

A Review of Wrist Joint Injury

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Abstract: Wrist joint injury is a common orthopedic disease, and its diagnosis and treatment are of great significance for the functional recovery and quality of life of patients. In addition, I have personally experienced the wrist injury recently, so I choose to explore the causes and diagnosis and treatment methods of wrist injury, to explore the most effective and latest technology and find the most effective way to minimize the damage to the human body by studying the overall technological changes and breakthroughs. At the same time, I think rehabilitation training plays a crucial role in the recovery process of wrist injury. Through static training and endurance training, the stability and flexibility of the wrist can be significantly enhanced. With various treatment methods combined with rehabilitation training can effectively promote the functional recovery of patients and reduce the occurrence of sequelae. At the same time, as a Chinese, I also deeply understand that some TCM therapies have particularly effective auxiliary effects in this stage.

Keywords: Wrist joint, injury, Diagnosis, Treatment

1. Introduction

The wrist joint is a complex joint composed of multiple joints, including the radial wrist joint, the intercarpal joint and the carpometacarpal joint, and the three joints are interrelated (except the carpometacarpal joint of the thumb), collectively referred to as the wrist joint. From a functional perspective, the wrist joint should include the radiocarpal, intercarpal, and distal radioulnar joints, which move evenly and are situated deep within the carpal tunnel. In the narrow sense, the wrist joint is the joint between the lower end of the radius and the first row of carpal bones (apart from the pea bone), or the radial wrist joint. The stability of the wrist joint is maintained by ligaments, muscles, and tendons. These structures work together to keep the joint stable and control movement. Including these muscles, the long radial extensor muscle of the wrist (located on the outer side of the forearm, mainly responsible for extending and abducting the wrist); the short radial extensor muscle of the wrist (located below the long radial extensor muscle of the wrist, mainly responsible for extending and abducting the wrist); the extensor digitorum muscle (located on the back side of the forearm, mainly responsible for extending the fingers); the extensor digiti minimi muscle (located on the inner side of the extensor digitorum muscle, mainly responsible for extending the little finger); the ulnar extensor muscle of the wrist (located on the inner side of the forearm, mainly responsible for extending and adducting the wrist). And ligaments, the dorsal intercarpal ligament (located on the back side between the carpal bones, connecting the carpal bones); the dorsal radiocarpal ligament

(located on the back side between the radius and the carpal bones, mainly connecting the radius and the carpal bones).

Injuries to the wrist joint encompass a variety of conditions, including fractures, dislocations, tendon injuries, cartilage injuries, ligament injuries, and the frequently encountered triangular fibrocartilage complex (TFCC) injury. Wrist joint fractures typically result from external forces or improper movements during intense physical activities. Imaging studies reveal that these fractures can affect the radius, ulna, or carpal bones, and are often associated with cartilage damage or joint dislocation. Multi-slice spiral computed tomography (MSCT) and magnetic resonance imaging (MRI) [1] are highly effective in diagnosing wrist joint fractures. MSCT utilizes high-resolution imaging and 3D reconstruction to clearly visualize bone structures, whereas MRI is particularly sensitive to soft tissue injuries and can accurately detect occult fractures and cartilage damage. Combining these two techniques enhances diagnostic accuracy and provides detailed imaging for clinical management. According to the injury site, wrist joint injury can be divided into internal ligament injury, external ligament injury and triangular fibrocartilage complex injury.

Wrist joint dislocations, often resulting from high-energy trauma such as car accidents or falls, can cause significant structural damage and impair joint function. Ligament injuries in the wrist joint, typically caused by overstretching or sprains, are common in sports that require hand support, like gymnastics and wrestling. These injuries can lead to wrist joint instability, accompanied by pain and swelling. MRI is a crucial diagnostic tool for ligament injuries due to its high sensitivity to soft tissues, allowing clear visualization of the extent and location of ligament tears. MRI not only provides direct evidence of ligament damage but also assesses the healing process, offering vital information for clinical decision-making.

Cartilage injuries, often caused by chronic fatigue or acute trauma, are particularly prevalent among athletes, especially gymnasts and divers, who endure high-intensity training and competition. Some studies have shown that wrist injury is also affected by gender differences, showing that the strength of women is decreased compared with that of men in general; When male intensity normalized, there was variation between directions of movement [2]. Women, who are weaker than men, are also more likely to get hurt. Clinical symptoms of cartilage injuries include joint pain, swelling, and reduced mobility. MRI is the preferred diagnostic method for cartilage injuries, as it offers high-resolution soft tissue imaging and accurately evaluates the degree of damage.

Typical symptoms include wrist pain, swelling, limited movement and weakness. Patients may not be able to move their wrists freely, or they may not be able to move them flexibly. In severe cases, patients may develop complications such as joint stiffness, traumatic arthritis, and chronic pain syndrome.

2. Diagnosis

Diagnosis of wrist joint injury is usually made through a visual examination, laboratory tests, and imaging. Imaging tests such as plain X-rays and magnetic resonance imaging (MRI) can help to determine whether the wrist has been broken and the details of the injury. Arthroscopy is a minimally invasive diagnostic and treatment technique that can directly observe the intraarticular injuries and has high diagnostic value for TFCC injuries and ligament tears.

For example, patients with TFCC injury complain of ulnar wrist pain during movement. This includes many wrist-rotating movements, such as turning the door handle and opening the lid of a jar or bottle, causing patients to experience varying degrees of pain symptoms. At this time the pain will appear unable to hold or unstable and loud sounds appear. This weakness of pronation and supination due to underlying DRUJ instability is characteristic of TFCC injury [3]. Palmer classification of acute TFCC injury. Type 1A, rupture of the cartilage center; Type 1B, ulnar cartilage plate avulsion; Type 1C, rupture of lateral ulnar ligament; Type 1D. Avulsion of the periradialis. MRI images of traumatic

TFCC injuries as classified by Palmer. Pc, proximal component; Dc, distal component; MRI, magnetic resonance imaging; Triangular fibrocartilage complex [4].

One thing to note here is that because there are small carpal bones in the wrist, determining the cause of pain is more common examination methods are radiography, MRI, CT, etc., but a new method is also proposed: the quadrilateral method (and palm, ruler, dorsal, radial) provides direction for diagnostic imaging and focusing examination during intervention [5]. However, in some cases, the positive test is also a good way to determine whether it is a carpal shift, such as the Waston shift test for lunavicular instability, First, use one hand to apply a dorsal force on the navicular bone, while using the other hand to make the wrist ulnar deviation and slight extension. While maintaining pressure on the scaphoid bone, offset the wrist towards the radius and bend slightly. Release the pressure on the navicular bone. If the navicular bone is violently displaced, causing pain and possibly a palpable and audible "thump", the test result is positive [6].

In addition to the advantages of combined diagnosis, studies have shown that the combined application of multi-slice spiral CT and MRI has shown significant advantages in the diagnosis of wrist injuries. This combined diagnostic method not only improves the detection rate of fractures, joint dislocation, concealed fractures and displaced fracture fragments, but also provides more detailed imaging information, thereby effectively reducing missed diagnosis and misdiagnosis. Specifically, combined diagnosis was significantly higher than single diagnosis in terms of dislocation rate, fracture rate, occult fracture rate and displaced fracture rate. For example, the dislocation and fracture rates in the observation group were 50.0% and 90.0%, respectively, compared to only 23.3% and 66.7% in the control group [7]. In addition, the accuracy and comprehensiveness of the combined diagnosis make it highly valuable in clinical application and can provide strong support for the formulation of treatment regimen.

3. Treatment

Most hand surgeons choose to respect the radial styloid process (LRTI) in cases of isolated scaphotrapezotrapezoid (STT) osteoarthritis; some also favor joint fixation, and a few recommend distal lunate excision. Although three-bone fusion surgeries have shown good patient satisfaction, they can also result in nonunion, the loss of wrist range of motion, and chronic discomfort in the thumb's carpometacarpal (CMC) and radiocarpal joints, which may require further surgery. Although distal lunate excision has the benefits of a simpler procedure, a shorter fixation period, and possibly a quicker recovery, it is less frequently chosen because of worries about increased midwrist instability [8].

Immobilization, rest, activity moderation, nonsteroidal anti-inflammatory medications (NSAIDs), and cortisone injections are the main nonoperative treatment options for wrist osteoarthritis (OA). Arthrodesis, bone spur removal, nerve excision, and partial or complete wrist fixation are surgical treatments for wrist OA. A detailed discussion of the patient's commitment to surgery is crucial because extended immobility and job incapacity can result in a bigger loss of function than the original symptoms. Nerve removal can help reduce pain while maintaining mobility in the wrist and should be considered if the patient has pain relief after an anesthetic injection around the anterior interosseous nerve (AIN) and/or posterior interosseous nerve (PIN) in the forearm. When arthritis is confined to the styloid process of the radius, it is best to perform a controlled styloid resection of the radius [8].

At the same time, there is a relatively new treatment method for replacing the carpal bone with 3D printed barium prosthesis, because the incidence of lunate bone fracture is relatively high, and the traditional carpal resection and carpal arthritis treatment of carpal bone necrosis will lead to more complications. Therefore, the use of 3D printing barium can be better personalized treatment and accurate drug positioning [9].

In most cases, some non-surgical treatment can be used to cure patients or alleviate the condition, but there is still a lack of data to prove its stability. Some cases still require surgery and medication, and there are postoperative complications. Examples include the most common local soft tissue infections and wound lacerations and hypertrophic scars [1, 4, 5, 10], which are often alleviated with non-surgical interventions, including oral antibiotics and local wound care.

It is worth mentioning that the combination of Chinese medicine therapy will bring good therapeutic effect. For example, in the rehabilitation treatment program, electroacupuncture therapy combined with traditional Chinese medicine, fumigation and rehabilitation exercise are widely used in the rehabilitation of wrist injuries. These methods can effectively relieve pain and promote the recovery of wrist joint function. Electroacupuncture treatment can dredge meridians and unblock qi and blood by stimulating acupuncture points with electric current, while herbal medicine and fumigation further relieve pain and swelling through the osmosis of drugs. Studies have shown that these comprehensive rehabilitation measures can significantly improve the quality of life and rehabilitation effects of patients [11].

4. Conclusion

In conclusion, the prognosis of wrist joint injury varies according to the type of injury, etiology, treatment and individual differences. Timely diagnosis and treatment are key to improving prognosis, while proper joint use and proper exercise in daily life are also important measures to prevent injury. Preventive measures include wearing protective gear, warming up adequately before exercise, controlling weight, and exercising regularly. When performing high-risk activities or specific sports, protective equipment such as training gloves and wrist bandages should be used reasonably.

In many instances, non-surgical treatments can effectively cure patients or alleviate their conditions. However, there is still insufficient data to confirm the long-term stability of these treatments. Some cases inevitably require surgical intervention and medication, which can lead to postoperative complications. Common complications include local soft tissue infections, wound lacerations, and hypertrophic scars. These issues are often managed with non-surgical methods, such as oral antibiotics and local wound care. Despite the potential for complications, non-surgical interventions play a crucial role in treatment, offering significant relief and promoting healing without the need for invasive procedures. Further research is needed to validate the stability and efficacy of these non-surgical approaches.

Combining Chinese medicine therapies, such as electroacupuncture, herbal medicine, fumigation, and rehabilitation exercises, can effectively treat wrist injuries. Electroacupuncture stimulates acupuncture points with electric currents to unblock qi and blood, promoting pain relief and recovery of wrist joint function. Herbal medicine and fumigation further alleviate pain and swelling through the osmosis of drugs. Rehabilitation exercises complement these treatments by enhancing joint mobility and strength. Studies indicate that these comprehensive rehabilitation measures significantly improve patients' quality of life and rehabilitation outcomes, making them a valuable approach in wrist injury recovery programs. This holistic method integrates traditional practices with modern techniques for optimal results.

References

- [1] Peterson L. and Renstrom P. (2017). *Sports injuries: prevention, treatment, and rehabilitation*. CRC press. chapter 10:227-256
- [2] Napper AD, Sayal MK, Holmes MWR, Cudlip AC. (2023). *Sex differences in wrist strength: a systematic review*. Peer J, 14;11:e16557. doi: 10.7717/peerj.16557.

- [3] Andersson JK, Axelsson P, Strömberg J, Karlsson J, Fridén J.(2016). Patients with triangular fibrocartilage complex injuries and distal radioulnar joint instability have reduced rotational torque in the forearm. *J Hand Surg Eur*, 41(7):732-8. doi: 10.1177/1753193415622342.
- [4] Abe Y, Tominaga Y, Yoshida K. (2012). Various patterns of traumatic triangular fibrocartilage complex tear. *Hand Surg*, 17(2):191–8.
- [5] Flores DV, Murray T, Jacobson JA. (2023). Diagnostic and Interventional US of the Wrist and Hand: Quadrant-based Approach. *Radiographics*, 43(8):e230046. doi: 10.1148/rg.230046. PMID: 37498783.
- [6] Hemmati S, Ponich B, Lafreniere AS, Genereux O, Rankin B, Elzinga K. (2024). Approach to chronic wrist pain in adults: Review of common pathologies for primary care practitioners. *Can Fam Physician*, 70(1):16-23. doi: 10.46747/cfp.700116. PMID: 38262758; PMCID: PMC11126282.
- [7] Liu, L. (2021). Application of Multi-slice Spiral CT Combined with MRI in the Diagnosis of Wrist Joint Injury. *Imaging Research and Medical Application*, 5(3), 125-127.
- [8] Look N, McNulty M, Rodriguez-Fontan F, Fenoglio AK. (2023). Radial-sided wrist pain differentials: presentation, pathoanatomy, diagnosis, and management. *Medicina (B Aires)*, 83(1):96-107. English. PMID: 36774602.
- [9] Zhang C, Chen H, Fan H, Xiong R, He R, Huang C, Peng Y, Yang P, Chen G, Wang F, Yang L. (2023). Carpal bone replacement using personalized 3D printed tantalum prosthesis. *Front Bioeng Biotechnol*, 30;11:1234052. doi: 10.3389/fbioe.2023.1234052. PMID: 37965053; PMCID: PMC10642728.
- [10] StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan.
- [11] Li Q, ZhaonL, Liu R, Feng Y, Zhang P. (2022). Kinematic Simulation and Efficacy Evaluation of Hybrid Wrist Joint Rehabilitation Mechanism. *Mechanical Science and Technology for Aerospace Engineering*, 41(12):1839-1843. <https://doi.org/10.13433/j.cnki.1003-8728.20200518>