New Advances in Wrist Arthroscopy


Abstract: Wrist arthroscopy is a commonly used procedure that has undergone many modifications and improvements since it was first described. The advent of new portals (both dorsal and volar) means that the wrist joint can be viewed from virtually any perspective ("box concept"). Indications for wrist arthroscopy have continued to expand and include diagnostic and reparative procedures and, more recently, reconstructive, soft-tissue, and bony procedures. Arthroscopic grading of Kienböck’s disease better describes articular damage compared with plain radiographs and can help guide surgical treatment options. Triangular fibrocartilage complex injury diagnosis, classification, and treatment can be performed arthroscopically, including distal ulna resection (wafer procedure). Assessment of fracture reduction of the distal radius and scaphoid is superior to that obtained with fluoroscopy, with the advantage of being able to look for associated soft-tissue and chondral injuries. Arthroscopic assessment of intercarpal ligament injuries and instability is now considered the gold standard by many authors. Arthroscopy can also aid us in the management of post-traumatic capsular contraction, resection of ganglia, and the relatively rare isolated ulna styloid impaction. Complications of wrist arthroscopy are relatively uncommon. With the ever-expanding list of indications and procedures that can be performed with this technique, it exists as an essential diagnostic and therapeutic tool for the orthopaedic surgeon. Key Words: Wrist—Arthroscopy—Kienböck’s disease—Fracture—Instability—Diagnosis.

Professor Kenji Takagi first reported large-joint arthroscopy in 1920.1 Hampered by large devices, it would be another 50 years before advances in technology allowed the design of small-joint instrumentation. The first wrist arthroscopy was described by Chen2 in 1979. In 1986 Roth et al.3 presented an “Instructional Course Lecture” on wrist arthroscopy at the American Academy of Orthopaedic Surgeons meeting, which brought wrist arthroscopy into mainstream orthopaedic surgery. Since then, wrist arthroscopy has continued to evolve as an essential diagnostic and therapeutic tool.4 Wrist arthroscopy now has a wide range of indications, and these continue to be extended as the principles of open surgical procedures become adapted to the arthroscope (Table 1). The purpose of this article is to outline some of the new developments and current techniques in the field of wrist arthroscopy.

**WRIST ARTHROSCOPY TECHNIQUE AND PORTALS: THE BOX CONCEPT**

Arthroscopic examination of the wrist should include the radiocarpal and midcarpal joints. Multiple portals are now described (Fig 1).5,6 Traditionally, the 3-4, 4-5, 6R, and midcarpal portals have been used as diagnostic and working portals.5,7 With the advent of new volar portals, it is now possible to have viewing and working portals that encircle the wrist.5,8,10 This enables the arthroscopic surgeon to view and instrument from all
The arthroscope and working portals can be adjusted to suit whatever diagnostic or therapeutic procedures are required.

**Our Surgical Technique:** General or regional anesthesia is preferred. The patient is supine on the operating table with the shoulder along the edge of the table (Fig 3; Video 1, online only, available at www.arthroscopyjournal.org). A tourniquet is placed above the elbow and inflated to 250 mm Hg. The shoulder is abducted 70° to 90°, and the forearm is suspended vertically (by use of finger traps) from an articulating arm attached to the operating table. A sling with 7 to 10 lb of weight is placed over the tourniquet to provide downward countertraction and thus distraction of the wrist joint. A 2.5-mm arthroscope is used with a 30° viewing angle. A short bridge arthroscope (lever arm of 100 mm) allows for easier control. The thumb is kept on Lister’s tubercle until the arthroscope has been introduced. Inflow (lactated Ringer’s solution) is gravity-fed (a pump is not required). Subsequent portals are made by use of an outside-in technique where the needle is introduced in the joint. The 6R portal is the commonly used radiocarpal portal. It is identified by use of transillumination and introduction of the needle radial to the extensor carpi ulnaris (ECU) tendon and distal to the triangular fibrocartilage complex (TFCC). A mini-open approach is used for the 1-2, 6U, and scaphoid-trapezoid-trapezium (STT) portals because of the proximity of the cutaneous nerves. An inside-out technique with an exchange rod for the volar radial portal is preferred (Video 2, online only, available at www.arthroscopyjournal.org). The radial midcarpal portal is in the soft spot 1 cm distal to the 3-4 portal. The ulnar midcarpal portal is introduced by use of the same transillumination technique.

### OPERATIVE PROCEDURES

#### Kienböck’s Disease

Historically, the radiologic classification of Kienböck’s disease of Lichtman et al. has been used to
assess the condition, although its reliability has been shown to be poor. Arthroscopy provides direct visualization and assessment of the pathology in the radiocarpal and midcarpal joints. The disparity between radiographic assessment and arthroscopic assessment has been highlighted by Ribak, who reported that plain radiographs were poorly correlated with arthroscopic findings. This was reinforced by Bain and Begg, who reported that it was not uncommon for plain radiographs to underscore the severity of the articular involvement identified with arthroscopy.

Wrist arthroscopy has become a valuable assessment and primary treatment tool in the treatment of Kienböck’s disease. The use of arthroscopy enables the surgeon to specifically identify the nonfunctional joints and tailor the surgical reconstructions to the anatomic findings. By specifically directing the treatment options to the findings identified, patient outcomes can be optimized.

We developed an arthroscopic classification system for the assessment of Kienböck’s disease (Fig 4). A normal articular surface has a glistening appearance with hard subchondral bone on palpation. Nonfunctional articular surfaces will have any one of the following: extensive fibrillation, fissuring, articular cartilage loss, loose floating articular cartilage pieces, or osteochondral fracture. The severity of the synovitis is not used as a specific grade but is an indication of the severity of the chondral changes (Video 3, online only, available at www.arthroscopyjournal.org).
This grading system assists in classifying the severity of the disease and better directs the surgeon toward the reconstructive surgical options. A patient with a grade 0 disorder could be treated with an extra-articular procedure, such as a joint-leveling procedure or revascularization of the lunate. Patients with grade 1 or 2a can be treated with a radio-scapho-lunate fusion. Patients with grade 1 or 2b can be treated with a proximal-row carpectomy, whereas those with grade 3 or 4 require salvage procedures (such as wrist arthrodesis or arthroplasty).14

Menth-Chiari et al.15 reported on the use of arthroscopic debridement for Kienböck’s disease. They reported excellent pain relief and improved range of motion in all grades of patients with up to 2 years of follow-up.

**TFCC Lesions**

Injury to the TFCC is a common cause of ulnar-sided wrist pain. Wrist arthroscopy has become the gold standard in the diagnosis and treatment of these injuries.16,17 Arthroscopy can assess the tear size and stability, as well as any associated synovitis and chondral or ligament lesions. The TFCC attaches to the sigmoid notch of the distal radius and spans across the ulna head to attach to the base of the ulna styloid.18 The function of the

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**Table 2. Arthroscopic Wrist Portals: Technique and Comment**

<table>
<thead>
<tr>
<th>Portal</th>
<th>Technique</th>
<th>Comment</th>
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<tbody>
<tr>
<td><strong>Dorsal</strong></td>
<td></td>
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</tr>
<tr>
<td>1-2</td>
<td>Inserted in the extreme dorsum of the snuffbox just radial to the EPL tendon to avoid the radial artery.5,6</td>
<td>Gives access to the radial styloid, scaphoid, lunate, and articular surface of the distal radius.</td>
</tr>
<tr>
<td>3-4</td>
<td>The portal is 1 cm distal to Lister’s tubercle between the tendons of the third and fourth compartment.</td>
<td>Main working portal. Gives a wide range of movement and view.</td>
</tr>
<tr>
<td>4-5</td>
<td>Between the common extensor fourth compartment and EI in the fifth compartment.</td>
<td>Usually the 6R portal is used in preference.</td>
</tr>
<tr>
<td>6R</td>
<td>Located distal to the ulna head and radial to the ECU tendon. This portal is established under direct vision of the arthroscopic by use of a needle. This avoids damage to the TFCC.</td>
<td>Main working portal.</td>
</tr>
<tr>
<td>6U</td>
<td>Established under direct vision similar to the 6R portal. Blunt dissection is always used to avoid the dorsal branches of the ulna nerve.</td>
<td>6U and 6R portals allow visualization back toward the radial side and access to the ulna-sided structures.</td>
</tr>
<tr>
<td>DRIJ</td>
<td>Forearm supinated to relax dorsal capsule. Arthroscope introduced into axilla between radius and ulna underneath the TFCC.</td>
<td>Gives a view of the DRIJ articulation.</td>
</tr>
<tr>
<td><strong>Midcarpal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCR</td>
<td>Soft depression palpated between proximal and distal carpal rows 1 cm distal to the 3-4 portal along a line bordering the radial edge of the third metacarpal.</td>
<td>Can be used to traverse to the STT joint, scapholunate articulation, and distal pole of the scaphoid.</td>
</tr>
<tr>
<td>MCU</td>
<td>Soft depression palpated between the proximal and distal carpal rows 1 cm distal to the 4-5 portal in line with the fourth metacarpal.</td>
<td>Allows visualization of distal lunate, lunotriquetral, and triquetral hamate articulation.</td>
</tr>
<tr>
<td>STT</td>
<td>Between EPL and ECRB in the midcarpal row. On the ulnar margin of the EPL tendon. Terminal branches of the radial sensory nerve at risk.</td>
<td>Used with the MCR portal for STT debridement.</td>
</tr>
<tr>
<td><strong>Volar</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VR</td>
<td>2-cm longitudinal incision overlying FCR on radial side of volar proximal wrist crease. FCR retracted ulnarly. Radiocarpal joint identified with needle, then port expanded with artery forceps. An inside-out technique can also be used here, between the RSC and LRL ligaments, staying to the radial side of the FCR tendon to avoid the median nerve.</td>
<td>Safe zone of 3 mm in all directions with respect to palmar cutaneous branch of median nerve (ulnarly) and radial artery (radially).</td>
</tr>
<tr>
<td>VU</td>
<td>2-cm longitudinal incision. FCU identified and retracted ulnarly with the ulna nerve. Interval between FCU and common flexor tendons. Needle inserted into joint, then expanded with artery forceps.</td>
<td>Both volar portals used to assist in reduction of distal radius fracture, with a view of the dorsal articular surface and dorsal ligaments.</td>
</tr>
<tr>
<td>DRIJ</td>
<td>Uses the same mini-open approach as for VU portal. Care taken to stay below the TFCC.</td>
<td>Gives a view of the DRIJ and deep-sided TFCC tears.</td>
</tr>
</tbody>
</table>

**Abbreviations:** EPL, extensor pollicis longus; EI, extensor indicis; DRIJ, distal radioulnar joint; MCR, midcarpal radial; MCU, midcarpal ulnar; ECRB, extensor carpi radialis brevis; FCR, flexor carpi radialis; RSC, radio-scapho-capitate; LRL, long radiolunate; FCU, flexor carpi ulnaris.
TFCC is both to stabilize (distal radioulnar joint and ulna-carpus) and to transmit load (20% of the total load in ulna-neutral variance). Only the peripheral 25% of the TFCC on the dorsal, volar, and ulnar margins is vascularized. The central and radial portions remain avascular. Lesions in these areas do not have the potential to heal and therefore are treated with debridement. The dorsal and volar ligaments (peripheral 2 mm) maintain stability of the TFCC, and it is crucial that these be preserved.

Palmer’s classification of TFCC injuries can be used to help guide treatment (Table 3). This divides lesions into type 1 (traumatic) and type 2 (degenerative). Type 1 lesions are classified according to the location of the tear.

Central tears (type 1A) are managed with arthroscopic debridement of the TFCC tear, performed with the arthroscope in the 6R portal and the instruments in the 3-4 portal. The 3.5-mm oscillating resector removes degenerative fibrocartilage and adjacent synovitis. The outcomes from this limited debridement are rewarding, with 80% to 85% of patients requiring no further surgery and having a good to excellent result. In those patients in whom there is a neutral or negative ulnar variance, arthroscopic debridement of the TFCC is all that is required. In patients who have a positive ulnar variance, additional procedures may be required (as described later).

A peripheral tear in the TFCC (type 1B) can be difficult to detect. A normal TFCC has tension within its substance when a probe is applied across it, referred to as the “trampoline effect.” Loss of this normal trampoline effect would indicate that there is a peripheral tear of the triangular fibrocartilage.

![Figure 4](https://example.com/figure4.png)

**Figure 4.** Arthroscopic classification of Kienböck’s disease. The grade for each wrist is dependent on the number of articular surfaces that are defined as nonfunctional. Grade 0 indicates a patient who has Kienböck’s disease identified on imaging, such as a magnetic resonance imaging scan, and may have associated synovitis identified on wrist arthroscopy but has intact articular surfaces. The usual progression of articular damage is from the proximal aspect of the lunate (grade 1) to the lunate facet of the radius (grade 2a). In those patients in whom there is a coronal fracture in the lunate, there will be involvement of the proximal and distal aspects of the lunate (grade 2b). In grade 3, there is further progression that involves both the proximal and distal aspects of the lunate and the lunate facet of the radius. Grade 4 involves all 4 articular surfaces (including the proximal capitate). (Reprinted with permission.)

**Table 3. TFCC Injuries: Classification and Management**

<table>
<thead>
<tr>
<th>Type of Tear</th>
<th>Description of Tear</th>
<th>Authors’ Management</th>
</tr>
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<tbody>
<tr>
<td>Traumatic</td>
<td></td>
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<tr>
<td>1A</td>
<td>Tear in horizontal or central portion of disk, often with an unstable flap</td>
<td>Initial splinting with or without steroid injection; arthroscopic debridement of central torn portion</td>
</tr>
<tr>
<td>1B</td>
<td>Tear from distal ulna insertion with or without ulnar styloid fracture</td>
<td>Arthroscopic repair; inside-out technique; with or without ECU sheath open repair</td>
</tr>
<tr>
<td>1C</td>
<td>Tear with ulnocarpal ligaments disrupted (ulnolunate and ulnotriquetral ligaments)</td>
<td>Arthroscopic-augmented repair by use of a mini-open approach with or without FCU augmentation</td>
</tr>
<tr>
<td>1D</td>
<td>Tear from insertion at radius</td>
<td>Debridement of torn portion or reattachment to sigmoid notch</td>
</tr>
<tr>
<td>Degenerative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2A</td>
<td>TFCC wear but no perforation</td>
<td>Diagnostic arthroscopy followed by open diaphyseal ulna shortening</td>
</tr>
<tr>
<td>2B</td>
<td>TFCC wear but no perforation Chondromalacia of lunate or ulnar head</td>
<td>Arthroscopic TFCC debridement plus arthroscopic wafer procedure or open diaphyseal ulna shortening</td>
</tr>
<tr>
<td>2C</td>
<td>Central perforation of TFCC Chondromalacia of lunate or ulnar head</td>
<td></td>
</tr>
<tr>
<td>2D</td>
<td>Central perforation of TFCC Chondromalacia of lunate or ulnar head Perforation of LT ligament</td>
<td></td>
</tr>
<tr>
<td>2E</td>
<td>Central perforation of TFCC Perforation of LT ligament Ulnocarpal arthritis</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: FCU, flexor carpi ulnaris; LT, lunotriquetral.
tients with a peripheral tear can be treated with either an outside-in or inside-out repair technique.\textsuperscript{23,25} Newer techniques using slotted cannulae, suture welding, and mini-incisions with arthroscopic assistance have also been developed.\textsuperscript{4,26,27}

**Our Surgical Technique:** We prefer to use the inside-out technique popularized by Poehling et al.\textsuperscript{25} with the use of a 14-gauge Tuohy needle and No. 2 polydioxanone sutures (Fig 5).\textsuperscript{23} When an unstable peripheral tear is associated with a fractured ulnar styloid, an open procedure must be performed to address the ulnar styloid fragment through either bony reattachment or fragment excision and reattachment of the TFCC to the remaining distal ulna. The ECU tendon sheath is intimately related to the dorsal aspect of the TFCC.\textsuperscript{28} A peripheral TFCC tear may be associated with ECU subluxation and require open reconstruction in addition to any arthroscopic procedures performed.

Type 1C lesions involve disruption of the TFCC from the ulnar extrinsic ligament complex. At arthroscopy, there will be laxity of the ulnar intrinsic ligaments, and the pisiform may be unusually easy to see because the adjacent ligaments are torn. These injuries are less common but more complex to manage.\textsuperscript{4} Augmentation with a flexor carpi ulnaris distally based strip (which is then brought to the dorsal aspect of the triangular fibrocartilage) can also be performed.

Type 1D radial-sided tears have a poor chance of healing. This is because of the relative avascularity of the radial side of the TFCC, as well as the fact that it attaches onto the articular cartilage of the sigmoid notch. Most of these tears are managed with arthroscopic debridement; however, a number of suture techniques have previously been described in the literature, with two thirds of patients having good to excellent results.\textsuperscript{4,29,30}

Type 2 TFCC lesions are degenerative tears that are often asymptomatic.\textsuperscript{31} Most symptomatic degenerative tears of the TFCC are related to chronic overloading of the ulnocarpal joint as a result of positive ulnar variance.\textsuperscript{4,32} The primary pathology in these cases is not limited to the TFCC itself but also to the sequelae of chronic ulnar impaction between the ulna and the carpus, with secondary damage to surrounding structures such as the lunotriquetral ligament or articular surfaces of the lunate, triquetrum, and distal ulna.\textsuperscript{4,18} When an arthroscopic debridement is being performed, the TFCC, adjacent synovitis, and chondral changes are all debrided. It is essential to preserve the peripheral 2 mm of the TFCC to maintain distal radioulnar joint stability.

If there is ulnar positivity, shortening of the ulna with either diaphyseal ulnar shortening or an arthroscopic wafer procedure should be performed. The arthroscopic wafer procedure involves resection of the prominent distal ulna through the TFCC tear.\textsuperscript{33-35} (Video 4, online only, available at www.arthroscopyjournal.org). Resection is continued until 2 to 3 mm of ulna is removed over the radial two thirds of the ulna to achieve an approximate −1.5 mm negative ulnar variance. Wnorowski et al.\textsuperscript{36} recommended that the wafer procedure be done to the level of the subchondral
bone, because this will unload the head of the ulna. The forearm is rotated from pronation to supination to visualize and resect the full circumference of the ulna head. Adequate resection is confirmed with fluoroscopy. Osterman\textsuperscript{35} reported pain relief in 73\% of patients and improvement in another 12\% of patients with this procedure (which is similar to the finding of good results in 78\% of wrists reported by Darrow et al.\textsuperscript{34} with ulnar shortening). The results of arthroscopic debridement of type 2 degenerative lesions have yielded good to excellent results in 75\% of cases with up to 5 years’ follow-up.\textsuperscript{37}

**Ulna Styloid Carpal Impaction**

Ulna styloid carpal impaction is an uncommon condition that has traditionally been managed with open excision of the ulna styloid.\textsuperscript{38} Arthroscopic techniques can also be used to resect the ulna styloid.\textsuperscript{39} The long ulna styloid can be easily identified at arthroscopy (Fig 6A). A fluoroscopy unit is used to confirm correct positioning of the bur, which is used to debride the ulna styloid under arthroscopic vision (Fig 6B). The TFCC is not violated, which ensures a more rapid rehabilitation.

**Distal Radius Fractures**

Wrist arthroscopy is now a valuable adjunct in the management of intra-articular distal radius fractures, both in assessing associated intercarpal ligament injury and improving the quality of joint surface reduction.\textsuperscript{40-44} It has been shown to be superior to intraoperative fluoroscopy and plain radiography in assessing joint surface reduction.\textsuperscript{45} Distal radius fractures with articular cartilage steps of less than 2 mm have less risk of developing degenerative osteoarthritis.\textsuperscript{46,47} Patients with arthroscopically assisted reduction of intra-articular distal radial fractures have been shown to have superior clinical outcomes, better range of motion, and improved radiologic variables (displacement and angulation), as compared with those undergoing fluoroscopically assisted reduction.\textsuperscript{44}

**Our Opinion:** With the advent of fixed-angle plating for the management of distal radius fractures, there has been a change in the utilization of wrist arthroscopy. In the past some we treated distal radius fractures with conminution with arthroscopy, percutaneous K-wires, and external fixators.\textsuperscript{47} These patients would now preferentially be treated with a fixed-angle plating system because we believe that this provides superior stability of the fracture. However, wrist arthroscopy still has a place in the management of some complex fractures. We have used it in those cases in which there is some doubt (after fluoroscopic assessment) as to whether the screws could be intra-articular. The arthroscope can be introduced by use of a volar portal with the use of the existing open volar surgical approach. An assessment of the articular reduction and associated soft-tissue ligamentous injuries can also be performed (Video 5, online only, available at www.arthroscopyjournal.org). We still use arthroscopic-assisted reduction for 2-part radial styloid fractures to assist in articular reduction and assessment of the scapholunate ligament,
which is often torn in this group of patients (Fig 7). Culp and Osterman reported good to excellent results in 85% of patients with arthroscopically treated radius fractures. They showed a mean grip strength loss of 20% and a flexion-extension loss of 20°.

The association of soft-tissue injuries with displaced distal radius fractures has been reported by a number of authors. These include tears of the TFCC (43%) and scapholunate (32%) and lunotriquetral (15%) ligament tears. Scapholunate and lunotriquetral tears are more common with intra-articular fractures, and TFCC tears are more common with extra-articular fractures.

**Arthroscopic-Assisted Reduction of Scaphoid Fractures**

Percutaneous fixation techniques have become increasingly popular for the management of scaphoid fractures. The concept of using wrist arthroscopy to assist in the treatment of scaphoid fractures was introduced by Whipple and subsequently reported by other authors. It is indicated for displaced but reducible scaphoid fractures and undisplaced but unstable fractures. The magnification provided by arthroscopy allows accurate assessment of fracture reduction. In addition, arthroscopy allows assessment of the other injuries within the carpus, including injuries to the interosseous ligaments and triangular fibrocartilage and osteochondral fractures.

It is our experience that arthroscopy is valuable in ensuring that there is correct rotation of the fracture. We have seen a number of scaphoid fractures that we considered to be simple and stable. However, when these were assessed arthroscopically, we have been surprised to find instability and associated chondral injuries. We find this to be one of the most technically demanding of the arthroscopic wrist procedures.

**Our Surgical Technique:** The wrist is initially examined and imaged with fluoroscopy. The line of the scaphoid is marked on the skin in both the coronal and sagittal planes (Fig 8). Attempted reduction of the fracture is performed (humpback deformity is reduced with wrist supination and extension). The wrist is then placed in the standard setup position. We find that the ulnar midcarpal portal best visualizes the reduction, because the radial midcarpal portal raises and opens the fracture. The fracture is reduced by use of joysticks in the proximal and distal poles and with the arthroscopic probe. A small volar incision is made at the distal end of the STT joint. The tuberosity of the scaphoid is identified through the volar approach, and the volar lip of the trapezium is excised with a rongeur to allow the correct line of access to the scaphoid. The K-wire is advanced into the scaphoid in the preassessed planes and confirmed to be satisfactory on fluoroscopy. It is common for the first K-wire to be incorrectly positioned. The best method is to leave the
first wire in place and to direct a second wire based on the 2-plane fluoroscopy images. Advancing the tip of the threaded wire to the cortex of the proximal pole of the scaphoid minimizes the chance of displacement. An extra derotation K-wire can be used if there is considerable rotatory instability.

Jigs can be used to stabilize the fracture and provide compression across the fracture before fixation. A K-wire can be positioned with accuracy with a cannulated screw insertion over the top. The other end of the jig is introduced through a 1-2 portal and positioned directly adjacent to the scapholunate ligament. Compression of the jig will stabilize the scaphoid. However, it is critical to assess whether reduction is obtained, because the jig may displace the fracture.

Fractures of the proximal pole of the scaphoid can also be managed with dorsal percutaneous fixation. A double-cut K-wire is advanced through the proximal pole of the scaphoid into the center of the circle identified on the fluoroscopy unit. It is advanced through the wrist to pierce the skin on the radial volar aspect of the thumb. This wire will likely be within the trapezium. The wire is withdrawn from the volar aspect so that the wrist can be extended. The position of the fracture and wire can now be better assessed with fluoroscopy and placed in the standard setup for wrist arthroscopy. Once correct wire positioning is confirmed, the wire is advanced from volar to dorsal. Over this wire, a cannulated headless screw is inserted into the scaphoid from the dorsal aspect.

Wrist arthroscopy is also useful in a proportion of scaphoid nonunions. Slade et al. reported on the use of arthroscopy in the assessment and management of selected scaphoid fibrous nonunions. Computed tomography scan showed well-aligned fractures with minimal sclerosis (<1 mm) and no cyst formation. Arthroscopy was used to confirm reduction and the presence of an intact cartilaginous envelope. The fracture was seen as a dark line on the articular cartilage, and probing revealed firm fibrous union. These authors recommended percutaneous compression screw fixation without bone grafting and had 100% union at 14 weeks in this group of patients.

Arthroscopic excision of the proximal pole of the scaphoid in patients with Preiser’s disease has been reported. Ruch et al. reported on arthroscopic radial styloidectomy and distal scaphoid excision for avascular necrosis of the proximal pole of the scaphoid with nonunion. There was improved pain and motion despite increased carpal collapse in their 3 patients.

**Chondral Lesions**

Arthroscopic debridement of chondral lesions in the wrist has been described in a number of anatomic sites. These include the STT joint, the radiocarpal joint in Kienböck’s disease, and the proximal pole of the scaphoid. Post-traumatic chondral lesions are not uncommon after wrist injuries including distal radius fractures. The patients who are most likely to obtain a good result with arthroscopic debridement are those with mechanical symptoms.

Patients with a type 2 lunate (with a second distal articular facet to articulate with the hamate) are at increased risk of degenerative osteoarthritis developing at the proximal condyle of the hamate. This is a less common cause of ulnar-sided wrist pain. The proximal condyle of the hamate can be debrided arthroscopically through a midcarpal ulna portal.
Assessment of Carpal Instability

Radiologic methods for assessing carpal instability include plain radiography, fluoroscopy, arthrography, computed tomography, and magnetic resonance imaging. Three-compartment arthrography will identify perforations of the intercarpal ligaments, but it does not provide accurate localization of the tears or the extent of instability. Arthroscopy has been shown to be more sensitive than magnetic resonance imaging in diagnosing intercarpal ligament and TFCC injuries.

Arthroscopy is now considered the gold standard for diagnosing carpal instability. It has the advantage of direct visualization of the scapholunate and lunotriquetral ligaments (Video 6, online only, available at www.arthroscopyjournal.org). The state of the ligament, the extent of the ligament injury, and whether it is a repairable ligament stump can be assessed directly. Associated hemorrhage, synovitis, chondral damage, and degenerative changes (e.g., radial styloid degenerative osteoarthritis) can also be visualized.

When infiltration into the midcarpal joint is being performed, a leakage of saline solution through the radiocarpal portals indicates that there must be a tear of the lunotriquetral ligament or scapholunate ligament. This is the same concept as that seen with an arthrogram where the midcarpal joint is injected and a leakage of contrast is seen in the radiocarpal joint on follow-up radiographs.

From the midcarpal joint, the degree of laxity between the scapholunate interval can be assessed. Geissler et al. described a classification for assessment of scapholunate instability (Table 4). This relies on identifying whether an arthroscopic probe can be placed into the scapholunate interval, whether it can be rotated, or whether a 2.7-mm arthroscope can be advanced between the scapholunate interval. In addition, the presence of a step between the scaphoid and the lunate can also be assessed. The functional significance of the ligament injury can be assessed as well—that is, the presence of a tear with or without associated significant instability (as identified in the midcarpal joint). Under the same anesthetic, a fluoroscopic assessment of the wrist can be performed. If this is performed before draping, then the opposite wrist can be used for comparison. This examination should include placing the wrist in a neutral position, moving to full ulnar deviation, applying an axial load, and also applying traction across the wrist to determine whether there is abnormal distal translation of the scaphoid.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Attenuation/hemorrhage of interosseous ligament as seen from the radiocarpal joint. No incongruence of carpal alignment in the midcarpal space.</td>
</tr>
<tr>
<td>II</td>
<td>Attenuation/hemorrhage of interosseous ligament as seen from the radiocarpal joint. Incongruence/step-off as seen from the midcarpal space. A slight gap (less than width of a probe) between the carpal bones may be present.</td>
</tr>
<tr>
<td>III</td>
<td>Incongruence/step-off of carpal alignment is seen in the radiocarpal and midcarpal space. The probe may be passed through the gap between the carpal bones.</td>
</tr>
<tr>
<td>IV</td>
<td>Incongruence/step-off of carpal alignment is seen in the radiocarpal and midcarpal space. Gross instability with manipulation is noted. A 2.7-mm arthroscope may be passed through the gap between the carpal bones (so-called drive-through lesion).</td>
</tr>
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The scapholunate instability test of Watson et al. can be performed under fluoroscopy or arthroscopic vision (or both). Abnormal widening of the scapholunate interval and subluxation or dislocation of the scaphoid over the dorsal rim of the distal radius can be identified.

Lunotriquetral instability can also be assessed by use of the same arthroscopic assessment techniques and specific provocation tests. Pressure is placed directly onto the pisiform and on the dorsal aspect of the lunate. By squeezing the lunate volarly and the triquetrum dorsally, lunotriquetral instability is identified. The wrist is taken through radial and ulnar deviation with direct visualization of the lunotriquetral articulation.

Post-traumatic Contractures

Verhellen and Bain reported on volar capsular release for contractures of the wrist. They recommended performing capsular releases in those patients who have restricted range of motion where the contracture is a result of the stiffness of the joint capsule.

Luchetti et al. reported that pain and restricted range of motion after distal radius fractures can be improved with arthroscopic debridement. This includes excision of scar tissue on the volar aspect of the radial carpal joint, leveling of articular steps, and debridement of TFCC and interosseous ligament tears. Other authors have also reported improvement after arthroscopic arthrolysis.

Our Surgical Technique: The volar capsular release is performed via the 3-4 and 6R portals. Release
of the volar capsule must preserve at least part of the radio-scapho-capitate ligament to minimize the chance of ulnar translocation. Knowledge of the major neurovascular structures is essential (Fig 9). To avoid causing injury, we do not instrument through the volar peri-articular fat (Video 7, online only, available at www.arthroscopyjournal.org). The dorsal capsule is also released through the same portals, although the volar portals (radial and ulnar) may be of assistance in examining the dorsal capsule. Because of the very close proximity of the extensor tendons to the dorsal capsule, we recommend placing a nylon tape through the 3-4 portal and “railroading it” between the dorsal capsule and the extensor tendons (Fig 10). Traction on this nylon tape then retracts the extensor tendons out of the way. Then, with the use of basket forceps introduced through the 3-4 portal, the dorsal capsule can be excised (Video 8, online only, available at www.arthroscopyjournal.org). We have used this technique in patients with post-traumatic capsular contractures (distal radius fractures and after open dorsal ganglion excision).

**Arthroscopic Resection of Wrist Ganglia**

The goal of arthroscopic ganglion resection is to reduce scarring and avoid any capsular wrist stiffness that may be associated with an open removal. In addition, any underlying instability of the intrinsic scapholunate ligament, implicated as causative for a dorsal ganglion, will be thoroughly assessed at the time of arthroscopy.

**Our Surgical Technique:** We use the technique as reported by Osterman and Raphael. The ganglion and standard portal sites are outlined with a marker. The arthroscope is placed in the 6R portal and instrumentation in the 1-2 portal. The ganglion is resected from the dorsum of the scapholunate ligament. Osterman and Raphael report that approximately two thirds of patients will have a visible pearl-like ganglion stalk. When such a stalk is not seen, the origin is assumed to be from the dorsal capsule, in which case synovitis is usually noted. A needle placed through the skin and extended into the stalk is used. A ganglion portal, almost always equivalent to the standard 3-4 portal, is established. A full-radius resector or basket punch is used to resect a 1-cm-diameter portion of dorsal capsule at the ganglion origin. Care should be taken to avoid injury to the scapholunate ligament and extensor tendons. Dorsal synovitis, when present, is debrided. In one third of cases, the underlying extensor tendons may be visible. The wrist is removed from the traction tower and re-examined. It is important to ensure that the extra-articular portion of the ganglion has been fully ruptured. Osterman and Raphael reported only 1 recurrence in their series of 150 patients.

**Complications**

Complications of wrist arthroscopy are uncommon, with authors reporting rates of approximately 2%. Most complications are related to the size of the...
instrumentation within a small joint space. Care must be taken with creation of portal sites because injury to the extensor tendons, radial artery, and branches of the radial and ulna nerve have all been reported. The extensor pollicis longus is the tendon most at risk during wrist arthroscopy. Other reported complications include infections and reflex sympathetic dystrophy and those relating to implanted material, such as sutures or K-wires. Skin lacerations on finger traps have been reported, and the use of flexible nylon finger traps has been advocated in those patients with very friable skin (e.g., rheumatoid arthritis patients).

CONCLUSIONS

Wrist arthroscopy is a relatively safe procedure that has undergone many advances since it was first described. It is now regarded as the gold standard in the diagnosis and treatment of a variety of conditions. Its clinical applications continue to expand, with more complex reparative, reconstructive, and salvage procedures now being performed. Further advances are likely to occur from adapting open reconstructive procedures into an arthroscopic model.

REFERENCES

36. Wnorowski DC, Palmer AK, Werner FW. Anatomic and bio-