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Current Indications for and the Technique of Wrist Arthroscopy

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Abstract: Since its introduction more than 30 years ago, wrist arthroscopy has become an essential diagnostic and therapeutic tool in hand surgery. This procedure minimizes exposures and allows access to otherwise remotely located anatomic regions with minimal morbidity. Advances in anatomic understanding and wrist scope technology have standardized the procedure and expanded indications. Current applications are diagnostic staging of various wrist pathologies where arthroscopy allows for a direct, magnified, and tactile-assisted examination. This includes injuries to the triangular fibrocartilage complex (TFCC), osteochondral lesion of the carpus, and dynamic assessment of carpal instability and radiocarpal arthritis. Therapeutic applications have continued to expand and include arthroscopic-assisted fracture reductions, treatment of radiocarpal synovitis and arthritis, TFCC repairs, and arthroscopic management of soft tissue pathologies such as ganglion excisions and release of contractures. [*Orthopedics.* 2014; 37(4):251-256.]

Technique

Wrist arthroscopy relies on small scopes ranging from 2.3 to 2.9 mm. After identification and marking of anatomic landmarks as well as planned access portals, the wrist is placed into a traction tower and 10 to 15 pounds of traction is applied via finger traps. Perpendicular traction tower placement allows for adjuvant use of fluoroscopy during the case (**Figure 1**). Traditionally, 5 standardized dorsal radiocarpal and 2 midcarpal portals have been described that allow access to all areas of these 2 main carpal joints.[1] The more common dorsal portals are numbered according to the adjacent extensor compartment and labeled regarding which side of this compartment is being accessed—radial or ulnar (**Figure 2**). Additional access portals, such as volar portals, have been developed, allowing enhanced visualization of the dorsal capsule and the rim of the distal radius.[2]

The surgeon determines whether tourniquets will be used and whether dry or wet arthroscopy will be performed. When using mechanical burrs or ablative radiofrequency probes, pressure-controlled pumps or gravity irrigation systems are recommended to prevent thermal injury. In standard setups, the working arthroscope portal is used for inflow and a separate outflow portal—commonly via the ulnar 6U portal—is established. Development of a routine arthroscopy setup and instrumentation and establishment of a dedicated “scope team” greatly facilitate the procedure. This applies to both extra-articular instrumentation and the arthroscopic procedure itself, where a diagnostic systematic survey of the radiocarpal and midcarpal joint precedes therapeutic intervention (**Figure 3**). In addition to traditional wrist arthroscopy, advances in scope technology have allowed for arthroscopic instrumentation of the carpometacarpal thumb joint as well as finger joints in selected indications.

Diagnostic Staging

Arthroscopic staging of various wrist pathologies, including cartilage injuries and chondromalacia, triangular fibrocartilage complex (TFCC) injuries, and ligamentous instabilities, is standard practice. This includes staging of

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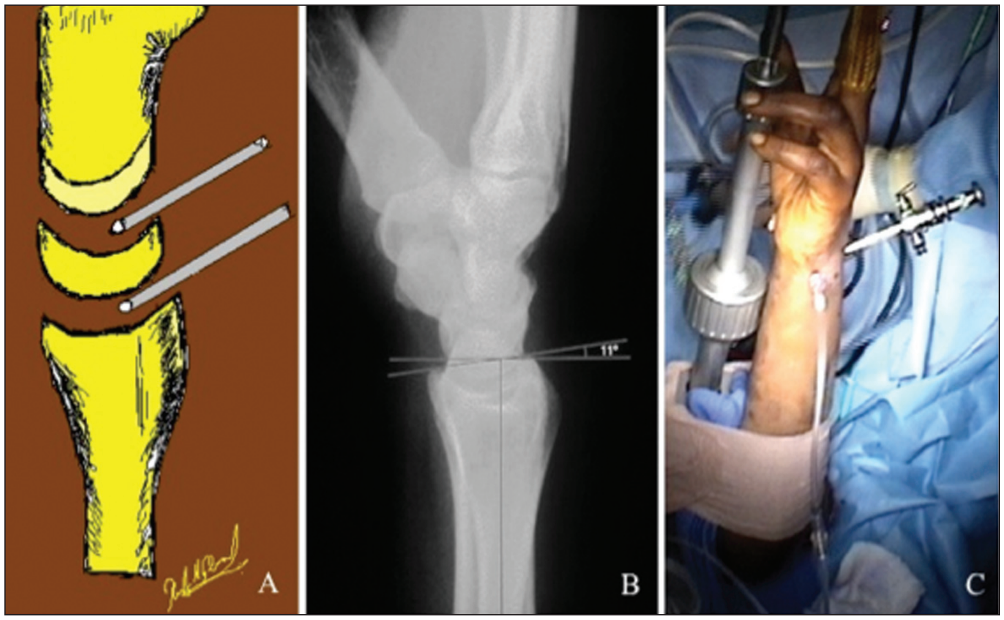

Figure 1: Instrument and camera positioning. The instruments and camera must be inserted with correct inclination regarding the midcarpal and radiocarpal joint anatomy to avoid iatrogenic cartilage damage. Schematic drawing (courtesy of Rodrigo Banegas, MD) (A). Conventional wrist radiography, lateral view (B). Intraoperative photograph of the hand placed in the perpendicular traction tower instrumentation with an outflow cannula visible at the 6R portal (C).

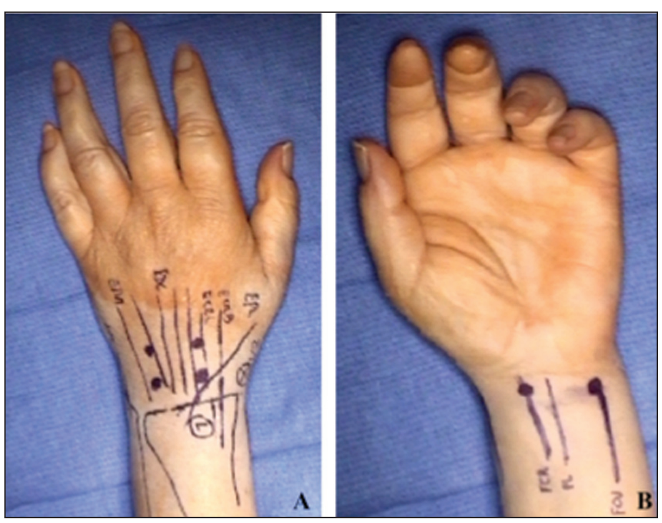

Figure 2: Standard wrist arthroscopy portals. Intraoperative site marking of dorsal radiocarpal and midcarpal portals along the 3/4 and 4/5 extensor compartments (A). Intraoperative site marking of volar radial portal over the flexor carpi radialis (FCR) sheath and ulnar-sided portal using the flexor carpi ulnaris (FCU) sheath (B).

wrist arthritis when deciding on wrist fusion vs motion-preserving salvage procedures such as proximal row carpectomy and 4-corner fusion. An understanding of intactness of the lunate facet and midcarpal joint is important in choosing the appropriate procedure for the individual case.

Kienbock's disease is a common indication for diagnostic staging using arthroscopy (**Figure 4**). Direct assessment of the structural integrity of the lunate facilitates understanding of disease stage and decision-making. Radiographic imaging often is not sufficient to determine cartilage integrity and the condition of the subchondral bone of the lunate. This is essential in choosing the appropriate treatment option—decompression or a revascularization procedure vs a salvage procedure.[3] The lunate can be visualized through the dorsal 3/4 portal. It is advised not to create a 4/5 portal if there is a possibility of needing a 4/5 extensor compartment artery vascularized bone graft, as this may damage the feeding intercompartmental vascular pedicle.

Treatment

Ganglion Excision

Arthroscopic resection of dorsal carpal ganglion cysts has gained popularity in recent years. This procedure minimizes dorsal scars, yet provides enhanced visualization of the cyst stalk, which can be completely ablated through arthroscopic instrumentation (**Figure 5**). Whereas standard 3/4 and 4/5 portals are routinely employed for visualization and instrumentation, an additional ulnar-sided 6th extensor compartment portal can be helpful for placement of shavers or radiofrequency probes. When performing an arthroscopic ganglion excision of the radiocarpal joint, it is equally important to assess the midcarpal joint, where ganglion cysts can also occur.[4] As in many arthroscopic procedures, synovitis can obstruct adequate visualization and a partial synovectomy using a shaver will facilitate subsequent ganglion excision. For large cysts with significant extra-articular components, it may be necessary, after complete excision of the stalk and all intra-articular cyst components, to remove remaining extra-articular portions of the cyst via a minimal dorsal approach. Lasting good outcomes have been described 2 years after this procedure.[5]

Triangular Fibrocartilage Complex Tear

Triangular fibrocartilage complex tears can have equivocal findings on magnetic resonance imaging (MRI) studies, and many authors recommend arthroscopic diagnostic work-up and treatment.[6] Wrist traction and direct, magnified visualization give the surgeon a better appreciation of injury than does an open procedure. Triangular fibrocartilage complex injuries are commonly staged and classified according to the Palmer classification.[7] For degenerative tears, debridement of frayed edges back to a stable rim—similar to the management of meniscal tears in the knee—may be all that is needed. In recent years, arthroscopic repair of foveal tears has been described with various techniques[8] (**Figure 6**). Shinohara et al[9] recommend placing sutures via a hypodermic needle through transosseous tunnels predrilled with 1.2-mm K-wires. Foveal tears have also been repaired with an arthroscopic-assisted technique using suture anchors.[10]

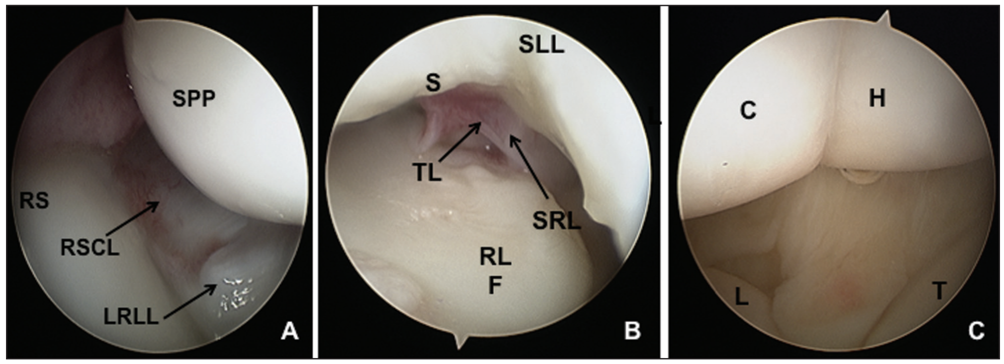

Figure 3: Arthroscopic carpal anatomy. Intraoperative arthroscopic radial-sided view through the 3/4 portal showing the radial styloid (RS), radioscaphocapitate ligament (RSCL), long radiolunate ligament (LRLL), and proximal pole of the scaphoid (SPP) (A). Intraoperative arthroscopic central 3/4 portal view showing the scaphoid (S), scapholunate ligament (SLL), and lunate on the top and the ligament of Testut (TL), short radiolunate ligament (SRL), and radiolunate facet (RLF) in the center of the image (B). Intraoperative arthroscopic ulnar midcarpal view showing the capitate (C) and hamate (H) on the top of the image and the lunate (L) and triquetrum (T) on the bottom (C).

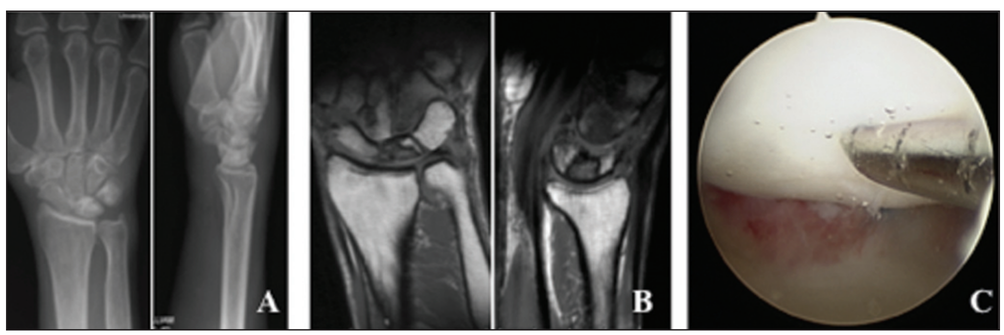

Figure 4: Arthroscopic staging in Kienbock's disease. Intraoperative standard radiographs showing sclerosis and deformity of the lunate in radiographic Lichtman IIIb stage (A). Intraoperative reduced lunate signal on T1-weighted magnetic resonance imaging indicative of an avascular lunate (B). Intraoperative arthroscopic probe penetrates lunate cartilage and subchondral bone for several millimeters. This demonstrates the loss of osteochondral integrity, confirming that the disease stage is not amenable to revascularization procedures (C).

Resection of Radial Styloid

Radioscaphoid arthritis is commonly seen in early stages of both scapholunate advanced collapse and carpal instabilities associated with scaphoid nonunion. Styloid impingement can lead to chronic pain for which open as well as arthroscopic resection of the radial styloid are well described treatment options. The smaller incisions in arthroscopic resections may allow for faster rehabilitation. Using high-speed burrs, the radial styloid is debrided. In addition to direct visualization, fluoroscopic guidance is helpful to ensure correct burr placement and prevention of overaggressive styloidectomy. No more than 3 to 4 mm should be resected to prevent ulnar translation of the carpus—a well-described complication associated with weakening or resection of the volar radioscapholunate ligament and the dorsal radiocarpal ligaments.[11,12]

Ulnar Styloid Excision

On the ulnar side, a functionally long ulnar styloid may contribute to ulnocarpal impingement. Bain and Bidwell[13] described an arthroscopic technique placing the arthroscope in the 4/5 portal and the burr in the 6U portal (after traditional complete diagnostic arthroscopy). The styloid is palpated through the skin and the burr is placed onto the styloid, followed by approximately 3 mm of styloid resection under fluoroscopic control. This technique minimizes soft tissue structure trauma and scarring and preserves the TFCC and dorsal and volar ligaments.

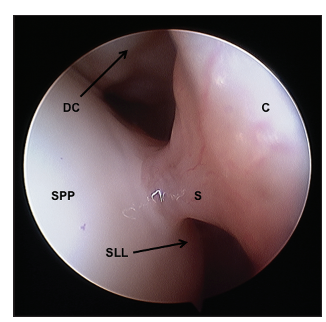

Figure 5: Intraoperative arthroscopic view of a ganglion cyst. (Abbreviations: C, cyst; DC, dorsal capsule; S, stalk; SLL, scapholunate ligament; SPP, scaphoid proximal pole.)

Proximal Hamate Excision

Arthritic involvement of the proximal hamate is well described in the setting of a type II lunate where the proxi-

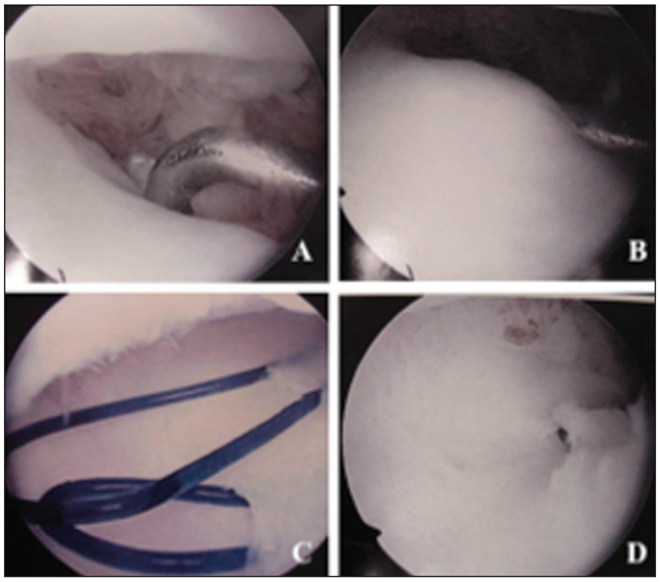

Figure 6: Arthroscopic repair of a triangular fibrocartilage complex (TFCC) injury. Intraoperative arthroscopic probe depressing the torn off TFCC as seen in a Palmer 1B injury (A). Intraoperative probe elevating the lateral border of the TFCC (B). After debridement, a suture is passed through the TFCC (C). After suture tying, the TFCC is tensioned and reattaches to the foveal insertion (D).

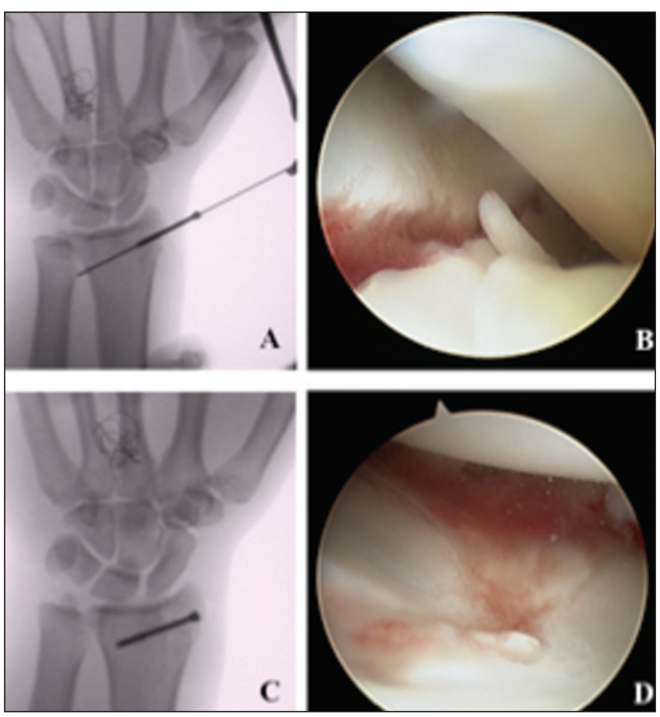

Figure 7: Arthroscopic-assisted distal radius fracture fixation. Cannulated headless compression screw fixation of a radial styloid fracture. The screw had been partially inserted and used as a joystick for styloid reduction under arthroscopic visualization (A). A greater than 2-mm gaping fracture prior to reduction and fixation (B). Radiograph after accomplished fixation (C). The reduced and compressed fracture (D).

mal hamate pole articulates and impinges the additional facet of the lunate.[14] Not only may the patient experience vague nontraumatic pain in the area associated with chronic overloading of the joint facets, but lunotriquetral tears may develop over time. Arthroscopic resection of the proximal hamate can unload the type II lunate facet and has been shown to provide good symptomatic relief. The scope and burr can be placed alternately in the radial and ulnar midcarpal portals to adequately resect the impinging bone. Patients with concurrent severe lunotriquetral ligament tears tend to do worse and are more likely to need a fusion in the future.[15]

Chondroplasty

Chondral lesions are amenable to arthroscopic debridement as well. Ragged cartilage edges can be gently smoothed using either shavers or various ablative probes. Arthroscopic scissors and graspers can facilitate removal of larger, denser tissue. Loose bodies can be removed under direct vision; fragments escaping MRI detection may be visualized. This treatment is most effective in patients with mechanical symptoms.[16,17]

Arthroscopic-Assisted Fracture Reduction

Distal Radius Fractures

Arthroscopic-assisted fixation of distal radius fractures can facilitate reduction and management of comminuted or depressed articular fragments (**Figure 7**). In addition to standard portals, the scope can be introduced using the extra-articular surgical approach employed for plate fixation of the fracture. Under direct visualization, fragments can be elevated and reduced using bone tamps, elevators, or K-wires for direct manipulation.[18] In addition to fracture reduction, associated ligamentous injuries such as scapholunate ligament injuries, as seen in radial styloid fracture patterns, can be diagnosed and treated.[19]

Scaphoid Fractures

Arthroscopic-assisted reduction of a scaphoid fracture can be technically difficult. Using a 4/5 portal, wrist and proximal pole fractures are more easily visualized than distal pole fractures. The scapholunate interval can be readily evaluated at this time as well. Once the fracture and any stepoff are identified, the fracture hematoma and any debris can be evacuated using a shaver or graspers. K-wires can be used as joysticks for fracture reduction before interfragmentary fixation with K-wires or cannulated screws.[20] In addition to fracture visualization, the arthroscope can aid in selecting the correct starting position for the cannulated screw guidewire. This can help minimize the number of passes before establishing correct guidewire position along the center axis of the scaphoid. Once the screw is inserted, direct compression of the fracture can be seen arthroscopically. Fluoroscopy is used to confirm adequate reduction and implant placement.

Septic Wrist

The morbidity of a dorsal wrist incision, especially in the setting of an acute wrist joint infection, can delay healing and increase scarring, which may leave the patient with contractures. Just as in cases of septic arthritis of the knee, an arthroscope can be used to wash out wrist joint infections.[21] A complete wrist joint irrigation can be performed through the radiocarpal and midcarpal portals. As long as no residual abscess is suspected necessitating separate drainage, arthroscopic irrigation, joint drainage, and debridement is a viable choice. Intact dorsal wrist soft tissues can be an added benefit if additional wrist salvage procedures are needed in the future.

Capsular Release

Dorsal Wrist Capsule

Dorsal or volar capsular releases can be performed arthroscopically using an arthroscopic shaver.[22] A benefit of limited-access arthroscopic contracture release is the minimal amount of new scar formation and the option to release prior scars. On the dorsal side, once the capsular contracture is released, care must be given to the extensor tendons to avoid shaver-induced tendon injury. The extensor tendons can also be drawn away from the instruments by a suture placed between them and the dorsal capsule.

Volar Wrist Capsule

Volar capsular release can be performed via standard dorsal portals, such as the 3/4 and the 6R portals. Care must be given to protect the radioscaphocapitate ligament to prevent ulnar translation of the carpus. In addition, volar neurovascular structures and tendons can be at risk during injudicious releases. An earlier study measured the distance from the volar capsule to key neurovascular structures in cadavers and on MRI studies. The average distance from the radiocarpal joint capsule to the median nerve was 6.9 mm, 6.7 mm to the ulnar nerve, and 5.2 mm to the radial artery.[22]

Contraindications/ Complications

Whenever safe access to the wrist joint cannot be established, wrist arthroscopy is not recommended. This can include any soft tissue condition where significant swelling is present or expected, such as tumors, traumatic ecchymosis, or extensive capsular tears where irrigation fluid can extravasate. In addition, any limb with neurovascular injury and patients with an underlying bleeding disorder can be contraindications to arthroscopy.

Wrist arthroscopy, when performed using a standardized technique, is a safe and reliable surgical procedure. Apart from general complications pertinent to any surgical procedure, the unique wrist anatomy with its close topographic relationship of access portals to tendons and neurovascular bundles can explain injuries to these structures during the procedure. Complications are described at rates of 4% to 5% of cases and include temporary or permanent injury to the dorsal sensory branch of the ulnar nerve as well as injury to the posterior interosseous nerve. Extensor tendon injuries and extensor sheath fistulas can be minimized by meticulous technique and detailed anatomic knowledge.[23-25]

Conclusion

The indications for wrist arthroscopy have increased during the past 2 decades along with technological advances and anatomic understanding. A thorough understanding of topographic anatomy and a standardized technique are essential to minimize complications and to ensure optimal outcomes.

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