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Lunotriquetral instability in a climber – case report and review

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Wrist injuries and carpal instability may result from various sport-related acitivites. Lunotriquetral instability (LTI) is an infrequently recognized cause of wrist pain in athletes. The diagnosis of LTI through history and physical examination can be confirmed by Magnetic Resonance Arthrogram (MRA). This case report describes a case of clinically suspected LTI confirmed by MRA. Relevant literature on lunotriquetral injuries is discussed. Lunotriquetral joint injury can present itself and should be considered within a differential diagnosis of a wrist injury. The diagnosis of LTI through clinical history and physical examination can be confirmed by MRA. This case report demonstrates the importance of MRA in the accurate diagnosis and management of a patient with wrist pain.
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KEY WORDS: ligament, lunotriquetral, carpal instabilities, MR-Arthrogram, wrist

Les blessures au poignet et l'instabilité carpienne peuvent être causées par diverses activités sportives. L'instabilité luno-pyramidale (ILP) est une cause moins reconnue de douleur au poignet chez les athlètes. Le diagnostic de l'ILP par le biais d'examens et des antécédents médicaux peut être confirmé par un arthrogramme par résonance magnétique (ARM). Cette étude de cas décrit une ILP cliniquement soupçonnée et confirmée par l'ARM. La documentation pertinente sur les blessures luno-pyramidales fait l'objet d'une discussion. Une blessure luno-pyramidale aux articulations peut survenir, et doit faire l'objet d'un diagnostic différentiel d'une blessure au poignet. Le diagnostic d'ILP par le biais d'examens et des antécédents médicaux peut être confirmé par un arthrogramme par résonance magnétique (ARM). Cette étude de cas démontre l'importance d'un ARM pour énoncer un diagnostic exact et gérer un gérer souffrant d'une douleur au poignet.
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MOTS CLÉS : ligament, luno-pyramidal, instabilité carpienne, arthrogramme RM, poignet

Introduction

Carpal injuries and instability commonly result from high energy trauma and sports-related activities.[1] Two commonly affected complexes include the scapholunate and lunotriquetral joints. The stability of these joints depends on both the interosseous ligaments and extrinsic capsular elements.[2] Lunotriquetral (LT) injuries occur approximately one sixth as commonly as scapholuntate injuries.[1] The strongest region of the LT complex is on the palmar side.[2]

Isolated injury of the lunotriquetral ligament (LTL) complex and associated structures is an uncommon injury and poorly understood compared with the other proximal row carpal ligament injuries including scapholunate le-

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sions. The spectrum of injuries to the LTL ranges from isolated partial tears to frank dislocation and from dynamic to static lunotriquetral carpal instability (LTI).[3] Carpal instability has been recognized as the absence of proper skeletal and ligamentous support to keep the wrist stable during static or dynamic positions to external loads involved in pinching and grasping.[4]

An individual may develop a LTL injury by means of a post-traumatic incident, degenerative changes over time, a positive ulnar variance, a perilunate injury or a reverse perilunate injury.[5] These individuals will complain of pain on the ulnar side of the wrist.[3] The diagnosis may be difficult to establish because of the many possible causes of ulnar-sided wrist pain and these patients often present with normal radiographic appearance.[5]

This report reviews the relevant literature on LT injuries and adds one more case report to the literature where the diagnosis has been made clinically and was confirmed by MRA.

Case Report

A 32-year-old male competitive climber presented with left wrist pain. He reported that the injury occurred as he was bouldering at a level around 80% of his maximum capabilities at an indoor climbing gym. He stated that he was climbing overhanging terrain, his feet cut, causing him to swing out, which lead to forceful ulnar deviation. He felt a 'crunch' and a low-grade pain that lasted several minutes. The patient stated that immediately following the injury it felt as though something was out of place on the medial aspect of his wrist. He did not continue to climb after the incident. The patient did explain that he had been experiencing pain with activities of daily living such as squeezing dish soap on a sponge, rolling over in bed, and pulling back a shower curtain.

Physical examination did not reveal any swelling or bruising. The patient experienced mild tenderness on palpation of the medial side of the left wrist on both the dorsal and palmar side. The patient reported pain upon end range of pronation/supination. The patients grip was noticeably weakened and made worse when griped in combination with full pronation. Pain was sharp and discrete. He rated the pain 2–3 on a 10 point scale.

The patient was then referred to a Sports Medicine Physician for a second opinion and possibly imaging. The Physician was concerned with a possible tear of the patient's Triangular Fibrocartilage Complex (TFCC) and referred him for an investigative MR-Arthrogram (MRA). Due to the length of the waiting time for the scheduled MRA, the patient was scheduled for an MRI within a significantly shorter time-frame.

The results from the MRI showed no convincing injury of the TFCC. There was a small amount of marrow edema along the base of the ulnar styloid but no associated fracture. It was thought that this could reflect a small area of bone bruising. After receiving the results from the MRI, the patient still felt something was wrong and decided to go ahead with the MRA.

Under fluoroscopic guidance, a 22-gauge needle was inserted into the radiocarpal joint. Position was confirmed with injection of radiopaque contrast material. Following this, 3 cc of a dilute gadolinium solution was injected into the radiocarpal joint. The patient then proceeded to obtain the MRI.

The MR demonstrated extensive contrast in the midcarpal joint and carpometacarpal joints (Figure 1). There was evidence of tear of the lunotriquetral ligament with extension of contrast from the radiocarpal joint into the midcarpal joint along the dorsal aspect of the joint. The radiologist stated that there was ill-definition of both the dorsal and volar bands of the LTL with no associated diastases (Figure 2). The articular cartilage and the rest of the surrounding structures were within normal limits.

The patient was referred for an orthopaedic consult with a hand surgeon. The surgeon suggested that he stop all climbing and mountain biking. She recommended a thermoplastic moulded brace to be worn for 3–5 months. The surgeon mentioned that surgery was an option but felt that bracing is a less invasive treatment and should be attempted first since the surgery is fairly invasive with a long recovery period. The patient decided to abstain from all physical activity involving his left wrist and wore the thermoplastic moulded brace 5 days per week, regularly for 6 months.

After the completion of this time frame, the patient began climbing again at a slow, progressive rate. He was told to pay close attention to his pain levels and as long as there was no pain he could slowly increase his activity level. The patient stated that he started climbing once a week for 3 weeks, progressed to twice a week for 3 weeks and then three times for 3 weeks. One year after the incident, and 8 months after the start of the rehabilitation

Figure 1 *Fluoroscopic spot radiograph of the left wrist. This image was taken during the injection of contrast medium to localize the structure of interest. This image demonstrates extensive contrast from the radiocarpal joint into the midcarpal joint along the dorsal aspect of the joint (arrow).*

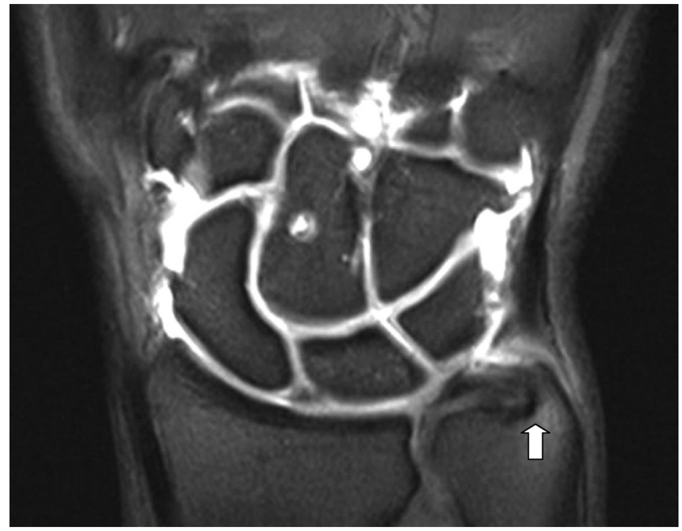

Figure 2 *Coronal T2-weighted MRI: The MR demonstrates increased signal intensity at the base of the ulnar styloid (arrow) and a large cyst in the capitate bone.*

process the patient stated that he was climbing at 75% of his pre-injury level. He also stated that he can still feel clicking in certain wrist postures. There is little pain during activity and he rates it less than 1 on a 10 point scale.

Discussion

Anatomy

The ligaments of the wrist are characterized as either extrinsic or intrinsic. An extrinsic ligament connects the radius to one or more carpal bones – a radiocarpal ligament. An intrinsic ligament interconnects two carpal bones together. Generally, the palmar extrinsic ligaments are more important than the dorsal extrinsic ligaments for carpal stability. The scapholunate and lunotriquetral ligaments are the most important intrinsic ligaments.[6]

There are three major palmar radiocarpal ligaments: the radioscaphocapitate ligament, the radiolunotriquetral ligament, and the short radiolunate ligament. The radiolunotriquetral ligament is the largest ligament of the wrist and originates just ulnar to the radioscaphocapitate ligament from the radial styloid process. It courses obliquely attaching to the lunate and triquetrum. The radioscaphocapitate and radiolunotriquetral ligaments are intracapsular as their volar surfaces are enveloped by the superficial fibrous portion of the joint capsule. They are also extrasynovial structures as their deep surfaces are enveloped by synovium.[6]

The proximal lunate and triquetrum is interconnected by the lunotriquetral ligament. It is a horseshoe-shaped structure that is uniformly thin and more lax in appearance than the scapholunate ligament. The central and proximal segments of the LTL are slim fibrocartilaginous structures with inadequate vascular supply.[7] The proximal margins of the scaphoid and lunate are connected by the scapholunate ligament. Its volar and dorsal portions are triangular and the middle portion of the ligament is thin and bandlike.[6]

Since the strongest region of the LT complex is on the palmar side it is important to stress this side of the wrist in an injured patient to determine if the critical restraining ligament of this joint has been compromised.[2]

Mechanism of Injury

The mechanism behind LT injuries is variable and can include a high-energy impaction after a traumatic incident (such as contact by falling on an outstretched hand).[5] The palmar portion of the LTL, dorsal radiocarpal ligament, and dorsal intercarpal ligament play the most significant roles in LT stability.[1] Volar midcarpal instability occurs when the lunate is no longer linked to the triquetrum. In this situation the lunate follows the scaphoid and angulates palmarly. As a result the capitate is displaced palmar to the radiometacarpal axis.[8]

Wrist instability can also develop from misalignment of a distal radius following fracture, which may produce relative length changes in the wrist ligaments leading to wrist instability.[9] In addition, dynamic wrist instability has been shown to result from an underlying ligament injury associated with wrist ganglions, lifting and twisting manoeuvres, overuse of the wrist, arthritis, positive ulnar variance, and perilunate or reverse perilunate injury.[9]

Signs and Symptoms

During the examination of a patient with a LTL tear will characteristically present with ulnar sided wrist pain or point tenderness over the LT interval.[3] Frequently, the patient will report symptoms of both generalized and focal pain, weak gripping abilities, and the inability to stabilize the wrist under load.[9] The instability during gripping actions will present itself while the wrist is positioned in dorsal flexion and ulnar-duction.[3]

Patients with dynamic patterns of midcarpal instability present with a wrist clunk when moving from radial to ulnar deviation but may be normal at rest. Instead of making a smooth synchronous transition during wrist movement the proximal carpal row will snap suddenly from a palmar flexed position to a dorsal flexed position.[10]

Orthopaedic Examination

Many individuals with carpal injuries and instability do not present with obvious clinical findings. Provocative manoeuvres to assess instability remain largely physician dependent and many of the tests proved to be more efficient at predicting the absence of injury than at predicting its presence.[11]

There are many commonly used stress tests for ruling out other wrist injuries including the Scaphoid Shift Test, Triquetroulnar Critical Test, Triangular Fibrocartilage Complex Stress Test, Midcarpal Stress Test and the Gripping Rotatory Impaction Test (GRIT) for TFCC tears.[15] Some of the commonly used stress tests for determining LTI include the Lunotriquetral Ballottment Test, Reagan Shuck test, Lunotriquetral Shear Test (Kleinman Shear Test), and the Linscheid Compression Test (Squeeze Test).[12]

Lunotriquetral ballottement is performed by compressing the triquetrum against the lunate. One hand is used to stabilize the wrist while the other thumb applies a radial force driving the triquetrum into the lunate.[12] This test has been shown to have a sensitivity of 64%, a specificity of 45%, a positive likelihood ratio of 1.2 and a negative likelihood ratio 0.80.[11] The *Regan Shuck test* involves one hand placed with the thumb and index on the triquetrum and pisiform while the other hand is placed on the lunate and radial wrist. The 2 hands are moved in opposite directions creating stress across the lunotriquetral joint.[12]

The Lunotriquetral Shear Test (Kleinman Shear Test) requires the clinician to grasp the pisiform and triquetrum. The contralateral thumb and index finger hold the lunate and radial carpus. The clinician will move the triquetrum while the lunate and the radial wrist remains stationary. The force transmitted across the LT joint is extremely precise and will cause a shift and pain in a patient with instability of the LT joint.[12]

The Linscheid Compression Test can also be referred to as the Squeeze Test. The clinician places their thumb on the ulnar border of the triquetrum and pushes in a radial direction. Compression force across the LT joint will elicit movement and/or pain in a patient with LT joint damage.[13]

Imaging for Lunotriquetral Injuries

Lunotriquetral instability is difficult to detect on radiographs and traditional MRI.[14] A wide range of sensitivities (40%–100%) and specificities (33%–100%) have been reported in the diagnosis of lunotriquetral ligament injuries using MRI.[8] For diagnosis, arthroscopic examination for LTI is the gold standard and most reliable.[3] However, recently multidetector computed tomography arthrography (MDCTA) and magnetic resonance arthrography (MRA) have become widely available and very useful in the detection of LTI.

CT-Arthrography (CTA) has been suggested for the assessment of SLL and LTL tears.[15] Schmid et al.[16] compared CTA to standard MRI for the evaluation of SLL and LTL tears. They found that CTA was superior to MR imaging in the detection of dorsal segment tears. Furthermore, CTA has ability to identify cartilage defects and thinning.[5] It has been suggested that CTA be used as the primary modality for the examination of intrinsic ligament tears.[17] Moser et al.[17] stated that the CTA sensitivities, specificities, and accuracies are similar or improved compared with MRA. They found that the sensitivity and specificity of MRI, MDCT arthrography, and MRA for tears of the SLL and LTL appeared equivalent for complete tears, but partial tears were significantly better visualized with MDCT arthrography.[18]

MRA combines the advantages of conventional MR imaging and arthrography by improving the visualization of small intra-articular abnormalities making lesions more conspicuous when they are outlined by contrast material in a distended joint space. Intra-articular injection of a contrast agent is generally performed under fluoroscopic guidance. The contrast agent will flow into both the scapholunate and lunotriquetral spaces. The intrinsic ligaments at the proximal margins of the scaphoid, lunate, and triquetral bones arrest the proximal flows of contrast, preventing communication with the radiocarpal compartment.[8] A solution of gadolinium diluted in a solution composed of saline, iodinated contrast material, and lidocaine is commonly used.[19]

The MRA modality allows for a confident assessment of ligament tears and potential diagnosis of associated abnormalities of cartilage, bone, and soft tissues.[17] Specific injuries to this area of the wrist which are detected through MRA include tears to the triangular fibrocartilage complex (TFCC), ulnar impaction syndrome, ulnar collateral ligament injury and instability of the scapholunate and lunotriquetral joint. The MRA is used to visualize disruption of the volar, dorsal and intrinsic carpal ligaments including the most crucial injuries to the interosseous scapholunate and lunotriquetral ligaments.[8] It has been suggested that direct MRA is equal to arthroscopy, but only an experienced radiologist who is familiar with this technique should perform this imaging.[14] However, the evaluation of ligamentous and TFCC injury must always begin with conventional radiographs.[17]

For MRA, this ligament will appear as linear in 37% and triangular in 63% of patients.[20] The signal intensity is homogeneous and low in the majority of patients and is distinguishable from a tear because it is not quite as bright as a fluid signal.[8] Disruption of the ligament is demonstrated on fat-suppressed T2-weighted images as a complete disruption or a discrete area of bright, linear signal intensity in a partial or complete tear.[8] It must be noted that even in advanced cases joint widening of the LT articulation is not usually evident. It is also important to note that the ligament tends to have a discontinuous appearance on MRA near the TFCC and it should not be mistaken for a tear.[8]

Treatment

Appropriate treatment requires assessment of the degree of instability and the chronicity of the injury. The methods for treatment of LTI of incomplete lesions without instability respond well to conservative, nonoperative treatments. Some of the most commonly used conservative therapies include immobilization/splinting, activity modification, strengthening exercises for grip and the wrist (isometric, isotonic, eccentric), peripheral joint mobilization, electrotherapy and corticosteroid injection.[1]

Surgery is sometimes necessary with complete ligament disruption. With a complete tear of the ligaments, LT joint reconstructions and stabilization is performed by tenodesis or arthrodesis.[3,5] Ulnar shortening may be required for individuals with problematic variances.[5] If the surgical approach is taken, after suturing the dorsal structures and skin, typically a high plaster cast reaching up above the elbow is applied for approximately 4 weeks, followed by application of a short plaster splint for another 2 weeks.[3]

Clinical Significance

The clinical significance of imaging findings of TFCC and ligament tears is controversial. Multiple studies have indicated that a large portion of asymptomatic wrists can present with communicating defects in the TFCC and intrinsic ligaments.[21] Several studies have verified defects in asymptomatic wrists as degenerative changes within the substance of the ligaments, as well as within the TFCC.[22–24] Therefore, a communicating defect of the ligaments or TFCC, through MRA, could present as an asymptomatic degenerative degradation within the wrist or as a symptomatic tear.

The clinical significance of a tear found through imaging on an asymptomatic wrist is complicated. Many people have several wrist injuries and therefore an asymptomatic wrist at the time of the examination cannot exclude that the wrist was previously damaged. Tears of different segments of the LTL have been shown to have varying clinical significance. The volar portion of LTL is the main contributors to stability of that joint consisting of closely packed collagen fibers.[25] The central portions of the LTL contributes little to stability as it is composed of a thin fibrocartilaginous membrane.[26] With increased age degenerative perforations in the middle segments of the LTL are commonly found and correlate poorly with patients' symptoms.[27]

Extrinsic ligaments between the radius, ulna, and carpal bones are important in maintaining carpal stability. The radiolunotriquetral ligament (RLTL) is one of the most important ligament complexes for carpal stability. The RLTL maintains the load transference and prevents ulnar translation.[28] If this ligament is damaged, it is more likely that there will be the need for treatment intervention.

Future studies should examine the clinical relevance of LT injuries in asymptomatic and symptomatic populations. It would be beneficial to observe the effects of conservative therapy, such as immobilization/splinting, activity modification, strengthening exercises for grip and the wrist, on these two populations and compare its effectiveness with surgery. It must be noted that this was only one case study demonstrating the diagnosis of a lunotriquetral ligament injury through fluoroscopy and MRI. It may be useful to support these findings with a lunotriquetral injury case series that can contrast differences found between various lunotriquetral injuries.

Conclusion

Carpal injuries and instability commonly results from high energy trauma sport-related activities.[1] Even though the scapholunate joint is more commonly affected, LT joint injury can present itself and should be considered within a differential diagnosis of a wrist injury. The diagnosis of LTI through clinical history and physical examination can be confirmed by MRA. This case report demonstrates the importance of MRA in the accurate diagnosis and management of a patient with wrist pain.

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