ISSN 1669-9106

SPECIAL ARTICLE - REVIEW

MEDICINA (Buenos Aires) 2023; 83: 96-107

RADIAL-SIDED WRIST PAIN DIFFERENTIALS: PRESENTATION, PATHOANATOMY, DIAGNOSIS, AND MANAGEMENT

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Abstract Patients with radial-sided wrist pain can be challenging to diagnose and treat. Various physicians, including emergency physicians, primary care physicians, and orthopedic or plastic surgeons can be involved in the initial and subsequent evaluation. We delve into the differential diagnosis of radial-sided wrist pain including osteoarticular, ligament, tendon, nerve, and other pathologies. We review the physical exam findings, diagnostic studies, and treatment options for each pathology based on recent and updated literature.

Key words: radial wrist pain, snuffbox, scapholunate, tendinitis, osteoarthritis

Resumen ***Dolor radial de muñeca: diferencias en la presentación, anatomía patológica, diagnóstico y tratamiento***

Los casos de pacientes que presentan dolor radial de muñeca pueden ser de difícil diagnóstico y tratamiento. Varias especialidades médicas, incluidas emergentólogos, médicos de atención primaria, cirujanos ortopédicos o cirujanos plásticos, pueden estar involucrados desde el inicio de la patología y subsecuente evaluación. Profundizamos aquí en el diagnóstico diferencial del dolor radial de muñeca incluyendo las debidas a patologías osteoarticulares, ligamentosas, tendinopatías y neuropatías, entre otras. Esta revisión incluye examen físico, estudios diagnósticos, y opciones terapéuticas para cada condición con base en la literatura reciente y actualizada.

Palabras clave: dolor radial de muñeca, tabaquera, escafolunar, tendinitis, artrosis

KEY POINTS
Current knowledge

- Radial wrist pain is often times challenging in terms of diagnostics and management, given the overlapping anatomical structures and symptomatology in that region, without considering occasionally associated conditions.

Contribution to current knowledge

- This review aims to provide a tool or resource for physicians in terms of clinical awareness and guidance in diagnosing and managing different radial-sided conditions based on current and updated literature.

Radial-sided wrist pain (RSWP) with stand-alone imaging can be challenging to diagnose. A methodical clinical approach to evaluating patients with RSWP includes obtaining a detailed history, focused physical examination, the possible application of diagnostic tests, and occasionally pursuing wrist arthroscopy. Anatomic structures that are palpable on the radial aspect of the wrist include the scaphoid tubercle, base of the first metacarpal, anatomic snuffbox, radial styloid, dorsal radiocarpal joint, scapholunate interval, Lister's tubercle, first extensor compartment, and the intersection of the 1st and 2nd compartments roughly 4 cm proximal to wrist (Fig. 1)[1]. To build a differential diagnosis, one must account for osteoarticular structures, tendons, ligaments, and nerves (Table 1). In this review article, we will focus on the pathophysiology, diagnosis, and treatment options of the more frequent causes of RSWP and aims to aid in the management of often times challenging patients.

Osteoarticular pathology

Trapeziometacarpal (i.e. carpometacarpal or CMC) arthritis of the thumb

The thumb carpometacarpal (CMC) joint is an irregularly shaped, biconcave saddle joint that allows for complex movements including circumduction, opposition, pinch, grasp, and fine manipulation. Biomechanical studies have

Received: 9-V-2022 Accepted: 29-VIII-2022

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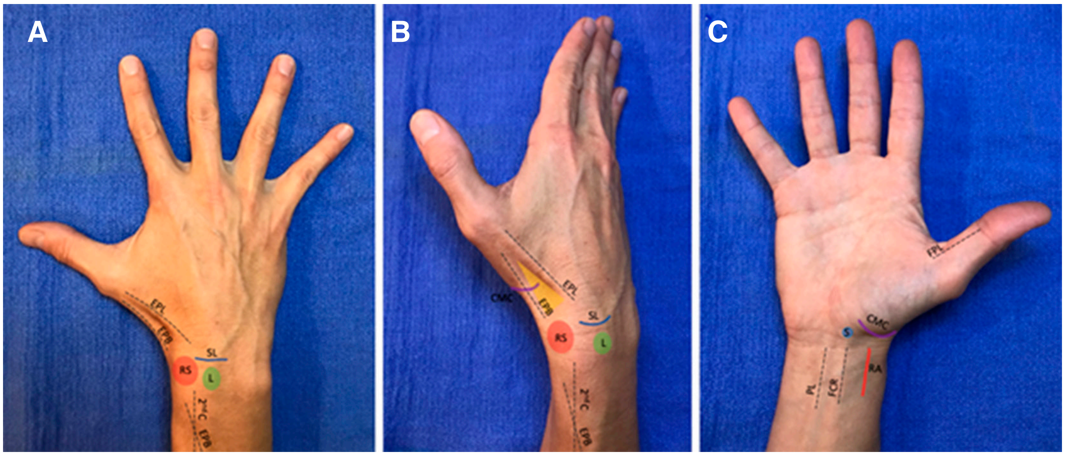
Fig. 1.– A, B and C: Dorsal, dorsoradial and volar aspects of a healthy appearing hand with delineated anatomical landmarks



EPL: extensor pollicis longus (dashed line); EPB: extensor pollicis brevis (dashed line); SL: scapholunate interval (blue line); RS: radial styloid (red circle); L: lister's tubercle (green circle); 2nd C: second extensor compartment (dashed line); CMC: carpometacarpal thumb joint (violet line); PL: palmaris longus (dashed line); FCR: flexor carpi radialis (dashed line); FPL: flexor pollicis longus (dashed line); RA: radial artery (red line); S: scaphoid tubercle (blue circle).
Anatomical snuff box in yellow. Limits: EPL, EPB, abductor pollicis longus, RS; floor: scaphoid and trapezium; and contents: superficial branch of radial nerve, RA and cephalic vein.

TABLE 1.– *Differential diagnosis by source*

Radial Sided Wrist Pain (RSWP) source:	Common differential diagnoses
Osteoarticular	• CMC arthritis of the thumb
	• STT arthritis
	• Wrist OA
	• Scaphoid fracture
	• Thumb CMC dislocation*
	• Thumb metacarpal base fracture*
	• Distal radius fracture*
	• Kienböck and Preiser disease*
Ligaments	• SLL insufficiency or rupture
Tendons	• de Quervain's tenosynovitis
	• Intersection syndrome
	• EPL tenosynovitis
	• FPL stenosing Tenosynovitis
	• Linburg-Comstock syndrome
	• FCR tendonitis
Nerves	• SRN impingement
Other	• Ganglion cysts, dorsal and volar radial

*CMC: carpometacarpal; STT: scaphotrapezi otrapezoid; OA: osteoarthritis; SLL: scapholunate ligament; EPL: extensor pollicis longus; FPL: flexor pollicis longus; FCR: flexor carpi radialis; SRN: superficial radial nerve; *, not discussed in this article*

shown that when the thumb is under load, the deep anterior oblique ligament and the dorsal radial ligament prevent radial subluxation[2]. If the joint becomes hypermobile, stress may lead to cartilage breakdown and degeneration of the articular surfaces[3]. The degeneration begins on the palmar aspect of the joint, with radiographic prevalence in about 7% of men and 15% of women above 50 years old[4,5]. Risk factors for CMC joint degeneration predominantly include female sex, hypermobility, increased body mass index, post-traumatic (e.g., Bennett fracture), and Ehlers-Danlos syndrome. Some patients may remain asymptomatic, while others develop pain, weakness, and instability that can severely limit hand function. Patients often complain of pain with pinch grip or opposition. Concomitant carpal tunnel syndrome (CTS) and de Quervain's tenosynovitis may be present in up to 43% and 15% of patients, respectively, which can confound the patient's clinical RSWP presentation[4].

On physical exam, there can be thumb base prominence with progressive ligamentous incompetence of the anterior oblique and dorsal radial ligaments. The thumb metacarpal may subluxate dorsally and proximally, thereby leaving the distal portion in adduction toward the palm. Compensatory metacarpophalangeal (MP) hyperextension to allow for an increased first web space leads to a characteristic "z-deformity" that can be appreciated both clinically and radiographically. Tenderness is typically located at the radial thumb CMC joint with radiation to the palmar thenar region. Varus and valgus stress might elicit pain in a hypermobile joint. Special clinical tests include the traction-shift (i.e., subluxation-relocation) test and the axially loading grind test. The traction shift test has greater sensitivity and specificity than the axially loading grind test (67% and 100% versus 30% and 97%, respectively). The traction shift test is performed by the examiner applying longitudinal traction to the thumb with dorsal pressure over the base of the metacarpal[6]. A subluxated joint will reduce, thereby eliciting pain. The axially loading grind test is performed by applying axial compression to the thumb while moving the thumb into flexion, extension, and circumduction. Pain indicates a positive test. Of note, excessive flexion could mimic Finkelstein's test and initiate pain in patients with concomitant de Quervain's tenosynovitis, which is felt more proximal to the joint but can certainly overlap[7].

Radiographs assess severity based on the Eaton-Littler classification system[8]. True anteroposterior (AP), lateral, and Robert's view radiographs may initially demonstrate widening at the CMC joint with minimal subluxation[9]. Progression to a narrowed CMC joint with further subluxation, osteophytes, sclerosis, and subchondral cysts are indicative of more severe arthritis. Involvement of the adjacent scapho-trapeziotrapezoidal (STT) joint receives the highest grade of severity, as can be found in 64% of thumb CMC arthritis cases. Notably, concomitant STT arthritis can be a source of residual pain following trapeziectomy[10]. Stress radiographs may be useful to elicit CMC joint instability and early CMC joint arthritis[3, 11]. Although radiographic changes can be significantly advanced, it should be emphasized that radiographic severity doesn't necessarily correlate with the degree of clinical symptoms. It is important to recognize that some patients with advanced radiographic changes of CMC arthritis may be minimally asymptomatic, while other patients with mild radiographic changes could present with significant clinical pain[12].

Non-operative management begins with rest, non-steroidal anti-inflammatory drugs (NSAIDs), and splinting to decrease mechanical stress and inflammation. Usually, patients with unstable or hypermobile thumb CMC joints are good candidates for splinting. The splint should position the thumb in palmar abduction with slight flexion and medial rotation[13]. Two main CMC splint types are used to immobilize the thumb MP joint: (1) a long opponens that extends past the wrist and (2) a short opponens that is hand-based. Another option, a Colditz splint, immobilizes the CMC but not the MP joint. Overall, each provide similar pain relief outcomes[14,15]. Corticosteroid injections (CSI) to the CMC joint are often beneficial in the short-term, although these are potentially more useful as a diagnostic tool than for long-term treatment[4,13]. Additionally, there is evidence that pain and grip strength can improve when patients are educated on thumb rest with activity modification[13].

Surgical treatment most commonly consists of trapeziectomy, either alone or combined with ligament reconstruction and/or tendon interposition (LRTI). There is little evidence of method superiority, as many methods are associated with good success[7]. CMC joint arthroscopy is a relatively new field and therefore lacks substantive data to support treatment applicability[11]. Isolated volar ligament reconstruction may be an option for early disease, but this method only addresses the hyperlaxity of the joint without improving pain from joint degeneration. Arthrodesis is a rarely performed option for heavy laborers who present with moderate CMC disease and absence of concomitant STT arthritis. The desired fusion position places the thumb in 30-40 degrees of palmar abduction, 10-20 degrees of radial abduction, and 15 degrees of pronation to allow for key pinch[11]. Pyrocarbon arthroplasty implants have recently been developed, but there is insufficient data to demonstrate their effectiveness at this time, given higher complication and reoperation rates[16].

Scaphotrapeziotrapezoid arthritis (STT)

STT arthritis is the third most common arthritis affecting the wrist[10]. It can occur in isolation but most commonly occurs with basilar thumb arthritis or a scapholunate advanced collapse (SLAC) wrist. While the etiology is unknown, the development of STT arthritis may be related to carpal mechanics associated with a form of non-dissociative dorsal intercalated segmental instability[10,17]. Isolated STT arthritis may be associated with "idiopathic" scapholunate dissociation, pseudogout, CTS, flexor carpi radialis (FCR) tendonitis, and de Quervain's tenosynovitis[18].

Pain with radial deviation can indicate STT arthritis or radiocarpal arthritis. Swelling may be present in the region of the STT joint, and sharp pain may be elicited with range of motion at the thumb or wrist. Onset is usually insidious and progressive with loss of grip strength. On exam, the practitioner can expect pain with the radial grind test where the wrist is radially deviated to load the STT joint[19]. Thumb CMC arthritis can have concomitant STT arthritis and is recognized as a source of residual pain after a successful trapeziectomy[10]. Radiographs have a lower accuracy for detecting STT arthritis compared to intra-operative evaluation[10]. Nonetheless, standard three-view radiographs of the thumb are useful in demonstrating narrowing between the scaphoid and trapezium or trapezoid, the presence of osteophytes, or calcium deposition in the triangular fibrocartilage complex region indicative of pseudogout as a source of pain[18].

Initial conservative treatment consists of activity modification, rest, NSAIDs, splinting, and CSIs. Injections have not been studied specifically for STT arthritis[20]. The majority of hand surgeons treat isolated STT arthritis by trapeziectomy with LRTI, but some choose arthrodesis and few favor distal scaphoid resection[10]. Triscaphe fusions have shown fair patient satisfaction but may lead to nonunion, loss of wrist ranges of motion, and need for future surgery with ongoing pain related to progressive arthrosis of the radiocarpal and thumb CMC joints[20]. Distal scaphoid resection is a less frequently utilized option due to the concern that it can lead to further destabilization of the mid-carpus. Advantages, however, include the ease of procedure, limited immobilization, and potentially faster recovery[19].

Wrist osteoarthritis (OA)

Wrist OA is often traced back to a traumatic insult such as a fracture, dislocation, or ligamentous injury[17]. A SLAC wrist is one of the most common patterns of wrist arthritis in adult patients. Degenerative changes occur due to articular malalignment and abnormal mechanics of the scaphoid, lunate, and distal radius with deficiency of the scapholunate ligament. Arthritis first occurs between the radial styloid and the scaphoid, then progresses to the more proximal radioscaphoid articulation, and finally involves the capitolunate joint while sparing the radiolunate joint[15]. Alternatively, an untreated scaphoid nonunion following a prior scaphoid fracture may lead to another predictable pattern of carpal instability termed scaphoid nonunion advanced collapse (SNAC)[21]. The degenerative changes are similar to a SLAC wrist with one notable difference - the proximal pole/fracture fragment of the scaphoid that remains attached to the scapholunate ligament is usually spared from developing arthritic changes. Other causes of wrist OA include malunion or articular joint incongruency from a prior distal radius fracture, crystal arthropathies, avascular necrosis of the lunate or scaphoid (Kienböck and Preiser disease, respectively), and congenital abnormalities[22].

Symptoms can include generalized pain, stiffness, and a sense of instability. Notably, evidence of radiographic wrist arthritis does not necessarily correlate to symptom severity[23]. Clinical assessment is therefore of paramount importance[22]. Consideration should be given to how symptoms are affecting the patient's work and lifestyle. A thorough evaluation of the primary wrist joints should include the radioscaphoid and radiolunate joints as well as the capitolunate joint at the capitate head. Secondary joints to evaluate include the STT, ulnolunate, and distal radioulnar joints[24]. Meticulous evaluation of posteroanterior (PA) and lateral radiographs of the wrist should accompany a physical exam to determine if the location of pain correlates to radiographic abnormality. Additionally, obtaining a bilateral clenched fist view of both wrists on the same radiograph can offer an excellent comparison view when assessing SLAC/SNAC wrist and can facilitate recognition of a prior scapholunate injury.

Non-surgical treatment revolves around symptom alleviation with immobilization, rest, activity modification, NSAIDs, and CSIs[17]. Surgical treatment may include denervation by neurectomy, debridement by styloidectomy, arthroplasty, or partial/total wrist arthrodesis. It is critical to discuss how surgery can involve a significant investment by the patient due to prolonged immobilization and time away from work with the potential for loss of motion that may be more burdensome than the original symptoms[22]. Neurectomy can help with pain while preserving wrist range of motion and should be considered if the patient has pain relief after an injection of anesthetic around the anterior interosseous nerve (AIN) and/or the posterior interosseous nerve (PIN)[17]. Radial styloidectomy can be performed when arthritis is confined to the radial styloid, although the extent of resection must be limited. If more than 6 to 10 mm of the styloid is resected, the radioscaphocapitate and radiolunotriquetral ligaments can be severely compromised, thereby leading to carpal instability[25].

Proximal row carpectomy (PRC) involves removal of the scaphoid, lunate, and triquetrum. This surgery is a viable option for radioscaphoid arthritis in the setting of healthy appearing proximal capitate and preserved lunate fossa cartilage of the distal radius. After removal of the proximal row of the carpus, the distal carpus migrates proximally and articulates in the lunate fossa to function as a simple hinge joint. Due to an inherent size mismatch of the novel articulation, arthritis may subsequently form at this joint[17]. PRC remains a good option for younger patients due to a shortened period of immobilization post-operatively. Additionally, PRC preserves the range of motion through the creation of a neo-articulation between the capitate and the lunate fossa. Studies have shown that at 10-year follow-up, the average wrist range of motion following PRC was approximately 63% of the contralateral wrist[26]. Four corner fusion involves removal of the scaphoid and fusion of the lunate, capitate, triquetrum, and hamate. The procedure is performed when arthritis has progressed to involve the midcarpal capitolunate joint and can only be done in the setting of a healthy radiolunate joint. It can be a salvage procedure for advanced arthritis while still preserving grip strength and range of motion to about 50-60% of the contralateral wrist[27-29].

In advanced arthritis with involvement of the lunate fossa, where the above surgical options are not possible, wrist arthrodesis or arthroplasty may be the only options. Arthroplasty is more often reserved for patients with rheumatoid arthritis due to severe limitations of postoperative weight bearing and activity[24]. It can also be useful for patients with bilateral wrist arthritis, in which one side undergoes wrist fusion and the other side undergoes wrist arthroplasty, in order to preserve unilateral wrist range of motion on the arthroplasty side for activities of daily living[24]. Arthrodesis of the radiocarpal joint, usually achieved by a dorsal spanning plate, exchanges range of motion for pain relief.[17] Fusion limits range of motion to about 30-40% of the contralateral wrist, but modification including excision of the distal pole of the scaphoid may increase range of motion by up to 25%.[30].

Scaphoid fracture

Scaphoid fractures usually result from a fall on an outstretched hand with the wrist in extension and radial deviation. Despite comprising 50-70% of all carpal fractures, acute scaphoid fractures can often go unrecognized or be misdiagnosed as a wrist "sprain." Practitioners should therefore have a high suspicion of scaphoid fracture in the setting of pain in the anatomic snuffbox (Fig. 1). Concomitant injuries may include distal radius fracture or peri-lunate injuries with associated carpal fractures. Anatomically, 80% of the scaphoid is covered with cartilage, and blood flow enters distally at the level of the dorsal ridge. This retrograde blood supply renders more proximal fractures vulnerable to vascular insufficiency and increases the risk for nonunion[31].

Patients typically present with radial wrist pain and a story consistent with the aforementioned mechanism. They demonstrate tenderness to palpation over the anatomic snuffbox and/or scaphoid tubercle with pain elicited from axial compression to the thumb[32]. Radiographs include four views: PA, scaphoid view, lateral, and 45 degrees semi-pronated oblique[33]. In the acute setting, about 15% to 35% of scaphoid fractures can be missed with initial radiographs[34, 35]. Traditionally, patients with physical exam findings suggestive of scaphoid injury, but with negative radiographs, should be immobilized in a thumb spica splint or cast with the return to clinic in two weeks for repeat imaging. Resorption at the fracture site may lead to a more visible fracture line on repeat, delayed imaging. However, more recent studies have suggested that advanced imaging is more cost-effective given the cumulative cost of cast immobilization, return clinic visits, repeat radiographs, and potentially lost wages while in a cast[36]. Deciding between MRI and CT scan in this acute setting is less clear. MRI has increased sensitivity (88%) and specificity (100%) for detecting edema patterns consistent with acute, nondisplaced fractures but comes at a much greater cost[37]. CT scans, although having decreased sensitivity (72%) and specificity (99%), are faster and generally easier to obtain in the emergency room setting, but these come with increased radiation burden[33, 37]. Ultrasound, despite being less expensive, has not been proven as a reliable secondary imaging test for detecting scaphoid fracture, as it is highly dependent on the operator and is complex to perform. Displacement assessment has been shown to be superior with the adjunct of a CT as compared to radiographs alone[38].

Conservative management for nondisplaced scaphoid waist or distal pole fractures often consists of cast immobilization for at least eight weeks[39]. With regard to immobilization, Clay et al showed no difference in union rate between a short arm cast with or without thumb interphalangeal joint immobilization[40]. Historically, operative treatment was reserved for displaced fractures or fractures prone to nonunion. Interestingly, systematic review and meta-analysis of acute nondisplaced or minimally displaced scaphoid waist fracture management showed that percutaneous fixation had union rates comparable with those of cast immobilization but with faster return to work and faster time to union (2.5 months versus 1.5 months) without significant difference in complication rates[41]. Therefore, proceeding with operative versus nonoperative management of acute nondisplaced scaphoid fractures is variable depending on patient factors and surgeon preference. Clearer indications for surgical intervention of acute fractures include proximal pole fractures, displaced fractures regardless of anatomic location, and fractures with concomitant injuries. Fixation is routinely achieved with compression screws, although it may occasionally be performed or supplemented with Kirschner wire fixation in the case of small fragments[25].

If a patient presents with either a missed scaphoid fracture or with a nonunion following attempted nonoperative and occasionally operative treatment, surgery is typically performed with the use of bone graft. Non-vascularized bone graft can be used when the proximal fracture fragment remains viable, and vascularized bone graft is instead used when the proximal fragment demonstrates evidence of avascular necrosis. Another novel salvageable option is scaphoid proximal pole excision and reconstruction with the hamate's proximal pole, which allows harvesting on the same surgical field and the use of the capitohamate ligament to repair the scapholunate ligament[42]. Preoperative evaluation of viability of the scaphoid fragment can be assessed with MRI[43]. Surgical treatment aims to avoid a SNAC wrist, as described above.

Ligament Pathology

Scapholunate ligament (SLL or SL) Injuries

The SLL is a three-part ligamentous structure, strongest dorsally, that stabilizes wrist carpal kinematics. Ligamentous injury can lead to carpal instability and subsequent development of wrist arthrosis that first manifests along the radial aspect of the radiocarpal joint leading to RSWP. The diagnosis of SLL insufficiency classically relied on static radiographic measurements, but this failed to capture patients with dynamic scapholunate interval widening when the wrist was mechanically loaded[44]. It is now known that insufficiency can manifest as both static and/or dynamic instability depending on the severity and chronicity of ligament injury[44].

The injury typically occurs with a fall onto a hyperextended, ulnarly deviated, and supinated wrist. There can be diffuse swelling about the wrist without localized tenderness. Patients with subacute injuries will have more localized tenderness to the dorsal SL interval, decreased grip strength, and often a painful popping/clicking sensation with activities. Specialized tests to evaluate for scapholunate ligament insufficiency include the scaphoid shift test (i.e. Watson test) and the finger extension test. The scaphoid shift test is performed by the examiner placing their thumb on the scaphoid tubercle and their fingers around the distal radius (Fig. 1). The thumb pushes a dorsally-directed force on the scaphoid with counterpressure from the fingers. The examiner's other hand then moves the patient's hand from a position of ulnar deviation/extension to radial deviation/flexion while maintaining direct thumb pressure on the scaphoid tubercle. This maneuver serves to dorsally subluxate the scaphoid base from its natural position. Thumb pressure is then released causing the scaphoid base to return to its native position in the scaphoid facet of the distal radius, oftentimes with a clunking sensation. A positive test occurs when this maneuver is painful. Due to ligamentous laxity, the scaphoid shift test may be falsely positive in up to one-third of patients[44]. The finger extension test can be performed by placing the patient's wrist in flexion and having the examiner resist active finger extension. A positive test occurs when this maneuver causes discomfort in the wrist.

Appropriate radiographs to evaluate for SLL injury include PA, lateral, scaphoid view, and a bilateral clenched fist view focusing on the SL interval with both wrists on the same radiograph for better comparison. On the PA view, widening of the SL interval greater than 3 mm, also known as the "Terry Thomas sign" when widening is extreme, is suggestive of SLL insufficiency, although it should be noted that there is normal anatomic variation in ligamentous laxity and any obvious widening should be compared to the contralateral side for a baseline[44]. Additional signs of SLL insufficiency can include the "signet ring sign" in which the abnormally flexed scaphoid demonstrates overlapping of the distal pole and scaphoid waist with the resultant appearance of a radiographic ring. There can also be foreshortening of the scaphoid on the PA film when the scaphoid is excessively flexed more than 70 degrees. The lateral radiograph should be repeated if the radius, capitate, and long finger metacarpal are not collinear in the sagittal plane, as this orientation represents a true lateral of the carpus[44]. A scapholunate angle greater 70 degrees is considered highly suggestive of increased flexion of the scaphoid[44]. In addition, the lateral radiograph can show dorsal intercalated segment instability (DISI) with dorsal tilt of the lunate and progressive dorsal subluxation of the capitate on the lunate. The bilateral clenched fist view is best for evaluating dynamic instability[45]. 3-T MRI has been found to have a specificity of 89.8-99.6% and a sensitivity of 66.8-83.2% for diagnosing SL ligament tears. Sensitivity can be improved with an MR arthrogram to 76.1-87.2%[46,47].

SLL injuries are categorized into various descriptive groups that are useful in determining the appropriate treatment: (1) occult instability (i.e. no discernible SL widening) with a partially intact ligament, (2) dynamic instability (i.e. SL widening on stress views) *with* a repairable ligament, (3) reducible SL dissociation *without* a repairable ligament, (4) reducible DISI deformity without associated arthritis, and (5) DISI deformity with associated arthritis or SLAC wrist[44,48]. Depending on the degree and chronicity of SLL injury, as well as the presence or absence of associated arthritic changes, treatment options will vary[49]. Treatment of a partially torn SLL can consist of immobilization or wrist arthroscopy with debridement, thermal shrinkage, and/or percutaneous pinning[50]. If a repairable ligament is present, then direct repair should be achieved. For groups 3 and 4 where the ligament is irreparable, bone-ligament-bone grafts or other ligament reconstruction techniques can be utilized. For group 5, treatment often consists of PRC or scaphoidectomy with midcarpal arthrodesis in the form of four-corner fusion (lunate, capitate, hamate, triquetrum), although other variations of midcarpal fusion exist[49].

Tendons

De Quervain's tenosynovitis

De Quervain's, or first dorsal compartment tenosynovitis, is thought to be due to repetitive motion between the tendons of abductor pollicis longus (APL) and extensor pollicis brevis (EPB) that produces a fibroblastic response with swelling and tenosynovium thickening[51]. Rather than demonstrating inflammatory changes, histology shows thickening of the tendons and retinaculum, increased vascularity, and accumulation of mucopolysaccharides that may lead to mucoid degeneration. De Quervain's typically affects adults in the fifth and sixth decade, but it is also common in peripartum and lactating women[52]. In this latter population, the disease is usually self-limiting and resolves after conservative management.

Gradual onset of pain occurs along the radial styloid with the potential for radiation proximally to the forearm or distally to the thumb (Fig. 1). It can be exacerbated by grip, thumb abduction, and wrist ulnar deviation. Diagnosis is made based on physical exam. Routine radiographs or advanced imaging is not necessary unless ruling out other painful sources such as thumb CMC and/or STT arthritis, which can certainly coexist. Specifically, Finkelstein test, Eichhoff test, and the Wrist Hyperflexion and Abduction Test (WHAT) are suggestive of de Quervain's pathology. Finkelstein test is performed by the examiner grasping the thumb and ulnarly deviating the wrist[53]. Eichhoff test, commonly confused with Finkelstein, involves the examiner ulnarly deviating the wrist while the thumb is clasped in the palm. WHAT has a higher sensitivity and specificity than Eichhoff's test (99% and 29% versus 89% and 14%, respectively) and is performed by the patient hyperflexing the wrist and abducting a thumb in full interphalangeal (IP) and metacarpophalangeal (MP) extension against a resistive force[54].

Conservative management consists of rest, splinting, NSAIDs, and corticosteroid injections (CSIs). The CSI is performed overlying the radial styloid with the needle parallel to the first dorsal compartment. It has been determined that complete relief can be achieved in 80% of patients[55]. Immobilization after CSI increases cost, inhibits activities of daily living, and does not contribute to improvement in relation to CSI alone[56]. In the peripartum and lactating population, Avci et al. compared the efficacy of CSI versus splinting. Although limited by sample size, CSI provided complete relief of symptoms while splinting did not[52]. When nonsurgical management fails, open surgical release of the first dorsal compartment with identification of sub-compartments and protection of the radial sensory nerve can be performed with good results. Up to 60% of patients with de Quervain's can have a septum between the APL and EPB tendons, which needs to be released during surgery for optimal symptom relief[57].

Intersection syndrome

Patients with intersection syndrome typically complain of pain roughly 4 cm proximal to the radial styloid, a more proximal location than pain in de Quervain's tenosynovitis, due to friction at the site of intersection between the first (i.e. APL and EPB tendons) and second (i.e. wrist extensor tendons) dorsal compartments (Fig. 1)[58]. Patients may also experience swelling and crepitation with wrist extension and flexion. Pain is exacerbated by wrist motion, especially resisted extension. There is a higher incidence of intersection syndrome in men compared to de Quervain's tenosynovitis[59]. Ultrasound may be helpful to distinguish intersection syndrome from de Quervain's tenosynovitis, although it is a diagnosis primarily based on physical exam[59].

Non-operative treatment with splinting at roughly 15 degrees of wrist extension, NSAIDs, avoidance of exacerbating activities, and CSI can provide complete relief. If ongoing pain, surgical release often reveals swelling within the first compartment muscle bellies and tenosynovitis of the second compartment tendons. Symptom relief has been accomplished with decompression of the second dorsal compartment without intervening on the first dorsal compartment[58].

Extensor pollicis longus (EPL) tenosynovitis

EPL tenosynovitis is rare, especially in patients without rheumatoid arthritis. Anatomically, the EPL takes a sharp turn at Lister's tubercle, which can lead to increased friction with motion. Tenosynovitis can occur in the setting of repetitive motion such as in drummers or following nonoperative treatment of nondisplaced distal radius fractures[60]. Microangiographic studies postulated that increased pressure within the tendon sheath of these nondisplaced fractures jeopardizes the blood flow to an already poorly vascularized tendon, thereby increasing the risk for degeneration and possible rupture[61]. Another postulated mechanism for tenosynovitis is direct injury to the EPL tendon during a fall with impaction of the tendon between Lister's tubercle and the base of the third metacarpal[62]. The EPL tendon can also become irritated in the setting of a volar distal radius plate with prominent screws along the far cortex of the dorsal distal radius[63].

Patients can present with diffuse wrist pain or with more focal symptoms of pain and swelling localized to Lister's tubercle[64]. Pain may be exacerbated by active or passive thumb extension. Patients may also present with triggering, snapping, or crepitus over the EPL tendon due to a size mismatch with the third dorsal compartment[60]. In this case, it is important to perform a good physical exam to distinguish between flexor pollicis longus (FPL) triggering volarly and thumb EPL triggering dorsally. Recognition of EPL tenosynovitis is important, as progressive degeneration of the tendon can lead to tendon rupture with inability to extend the thumb at the IP joint. The diagnosis does not necessitate imaging, but both ultrasound and MRI can be used to further evaluate for EPL tenosynovitis when the diagnosis is unclear. It is argued that ultrasound is superior due to the oblique course of EPL tendon, which makes it difficult to visualize on MRI[65]. Furthermore, the dynamic nature of ultrasound can be beneficial in documenting triggering or snapping.

Surgery is the preferred method of treatment due to high risk of EPL tendon rupture with chronic attrition[60,66]. The extensor retinaculum over the third dorsal compartment is released followed by sectioning of the adjacent septae between the second and fourth compartments. While some argue that bowstringing occurs if the tendon is not included under the extensor retinaculum, studies have demonstrated that transposition of the EPL superficial to the extensor retinaculum is a safe and effective method of treatment[64].

Stenosing tenosynovitis of the flexor pollicis longus (FPL)

Although stenosing tenosynovitis of the flexor tendons most commonly affects the ring and long fingers, the thumb is the third most commonly affected digit[67]. Associated factors are as follows: female sex, hand sports, repetitive trauma (e.g., manual work), diabetes mellitus, rheumatoid arthritis, hypothyroidism, CTS, calcific or septic tendinitis, crystal arthropathy, amyloidosis[66]. Regarding the thumb, the FPL approaches the palmar plate at a more acute angle than the digital flexor tendons before entering the retinacular tunnel. This anatomic configuration may contribute to the higher frequency of triggering in the thumb[68]. Inflammation leads to thickening of the tendon or tendon sheath that can occur focally or more diffusely. If localized, the inflammation is usually just distal to the A1 pulley causing deformation and development of a palpable nodule known as a "Notta's nodule". The diffuse pattern may have inflammation that extends beyond the A1 pulley. The resultant pathological disproportion between the volume of the retinacular sheath and its contents leads to dysfunction of tendon gliding.

Pain is typically located overlying the volar base of the thumb metacarpophalangeal joint at the A1 pulley in the region of the Notta's nodule, but patients may present with radiating pain more proximally to the radial wrist or more distally to the thumb (Fig. 1). They may note clicking, catching, or locking with inability to fully flex or extend the thumb depending on the severity. Symptoms may be worse in the morning and improve throughout the day. Diagnosis is made based on a thorough history and physical exam.

Studies have found that systemic conditions (e.g., diabetes mellitus, rheumatoid arthritis, hypothyroidism) and symptoms that have been present for at least 6 months are less likely to respond to nonoperative management[67]. As with triggering in other digits, stepwise approach begins with nonsurgical management. This can include observation, avoiding inciting activities, NSAIDs, splinting, or CSI. The CSI demonstrated a success rate anywhere from 60-90% with the most benefit in the thumb[69]. If there are ongoing symptoms after two injections, it is generally recommended to proceed with surgical release of the A1 pulley given risk of tendon degeneration and rupture with repeated injections[70]. The FPL sheath of the thumb differs from the flexor tendon sheaths of the fingers. While the A1 pulley is present in the thumb, a cadaveric study found a high rate of the variable pulley (Av) at the thumb just distal to the A1 pulley. This structure should also be partially released if there is ongoing triggering after release of the A1 pulley, but care must be taken to avoid injury to the more distal oblique pulley due to the potential of bowstringing[71].

When considering a thumb pain differential, it is worth mentioning Linburg-Comstock syndrome. This describes an anomalous tendinous slip or hypertrophic tenosynovium connection between the thumb FPL and the index flexor digitorum profundus (FDP) tendons, which can be acquired or congenital. Prior studies showed it can be unilateral (20-31%) or bilateral (7-14%)[66, 72, 73]. This connection can be either asymptomatic or symptomatic (also called thumb-index flexor tenosynovitis). In the symptomatic patient, the most frequent presentation is an insidious onset of vague, activity related pain to the thumb, thenar region, and radial wrist/forearm. Patients may complain of tightness or cramping, but the pathognomonic sign of Lindburg-Comstock syndrome is the lack of independent thumb and index flexion with thumb IP joint flexion[74]. Hence, the most reliable provocative test is reproducible pain with passive extension of the index finger while flexing the IP joint of the thumb[66,74]. Regarding imaging, MRI can aid in diagnosis and locating the anomalous connection for surgical planning[73]. Unless symptomatic, no treatment is warranted. In the symptomatic patient, CSI of the FPL sheath aids in diagnosis and treatment. If pain persists despite CSI, open release of the anomalous connection provides significant relief[73, 74].

Flexor Carpi Radialis (FCR) Tendonitis

The FCR muscle originates at the medial epicondyle and acts as a strong wrist flexor. The tendon is fixed in a volar tunnel radial to the carpal tunnel, courses distally over the volar aspect of the scaphoid, and finally enters a fibro-osseous tunnel adjacent to the trapezium with insertion at the trapezium and second and third metacarpal bases[75]. The FCR tendon occupies roughly 90% of the fibro-osseous tunnel which is predominantly formed by bone, leaving very little room for swelling[76]. Throughout the anatomic course of the tendon, osseous ridging created by osteophytes of the scaphotrapezium articulation can encroach on the FCR tendon resulting in tendinopathy and partial or complete tear. This anatomic relationship explains the coexistence of FCR tendinopathy and STT arthritis[77].

FCR tendinopathy is associated with repetitive flexion of the wrist, fracture of the scaphoid, fracture of the distal radius, excision of a ganglion, or blunt trauma[78]. Pain is typically located at the radial volar border of the wrist. It worsens with resisted wrist flexion and radial deviation, as well as with passive stretching of the FCR during hyperextension. Pain may also be present with extension of the second and third fingers[79]. Imaging is not necessary to diagnose FCR tendinopathy. Radiographs can be obtained to determine the presence of osteoarthritic changes. MRI, if obtained, can lead to incidental findings. A study demonstrated signal changes of the FCR tendon on MRI in about 1 in 30 patients, and 55% of these patients were without radial-sided wrist pain[80]. In addition, the signal changes of the FCR tendon were associated with peritrapezial osteoarthritis[80].

Nonoperative treatment with rest, splint, NSAIDs, and possible CSI is first line treatment. Lidocaine injection into the FCR tendon sheath can be used for diagnostic purposes, although caution must be taken to avoid infiltration of the radial artery[79]. Less than 10% of patients are reported to improve with conservative management. Surgical decompression of the FCR tunnel may be required if symptoms do not improve, especially when there is lack of evidence of post-traumatic or degenerative changes. Surgical release is achieved by opening the retinacular septum between the carpal tunnel and the FCR tunnel. Roughly 60% of patients achieved complete resolution of symptoms following surgical release of the septum[79]. A ruptured FCR tendon does not usually need to be repaired, as there is typically minimal loss of function in the setting of an intact flexor carpi ulnaris (FCU) tendon.

Nerves

Superficial radial nerve (SRN) impingement

SRN impingement, also known as Wartenberg Syndrome or Cheiralgia Paresthetica, should be considered when a patient presents with burning pain at the radial aspect of the wrist that radiates into the dorsum of the thumb. SRN impingement is a rare compression neuropathy[81]. Anatomically, the radial nerve bifurcates into the SRN and the posterior interosseous nerve (PIN) at the proximal forearm. The SRN courses distally deep to the brachioradialis and exits roughly 9 cm proximal to the radial styloid[81]. As it courses superficially in the subcutaneous tissue between the tendons of brachioradialis and extensor carpi radialis longus (ECRL), it innervates the dorsum of the thumb, index, and radial half of the long finger. The greatest risk of compression occurs when the nerve transitions from the deep to superficial tissue, especially when the arm is pronated[81,82]. SRN impingement may be related to tight wristwatches, lipomas, osteophytes, shoulder surgery positioning, and work-related activities with excessive pronation or supination[82,83].

Patients present with tingling, paresthesia, and burning pain over the dorsal aspect of the thumb. They tend to have symptoms at rest, as opposed to tendinopathy symptoms that occur during use. Abnormal touch perception, abnormal two-point discrimination, and aggravation of symptoms with forced forearm pronation and wrist ulnar deviation may all be found on physical exam[84]. A positive Tinel's sign may be elicited by lightly tapping over the distribution of the superficial branch of the radial nerve. There have been studies associating SPN impingement with diabetes[84]. In addition, up to 50% of patients experience SRN compressive neuropathy with de Quervain's[84]. Radiographs or advanced imaging are not necessary for diagnosis and EMG demonstrates inconsistent results[84].

There is limited literature related to management. Spontaneous resolution is common, especially after removal of external compression. Rest, splinting, and NSAIDs are considered first-line treatment. Providers may consider a steroid injection, although little has been studied on outcomes in this regard. Dellon et al. demonstrated that 37% of patients improved without surgical management, and 37% recovered with excellent results following surgery[84]. More recently, there was a case report published on ultrasound-guided hydro-dissection by injecting 1% lidocaine around the nerve[85]. They suggested 90% pain relief but there was no discussion on length of time for relief of symptoms. Finally, there are no randomized controlled trials assessing the difference of treatment management.

Other

Ganglion cyst

Ganglion cysts of the wrist and hand are common benign lesions that can present either at the dorsal (more common) or volar aspect of the wrist. They are thought to form from mucin production by modified synovial cells or fibroblasts at the synovial capsular junction following tissue trauma. The material coalesces into an area of degeneration, and a cyst forms[86]. The dorsal ganglion cysts most commonly arise from the SL interval, while the volar ganglions arise from the radioscaphoid or STT joint adjacent to the radial artery and FCR tendon[87]. Smaller dorsal ganglions can be more symptomatic possibly due to a pressure phenomenon within the SLL[88]. Patients may present with no history of injury and minimal physical exam findings except for tenderness to palpation overlying the SLL or pain with loaded wrist extension. On physical exam, the cyst is assessed for transillumination, mobility, and softness. Providers should confirm that a presumed volar cyst is not pulsatile, as a radial artery aneurysm can present in a similar location as a volar ganglion cyst[87].The pain of a dorsal cyst is postulated to be caused by compression of the PIN since its fibers supply innervation to the dorsal wrist capsule, whereas the pain of a volar cyst is thought to be caused by median nerve compression[86,87].

A 1999 study evaluated 21 patients with vague dorsal wrist pain, in which 18 of them demonstrated a small ganglion upon surgical exploration that was confirmed by histology[89]. MRIs have proven beneficial for the diagnosis of occult dorsal ganglions with very high signal intensity on T2-weighted images due to high water content. The advanced imaging can show an intimate relationship of the cyst with the SLL and can demonstrate the ganglion stalk deeply arising from the joint[90]. While ultrasound has the same sensitivity and specificity as an MRI, it is more dependent on the operator[87]. Patients can attempt non-operative management via observation or aspiration, but surgical excision is recommended for continued pain or recurrence. Volar ganglion cysts have a higher recurrence rate following aspiration, and open excision results in lower recurrence. During open excision, the cyst and/or area of myxomatous degeneration should be circumferentially dissected down to the level of the stalk near the site of the cyst's origin. The surgeon must take care to avoid injury to the SLL for dorsal ganglions and radial artery for volar ganglions[87]. Arthroscopic cyst excision is an alternative option for surgical treatment but is used less commonly than open excision.

Conclusion

A variety of pathologies involving osteoarticular, ligament, tendon, nerve, or soft tissue components can produce radial-sided wrist pain. As the health care provider, it is critical to perform a thorough physical exam and correlate findings with appropriate diagnostic tests to narrow down the diagnosis and adequately manage radial-sided wrist pain or refer to an orthopedic surgeon.

Conflict of interest: None to declare

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