests, grip strength, x-ray, and magnetic resonance imaging. This article begins with a description of the hand and wrist anatomy. For each case study, the clinical history is described, followed by a discussion of the pathophysiology, clinical assessments, and diagnostic tests.

Anatomy of the Hand and Wrist

The hand consists of bones, ligaments, and tendons. There are 27 bones-–14 phalanges (proximal, middle, and distal) of the fingers, five metacarpals, and eight carpal (wrist) bones organized in two rows. The proximal carpal bones are connected to the larger radial and ulnar bones via ligaments.

Tendons connect muscles to bones and are subdivided into the flexors and extensors, which are responsible for allowing the normal flexion and extension of fingers, respectively, through the maintenance of a complex pulley system. The flexor tendons are on the palmar side of the hand, and the extensor tendons on the dorsal side of the hand. During finger movement, the flexor tendons slide through the tunnels in the finger known as the tendon sheaths, which keep the tendons in place next to the bones.

Ligaments are connective tissues, which connect bone to bone. The wrist consists of several ligaments to connect the eight carpal bones. Ligament injuries frequently occur at the wrist. A minor or major sprain could occur depending on the severity of ligament injury caused by minimal stretches to complete tears respectively.

Motor and sensory functions are controlled by the median, ulnar, and radial nerves. The median nerve passes through the carpal tunnel, and innervates the thenar muscles, index, and middle finger lumbrical muscles. The ulnar nerve passes through the Guyon canal and innerves the rest of the intrinsic hand muscles (muscles located in the hand).

Malfunction of any component of the hand due to injury or wear and tear can lead to decreased functionality or even disability in more severe cases. Hand movement is regulated by many components; hence, proper assessment of the hand is required to identify the disorder.

Case Study 1: Trigger Finger

Mr. T is a 44-year-old Chinese man working as a technician. He is a nonsmoker and nondrinker. He has drug allergies for Bactrim, aspirin, and Panadol. He denies having any chronic disease and being on long-term medications. Mr. T complained of having his left thumb "stuck" in the flexion position every morning for 2 years. The locking on this right index finger occurred more recently, 4 months ago. There was no pain accompanying the symptom for both fingers. He denied having any previous trauma to both fingers, and never received any steroid injection for his fingers. A clinical examination of the hand was performed, and Mr. T was diagnosed as

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having Grade 1 trigger finger. He was referred to the hand therapist for splinting and laser treatment of the affected fingers. He declined all medications due to his history of drug allergies.

Pathophysiology

Trigger finger is a common hand condition, which has a prevalence of 2.6% in the general population (Makkouk, Oetgen, Swigart, & Dodds, 2008). However, people who have arthritis and diabetes are more susceptible to the condition, with a prevalence ranging from 5% to 36% (Cagliero, Apruzzese, Perlmutter, & Nathan, 2002; Ray et al. 2011). It is more common in women than in men, and affects people in their 50s and 60s (Choudhury & Tay, 2014). Trigger finger is caused by inflammation and subsequent narrowing of the annular one (A1) pulley, resulting in pain, clicking, catching, and loss of motion of the affected finger. It is believed that the loss of elasticity of the A1 pulley could have also resulted in its reduced pliability. The most characteristic complaint of trigger finger is the locking of a finger in a flexed position and subsequent difficulty in achieving a full extension. However, it can eventually be released with a snap or forced open passively. In milder cases, patients might experience uneven finger movements, or experience discomfort and stiffness in moving the digits particularly after periods of rest. Based on these symptoms, the severity of the trigger is graded. We used a modified Quinnell's (1980) 4-point classification system to assess the severity of the trigger finger: Grade 1—pain and tenderness at A1 pulley, Grade 2—catching of digit, Grade 3A—locking of digit in flexion, passively correctable, Grade 3B—locking of digit in extension, requires passive flexion.

Clinical Examination

Assessment for trigger finger includes palpation for swelling and clicking at the A1 pulley, and measurement of finger range of motion (ROM). A hand assessment was done for the left thumb and right index finger, where Mr. T complained of locking when he awakes in the morning. Palpation at the A1 pulley on both fingers revealed swelling (see Figure 1A). However, during assessment, no locking was observed. There was no pain during palpation, and no clicking or triggering when Mr. T was asked to flex and extend his fingers multiple times. Hence, he was diagnosed as having Grade 1 trigger finger.

As trigger finger can potentially result in finger deformity, the ROM of the affected fingers was measured to monitor the changes in severity over time. The active range of motion (AROM) of the affected fingers was measured using a manual goniometer. Mr. T was asked to fully straighten his fingers to measure the affected fingers at extension, and then clench his fingers tightly for measurement at flexion. The ROM is measured by placing the goniometer on the dorsal aspect of the hand, using the dorsal surface of the metacarpals or phalanges to align the goniometer (see Figure 1B). The normal thumb flexion arc is 50°–55° for the metacarpophalangeal joint (MCPJ) and 85°–90° for interphalangeal joint (IPJ); normal finger flexion arc is 85°–90° for MCPJ, 100°–115° for proximal interphalangeal joint (PIPJ), and 80°–90° for distal interphalangeal joint (DIPJ) (Norkin & White, 2009). Mr. T's ROM at the MCPJ and IPJ of the thumb was 60° and 80°, respectively. For the right index finger, the MCPJ, PIPJ, and DIPJ were 90°, 110° and 75°, respectively. Based on these values, Mr. T's ROM was considered to be within the normal ranges.

Case 2: Carpal Tunnel Syndrome

Ms. C is a 42-year-old Chinese woman working as a hawker chef. She has no medical history. Ms. C complained of persistent numbness in her right hand for more than a year, especially when handling utensils and knives. The numbness has been worsening over the month, and she verbalized having disrupted sleep every night due to the numbness. Clinical examination included Tinel's sign over the carpal tunnel region, Phalen's sign, abductor pollicis brevis (APB) muscle bulk assessment (a component of the thenar eminence), and two-point discrimination (2PD). After clinical examination, Ms. C was sent for a nerve conduction study (NCS) diagnostic test. She was diagnosed as having moderate carpal tunnel syndrome on the right, and mild on the left. Conservative management consisting of a splint and occupational therapy was prescribed for the left wrist. She was given the options of conservative management or surgery for the right hand, and she opted for surgery.

Pathophysiology

Carpal tunnel syndrome is caused by long-term compression of the median nerve at the wrist, resulting in pain and paresthesias, which may radiate to the forearm, elbow, and shoulder (Viera, 2003). A large study conducted in the United States found a prevalence of 7.8% and an incidence of 2.3% for people with carpal tunnel syndrome (Dale et al., 2013). Risk factors of carpal tunnel included higher body mass index, older age,

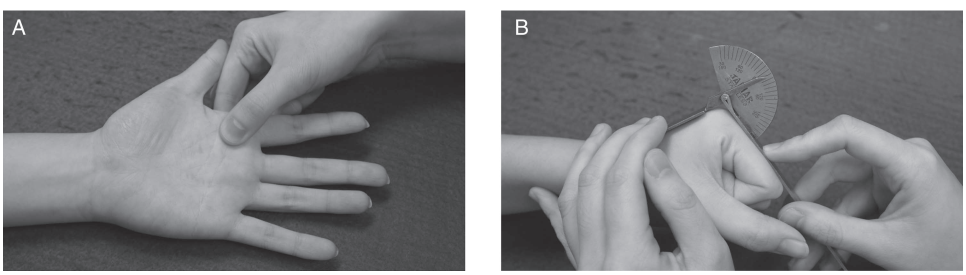

Figure 1. (A) Palpation of annular one pulley. (B) Measuring finger range of motion.

female, and high job strain (work that had a high strain on the wrist) (Harris-Adamson, 2013). Comorbidities such as diabetes and hypothyroidism were also found to be associated with carpal tunnel syndrome (Karpitskaya, Novak, & Mackinnon, 2002).

Carpal tunnel syndrome affects the patient by causing numbness, tingling sensation, weakness, and pain over the lateral 3.5 digits. Long-standing carpal tunnel syndrome could lead to permanent nerve damage, resulting in constant numbness and atrophy of muscles in the thenar eminence, which are controlled by the median nerve.

Clinical Examination

Tinel's sign and Phalen's sign are commonly used as provocative tests for carpal tunnel syndrome. Both were positive on the right but negative on the left. A tingling sensation felt during by light percussion over the course of distribution of median nerve reflected a positive Tinel's sign (see Figure 2A). Phalen's sign is commonly performed by holding the forearms vertically and allowing both hands to drop into complete flexion at the wrist for 1 minute, to reproduce symptoms of carpal tunnel (Munson & Traister, 2005). However, this method will also test positive for cubital tunnel syndrome. Hence, we performed Phalen's sign with the elbow extended in supination and wrist in flexion, which is more specific for carpal tunnel syndrome (see Figure 2B). The literature has reported a wide range of sensitivity and specificity for both Tinel's and Phalen's signs, and Phalen's sign is more specific for diagnosis of carpal tunnel syndrome compared with Tinel's sign (Bruske, Bednarski, Grzelec, & Zyluk, 2002; Kuschner, Ebramzadeh, Johnson, Brien, & Sherman, 1992). The carpal compression test, which is more sensitive and specific than the Tinel's and Phalen's tests, can be conducted for patients suspected of carpal tunnel syndrome (Durkan, 1991).

Motor function of the APB muscle was assessed by providing thumb resistance to abduction up and away from the plane of the palm (see Figure 2C). The test showed full strength for both hands. The APB muscle was also palpated for bulk and consistency to determine if there was any thenar atrophy. In this patient, there was none. A study on thenar atrophy of patients with severe carpal tunnel syndrome found that almost 15% of patients did not have thenar atrophy and intact thumb opposition (Ebata, Imai, Tokunaga, Takahasi, & Abe, 2014).

A 2PD test was done on the radial and ulnar pulp of the index finger, middle finger, and ring finger, with normal values being less than 6 mm (Buch-Jaeger & Foucher, 1994) (see Figure 2D). Slight abnormality was detected in Ms. C, as her 2PD was 7 mm.

Diagnostic Tests

An NCS consisting of a motor conduction study and sensory conduction study was done for both hands. Ms. C was tested positive for carpal tunnel syndrome for both hands—moderate on the right and mild on the left. The motor conduction velocity from elbow to wrist was 52.8 M/second for the right median nerve and 60.9 M/second for the left median nerve; the right ulnar nerve was 60.5 M/second and 59.1 M/second for the left ulnar nerve. The sensory conduction velocity from wrist to second digit was 28.3 M/second for the right median nerve and 40.6 M/second for the left median nerve; the ulnar nerve for both sides was 55.0 M/second. Normal nerve conduction velocity is above 50.0 M/second (Witt, Hentz, & Stevens, 2004), and the sensory conduction velocity for both hands was below normal values. Compared with the right ulnar nerve recordings for both motor and sensory conduction velocity, the right median nerve showed significantly slower velocities, which indicates a higher degree of severity of median nerve involvement.

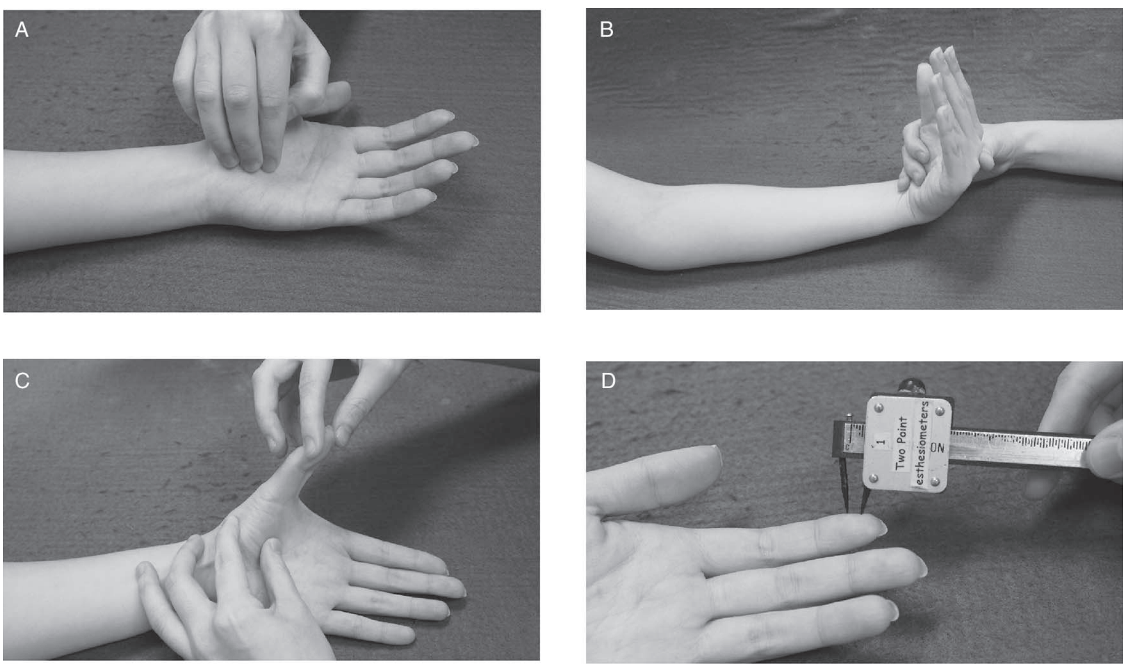

FIGURE 2. (A) Tinel's sign. (B) Phalen's sign. (C) Abductor pollicis brevis muscle. (D) Two-point discrimination.

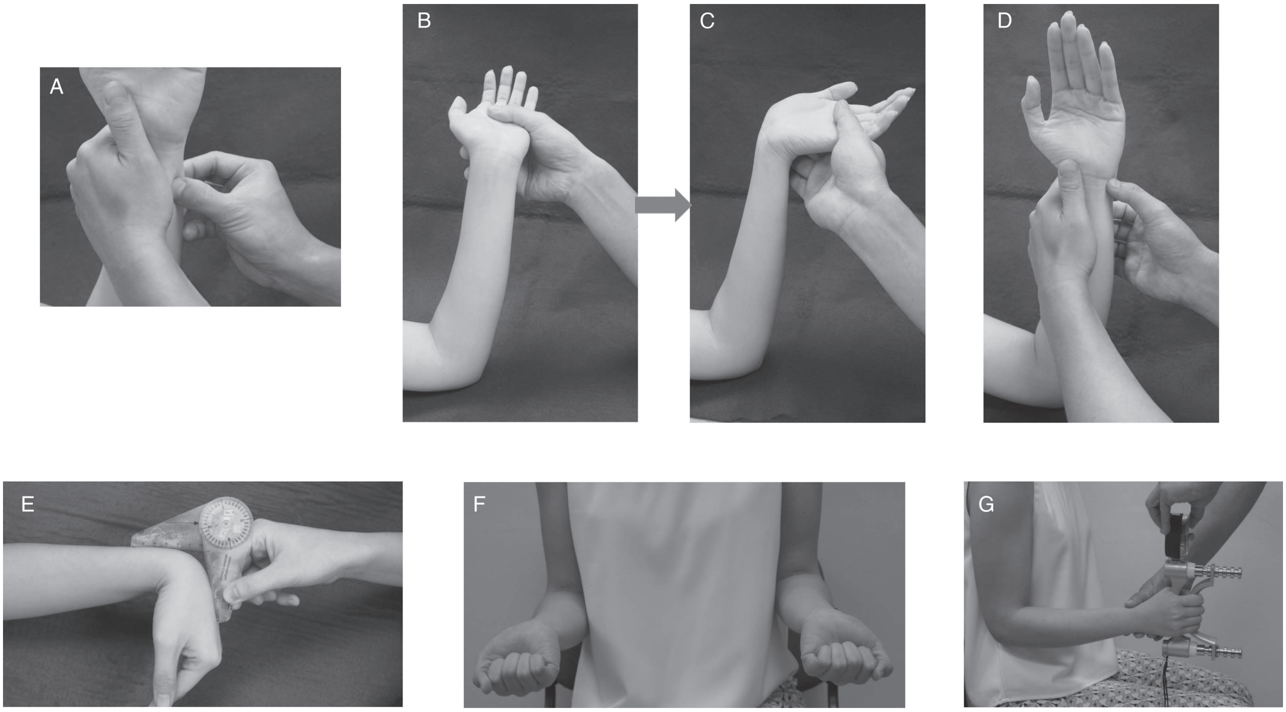

Figure 3. (A) Distal radial ulnar joint stability. (B) Ruby's test (neutral). (C) Ruby's test (supination). (D) Fovea's sign. (E) Palmar flexion. (F) Supination. (G) Grip strength.

Although NCSs are the "gold standard" for diagnosing carpal tunnel syndrome, the sensitivity of the test has been reported to be only 90% (Stevens, 1997). Because of the limitations of both clinical examinations and electrodiagnostic tests, a combination of both is required to confirm the diagnosis and classification of carpal tunnel syndrome (Rempel et al., 1998).

Case Study 3: Wrist Injury—Ulnar Styloid Impingement, Mild Distal Radial Ulnar Joint Instability Secondary to Triangular Fibrocartilage Complex Tear

Mr. L is a 46-year-old Chinese man working as a casino dealer. He was driving his scooter to work when he fell off, and landed on his outstretched right hand. He is a nonsmoker and nondrinker, and had no history of medical condition or drug allergy.

Clinical hand assessment was conducted on the bones, tendons, and ligaments. He was diagnosed as having ulnar styloid impingement, with mild distal radial ulnar joint (DRUJ) instability secondary to triangular fibrocartilage complex (TFCC) tear. Diagnostic tests included x-rays and magnetic resonance imaging (MRI). X-rays showed that there was no fracture. The patient was referred for MRI, which showed a TFCC tear. He was offered a wrist splint and referred to the hand therapist for rehabilitation.

Pathophysiology

Ulnar styloid impingement (Zahiri, Zahiri, & Ravari, 2010) and injury to the TFCC are common causes of ulnar-sided wrist pain (Fufa & Goldfarb, 2013; Toppler, Wood, & Ruby, 1997). Ulnar styloid impingement syndrome refers to ulnar-sided wrist pain, resulting from the ulnar styloid impacting upon the triquetral bone. The TFCC is a triangular structure, consisting of ligaments and cartilages located on the ulnar side of the wrist, which is responsible for stabilizing the distal radius to the distal ulna during hand grasping or forearm rotation (Palmar & Werner, 1981). TFCC tear results in DRUJ instability.

Clinical Assessment

A physical assessment was conducted on the structures that were associated with ulnar-sided wrist injury. The bone structures included the ulnar styloid, DRUJ, and dorsal triquetrum. Other structures that could be involved include the extensor carpi ulnaris (ECU) tendon, ulnotriquetral (UT) ligament, and TFCC. Assessment for ulnar-sided wrist injury includes wrist range of motion, assessment of DRUJ stability, provocation tests, and grip strength.

First, palpation for tenderness at the wrist was conducted. Palpation typically begins at the Lister's tubercle, followed by the other bones and soft tissues. The ulnar styloid, DRUJ, dorsal triquetrum, and ECU tendon were palpated. Tenderness was felt in all palpated areas. The ECU was palpated in its groove adjacent to the ulnar styloid.

The DRUJ was assessed for instability, using the DRUJ displacement test. The test was performed by displacing the distal ulna volarly and dorsally, while stabilizing the radius with the forearm only in neutral rotation, unlike the DRUJ ballotment test, which is tested in both supination and pronation (see Figure 3A). DRUJ instability is diagnosed when there is increased displacement of the distal ulna relative to the distal radius compared to the normal side. In a normal DRUJ displacement test, the volar endpoint is bony, whereas dorsal endpoint is firm ligamentous. Loss of these endpoints indicates a more severe instability of the DRUJ. In this patient, the DRUJ displacement was slightly increased at 2-3 mm compared to 1-2 mm on the normal side. His volar and dorsal endpoints were normal.

Ruby's test is used to test for ulnar styloid impingement (Topper et al., 1997). During rotation, the distance between the ulnar styloid bone and triquetrum is decreased, reproducing the effects of impingement. It is performed with the patient's elbow resting on a table and the forearm initially in neutral rotation. The dorsiflexed wrist is then rotated into full supination (see Figures 3B and 3C). Ruby's sign was positive, which usually suggests impingement at the ulnar styloid bone. Twenty-five percent of patients with ulnar styloid impingement have concomitant DRUJ instability. This is not surprising, because the distal ulna is often dorsally subluxed in DRUJ instability, making it more likely to impinge on the triquetrum.

The fovea sign test is used to assess for ulnar-sided TFCC injury and/or ulnotriquetral ligament tears (Tay, Tomita, & Berger, 2007; Tay, Berger, & Parker, 2010). Fovea's sign is performed by pressing the examiner's thumb distally into the interval between the ulnar styloid process and the flexor carpi ulnaris tendon, between the volar surface of the ulnar head and the pisiform (see Figure 3D). Fovea'a sign was positive. In conjunction with mild instability of the DRUJ, this suggests a clinical diagnosis of ulnar-sided TFCC injury.

The ROM of the wrist was obtained, which was 80° for palmar flexion, 70° for dorsiflexion, 80° for pronation, and 90° for supination. Palmar and dorsiflexion were measured with the hand positioned in supination, and instructing the patient to extend palm down and wrist up respectively. The goniometer was placed on the wrist axis and in line with the dorsal third metacarpal (see Figure 3E). Pronation and supination were measured by placing the elbow by the side, and taking the angle between the humerus and volar surface of the ulnar (see Figure 3F). Reduction in pronation and supination might be associated with volar and dorsal portion of TFCC tear respectively (Parmelee-Peters & Eathorne, 2005). Mr. L's wrist ROM for pronation, supination, flexion, and extension was within the normal ranges of 80°, 80°, 60°, and 60°, respectively (Norkin & White, 2009).

Grip strength was measured to assess the impact of the injury on hand strength. Grip strength was measured using the Jamar dynamometer. The patient was instructed to sit upright, hold the dynamometer with the elbow by the side of the body at 90° angle, and to squeeze the dynamometer with maximum force without moving the other parts of the body (see Figure 3G). Grip strength was 12 kg on the affected right hand and 20 kg on the unaffected left hand, representing a 40% reduction in the affected right hand grip strength.

Diagnostic Tests

X-rays were performed to assess for bone fracture, and no fracture was observed. In wrist injuries, MRI could be used to assess for injury to wrist ligaments (lunotriquetral, ulnotriquetral, and scapholunate) and the TFCC (Bittersohl et al., 2007). The tear in the TFCC explained the mild DRUJ instability.

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