Technical Note

Wrist Arthroscopy: Positioning, Portal Placement, and Diagnostic Evaluation

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Abstract: Wrist arthroscopy can be an invaluable technique with both diagnostic and therapeutic utility for surgeons treating pathologies of the wrist. Its use has increased in recent years for a myriad of diagnoses. Understanding the foundations of the preparation for and performance of diagnostic arthroscopy is critical to the successful execution of arthroscopic treatment of pathologies of the wrist. This Technical Note aims to describe a reproducible surgical technique for wrist arthroscopy, including patient positioning, portal placements, and diagnostic evaluation.

The foundation of wrist arthroscopy dates to the 1800s, when beeswax candles were used for illumination with primitive scope designs. Since then, scope designs have evolved in light source and size, allowing for introduction to the wrist joint first described by Burman (United States) in the 1930s. After the development of the breakthrough No. 24 arthroscope (1.7 mm), wrist arthroscopy became more popular and grew at a rapid pace.[1] This arthroscope provided greater viewing angles, demonstrated easier maneuver capabilities, and made wrist joint arthroscopy more practical, which allowed for Chen's (Japan) case series of 90 wrist arthroscopies in 1979.[2] Today, advancements in wrist arthroscopy give rise to a wide range of surgical procedures, including diagnostic evaluation, debridement, ligament repair or reconstruction, and fracture fixation.[3] In comparison to an open surgical approach, wrist arthroscopy has advantages of reduced intraoperative bleeding and recovery time and smaller incisions.[4] These benefits make wrist arthroscopy a more favorable surgical approach for some pathologies, which resulted in an 8-fold increase in its procedure rates from 1997 to 2014.[5]

This Technical Note aims to describe a reproducible surgical technique for wrist arthroscopy, including patient positioning, portal placements, and diagnostic evaluation.

Indications

Wrist arthroscopy is a useful tool in the armamentarium of the hand and wrist surgeon in the evaluation and treatment of several conditions. Indications to perform wrist arthroscopy include acute and chronic tears of the triangular fibrocartilage complex (TFCC), ulnocarpal abutment syndrome, carpal instability, scaphoid and distal radius fractures, ganglion cysts, synovial chondromatosis, intra-articular loose bodies, carpal avascular necrosis, sepsis of the wrist, wrist contracture, and assessment of arthrosis about the wrist.[3,6]

Surgical Technique

Patient Positioning

Wrist arthroscopy is typically performed under general anesthesia or regional anesthesia and sedation. Proper positioning is vital to the success of wrist arthroscopy. Thus, the surgeon and operative team should ensure attention is paid to this process. The patient is positioned supine with a hand table with a leg to support the end of the hand table. The shoulder is abducted 90° and the elbow flexed to 90°. The arm is prepped from fingertips to shoulder. A sterile tourniquet is placed to the brachium (Fig 1). A device used to aid with distraction of the radiocarpal joint is used. A

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Fig 1. Operative image of a left arm with the patient in the supine position prepped and draped and a brachial tourniquet applied in preparation for wrist arthroscopy.

common commercially available construct is the Arc Wrist Tower (Acumed LLC). Prior to moving the tower to the hand table, the surgeon and/or a member of the operating team should confirm that all parts are present

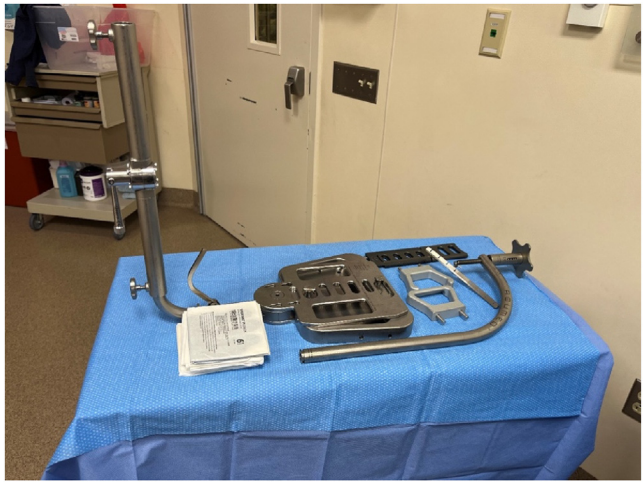

Fig 2. Operative image of a distraction tower partially assembled on the back table in preparation for wrist arthroscopy.

Fig 3. Operative image of left upper extremity positioned in a distraction tower in preparation for wrist arthroscopy with the patient in the supine position. Two digits are placed in finger traps to pull distal traction.

and in good working order (Fig 2). When transferring the tower to the hand table, it should be carried by the base, not by the vertical arm, to prevent inadvertent disassembly of the arm from the base. With this system, an arm strap is used to secure the brachium to the base of the tower (strap placed over the sterile tourniquet), and a forearm strap is also applied to secure the antebrachium to the sliding forearm support. Care should be taken to ensure that the edges of the straps do not impinge on the skin. One technique to mitigate this issue is to place an operating room towel around the extremity under the strap. Finally, finger traps are placed to at least 2 of the fingers, commonly the index and middle or ring fingers, in order to attach to the

Fig 4. Operative image of a left wrist positioned in a hand plate for wrist arthroscopy with the patient in the supine position.

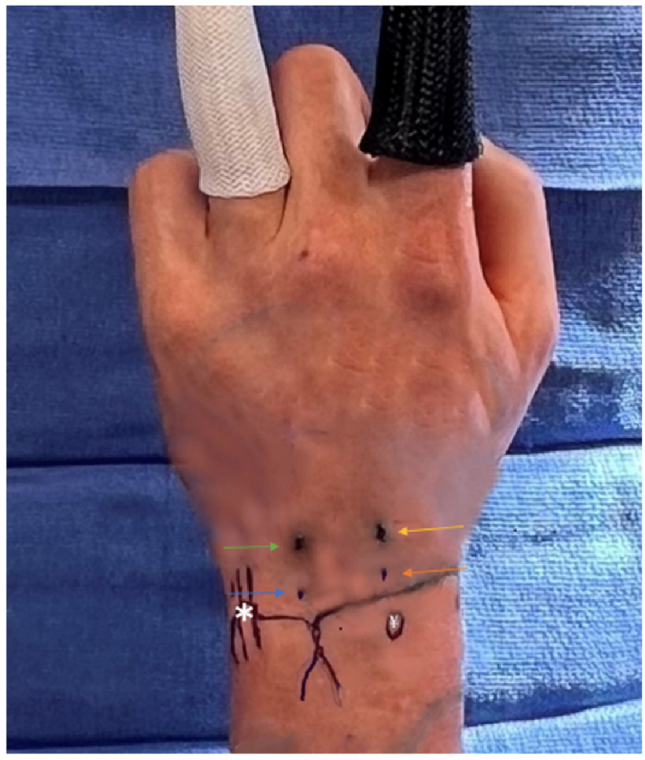

Fig 5. Dorsal view of a left wrist in finger traps for distraction with the patient in the supine position, demonstrating the 3-4 portal (orange arrow), 4-5 portal (blue arrow), radial (yellow arrow) and ulnar (green arrow) midcarpal portals, and 6-U portal marked out. *Extensor carpi ulnaris. ¥Lister's tubercle.

finger trap bar. It is imperative that the finger traps are placed proximal to the proximal interphalangeal joints so that prolonged traction force is not applied to these joints as this may result in digital stiffness. Typically, no more than 10 lbs. of traction should be applied. Once slight distraction is noted at the metacarpophalangeal joints of the digits in the finger traps, it is typically a suitable amount of traction to access the radiocarpal and midcarpal joints. Slight flexion of the wrist may be applied to facilitate access to the intra-articular space. This can be achieved by adjusting the wrist joint on the arm of the tower (Fig 3).

An alternative device that may be used to provide distraction for wrist arthroscopy is the Trimano with the hand plate attachment (Arthrex). With this system, the sliding rails are placed between the digits, and the plate is attached to the articulating Trimano system (Fig 4). An assessment is then made to determine if the weight of the arm provides enough distraction through the joint. If additional traction is needed, a weighted stockinette can be applied to the brachium. This construct is one that is useful in both an operating room setting and an in-office procedure room where diagnostic arthroscopy and debridement can be performed under local anesthesia without a tourniquet.[7]

Portal Placements

When determining portal placement, it is helpful to mark out the relevant landmarks (Fig 5).

The 2.7-mm Wrist Arthroscope

The traditional wrist arthroscope is the 2.7-mm 30° arthroscope. The standard 3-4 viewing portal is established first. This is identified by palpating Lister's tubercle, the bony prominence on the dorsal aspect of the distal radius. Approximately 1 cm distal to this is the interspace between the third and fourth extensor compartments, which is a palpable concavity. A 22-gauge needle with an attached 10-mL syringe is inserted into this space, and 5 to 10 mL of normal saline is injected to distend the joint. Typically, removal of the syringe from the needle will result in some backflow of saline if the needle is indeed within the joint. However, this may not be present if there is a large central tear of the TFCC. The needle is removed and a No. 11 or No. 15 blade is used to make an incision through the skin. To protect the extensor tendons and dorsal sensory nerves, a small hemostat is then used to bluntly spread to the joint capsule. Keeping in mind the patient's volar

Fig 6. Operative image of a left wrist in traction with the patient in the supine position demonstrating arthroscope placement into the joint, maintaining the angle of the volar tilt of the distal radius while entering the joint.

tilt of the radius, the hemostat or the camera sheath with the blunt trocar inserted is used to enter the joint capsule (Fig 6). The trocar is removed, and the camera placed into the sheath, ensuring it is fully seated, often indicated by it "clicking" into place. With standard wrist arthroscopy, normal saline is introduced through the side port on the cannula through arthroscopy tubing with gravity feed or through an arthroscopy pump calibrated for wrist arthroscopy.

Next, it is helpful to establish an outflow portal. Commonly, the 6-U portal is used for this purpose. This portal is so named as it is at the ulnar aspect of the sixth dorsal compartment, which contains the extensor carpi ulnaris. There is a soft spot just ulnar to extensor carpi ulnaris where an 18-gauge needle can be placed at the level of the joint line under direct visualization. This needle can be left in place as an outflow cannula. A

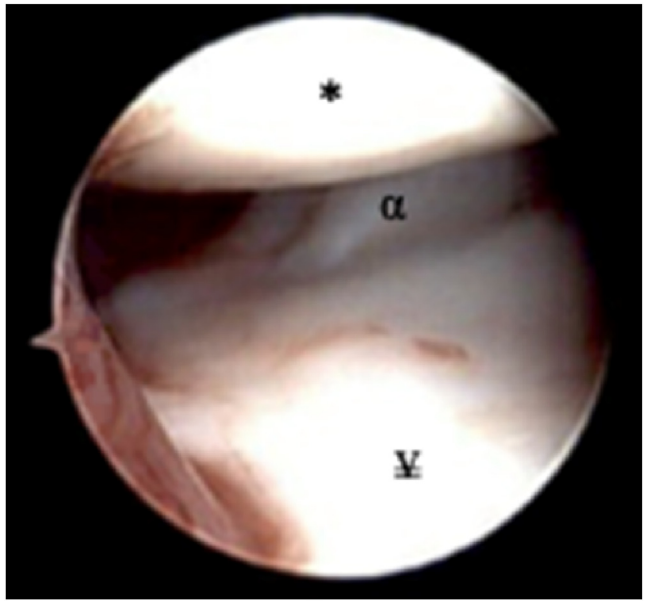

Fig 7. Arthroscopic image of a right wrist in finger trap traction with the patient in the supine position viewing from the 3-4 portal, demonstrating the scaphoid*, radius[¥], and radioscapholunate ligament[α].

basin can be placed on the table beneath this to collect the outflow. Alternatively, intravenous tubing can be attached to the hub of the needle and flow directed through the tubing to a basin on the table.

The 4-5 working portal is then established under direct visualization using a similar technique as that

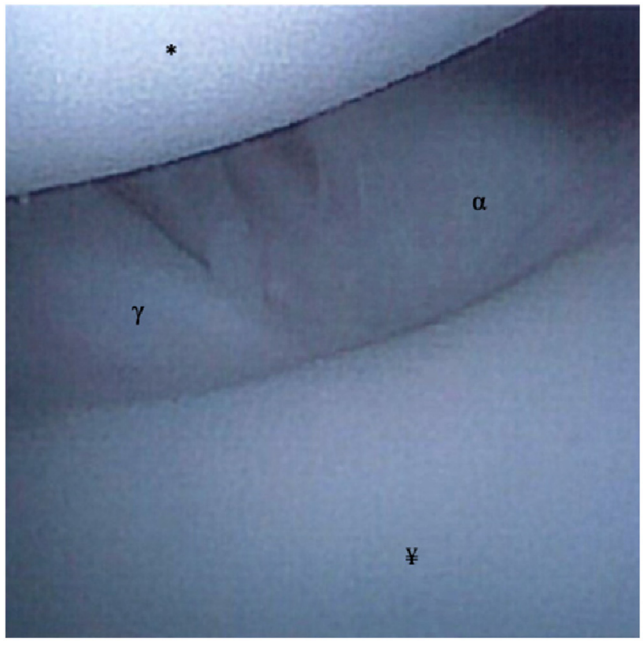

Fig 8. Arthroscopic image of a left wrist in finger trap traction with the patient in the supine position viewing from the 3-4 portal. Scaphoid*, radius[¥], radioscapholunate[α], and long radiolunate[γ] in view.

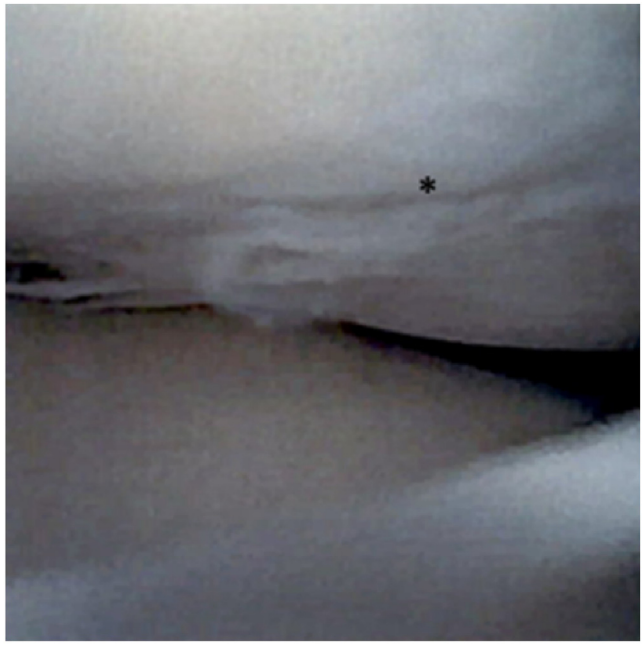

Fig 9. Arthroscopic image of a right wrist in finger trap traction with the patient in the supine position with membranous fraying of the scapholunate interosseous ligament* as viewed from the 3-4 portal.

Fig 11. Arthroscopic image of a right wrist with the patient in the supine position viewing from the 3-4 portal while establishing the 4-5 portal. Lunate and triangular fibrocartilage complex** in view.

described for the 3-4 portal, starting with placing an 18-gauge needle to ensure proper positioning prior to making an incision. The 4-5 portal is between the fourth and fifth dorsal compartments containing the EDC and extensor digiti minimi, respectively. Again, a sulcus can be palpated, and it is typically slightly more proximal than the 3-4 portal due to the typical radial inclination and decreased radial height as one moves more ulnarly on the wrist. Once this portal is established, a probe can be inserted for palpation of the

Fig 10. Arthroscopic image of a right wrist in finger trap traction with the patient in the supine position viewing from the 3-4 portal with intact scapholunate interosseous ligament*; scaphoid left and lunate right.

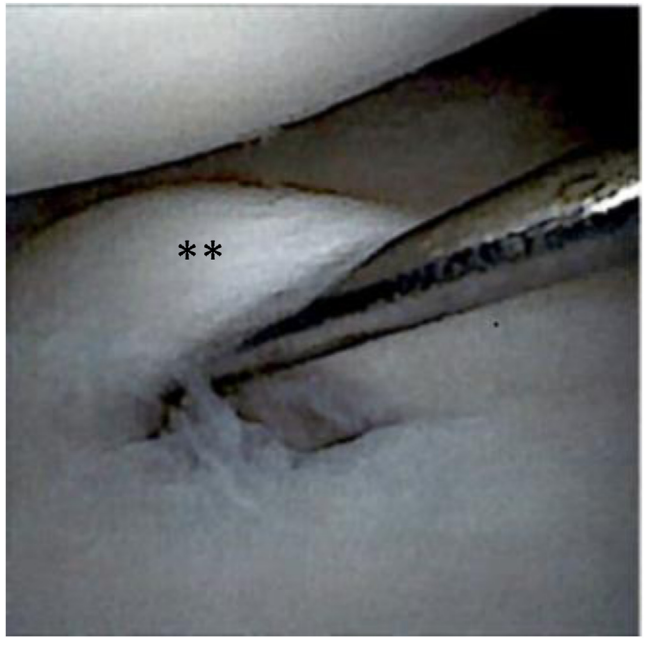

Fig 12. Arthroscopic image of a right wrist with the patient in the supine position viewing from the 3-4 portal with a probe in the 4-5 portal elevating a central tear in the triangular fibrocartilage complex**.

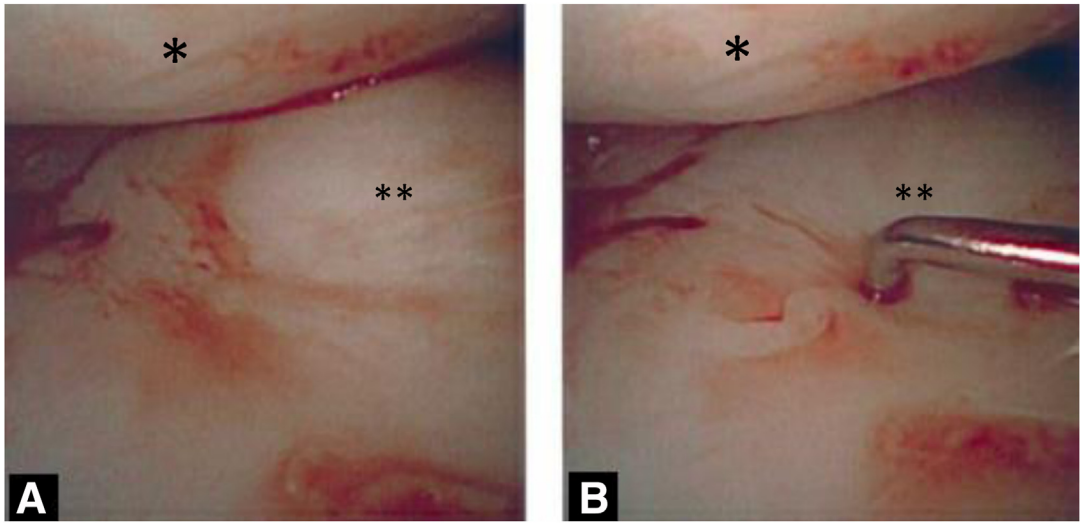

Fig 13. Arthroscopic images of a right wrist demonstrating dry arthroscopy with the patient in the supine position viewing from the 3-4 portal (A) and with probe in the 4-5 portal assessing the triangular fibrocartilage complex** (B). *Luante.

TFCC, articular cartilage, and scapholunate interosseous ligament (SLIL). It can then be exchanged for additional arthroscopic instruments such as the shaver, grasper, biter, and/or burr, as indicated by the intra-articular pathology.

Diagnostic arthroscopy of the radiocarpal and ulnocarpal joints can reliably be performed through these portals. Additional accessory/advanced portals, including the 6-R, 1-2, volar radial, and volar ulnar portals, are beyond the scope of this review.

Assessment of the midcarpal joint is also a key component of diagnostic wrist arthroscopy. The radial midcarpal and ulnar midcarpal portals are used for assessment of this joint. The radial midcarpal portal is established first and is found approximately 1 cm distal to the 3-4 portal. An 18-gauge needle is placed into this space perpendicular to the forearm axis, just distal to

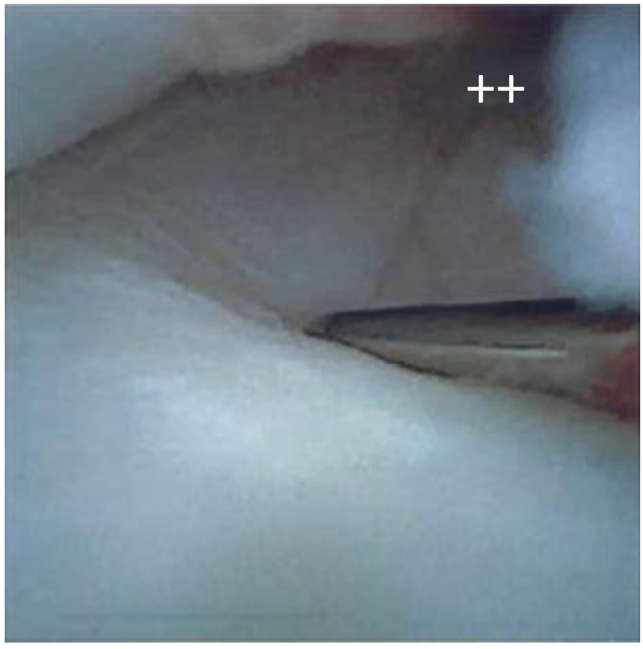

Fig 14. Arthroscopic image of a right wrist in finger trap traction with the patient in the supine position viewing from the 3-4 portal with a probe in the 4-5 portal demonstrating a peripheral triangular fibrocartilage complex (TFCC) tear++. When the probe is used to compress the TFCC and there is not a prompt bouncing back of the disc, it is considered a positive test, concerning for a peripheral TFCC tear.

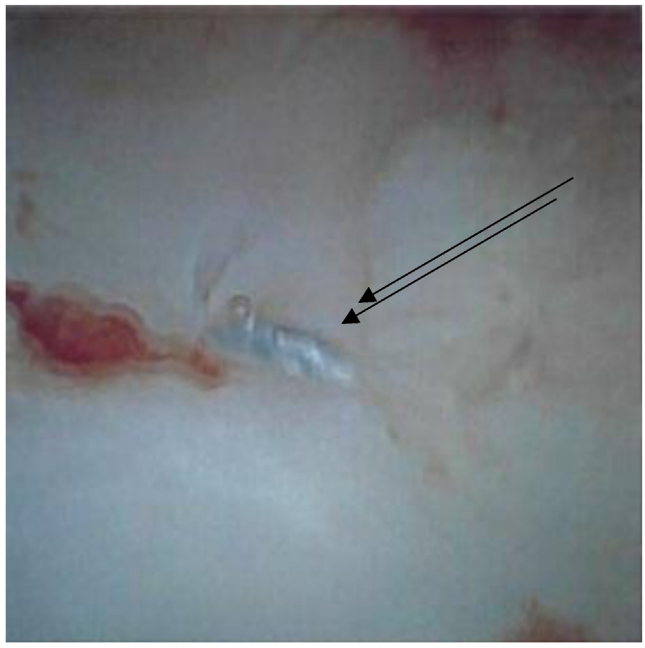

Fig 15. Arthroscopic image of a right wrist with the patient in the supine position in finger trap traction viewing from the 3-4 portal demonstrating a suture repair of the triangular fibrocartilage complex (arrow).

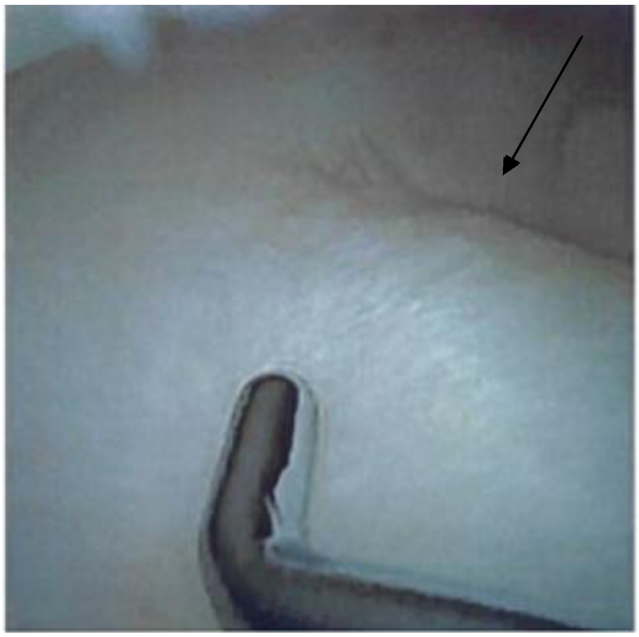

Fig 16. Arthroscopic image of a right wrist with the patient in the supine position viewing from the 3-4 portal demonstrating a stable (for comparison, see Fig 14) triangular fibrocartilage complex after repair (arrow).

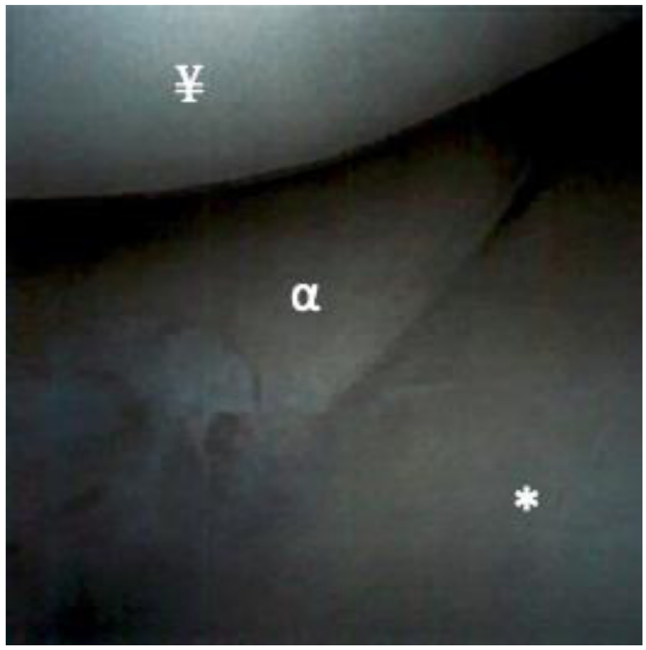

Fig 18. Arthroscopic image of a left wrist with the patient in the supine position viewing from the radial midcarpal portal. Capitate[¥], scaphoid*, and lunate[α] in view.

the scapholunate ligament and proximal to the capitate. The aforementioned "nick-and-spread" technique should be used to protect the dorsal extra-articular structures and the arthroscope inserted. After assessment of the radial-sided structures described below, the ulnar midcarpal portal is established in a similar fashion. It is approximately 1 cm distal to the 4-5 portal and directly distal to the lunotriquetral ligament. Given the narrowness of these articulations, it is important to have adequate traction through the finger traps, ensuring that no more than 10 lbs. of traction is applied.

The 1.9-mm Wrist Arthroscope

Advancements in imaging technology have resulted in the development of an arthroscope that can be inserted without a formal incision due to its small size. When using the 1.9-mm arthroscope, the same portals

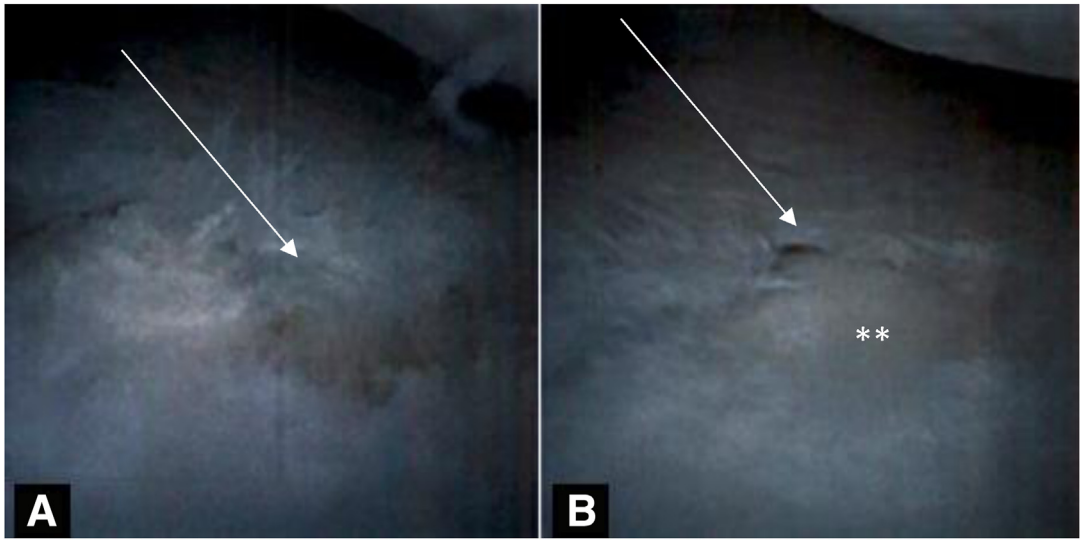

Fig 17. Arthroscopic image of a left wrist with the patient in the supine position viewing from the 3-4 portal demonstrating a central triangular fibrocartilage complex tear before (A) and after (B) debridement with ulnar head visible**. It is through this defect where the arthroscopic wafer procedure can be performed in patients with ulnocarpal impaction syndrome with mild ulnar positive variance.

Fig 19. Surgical table with the array of arthroscopic instruments for wrist arthroscopy. (a) Small hemostat. (b) No. 15 scalpel. (c) Curved cannula. (d) Straight cannula with sharp trocar in place and syringe attached to side port. (e) Flexible blunt trocar. (f) Arthroscopic suction biter. (g) Variety of 2-mm curved and straight graspers and biters. (h) Retractable probe. (i) A 1.9-mm arthroscope. (j) Spinal needle. (k) Arthroscopic shaver. (l) Cannula with obturator.

noted above are used. The technique for insertion can be modified to a more percutaneous technique, and less traction is required to atraumatically maneuver through the intra-articular spaces. However, the dorsal extra-articular structures, extensor tendons, and dorsal sensory nerves still need to be protected.

"Wet" Versus "Dry" Arthroscopy

Traditional arthroscopy involves continuous instillation of fluid into the joint through the arthroscopic sheath. Dry arthroscopy involves assessment of the joint without the continuous instillation of fluid into the joint. Advantages of this technique include the ability to perform wrist arthroscopic analysis without fluid extravasation, which is of particular importance in cases such as distal radius fractures. Further, floating synovial villi do not obscure the view. When performing arthroscopic bone grafting, one has more control of the bone graft in the "dry" environment. Disadvantages include the shavers and burrs clogging more easily, fogging of the lens, and radiofrequency probes not indicated for use.[8]

Diagnostic Evaluation

The diagnostic evaluation of the radiocarpal joint should be consistently conducted in a systematic manner. Once the 3-4 viewing portal is established, the diagnostic arthroscopy is started at the tip of the radius. Distal to this is the proximal pole of the scaphoid (Fig 7). Viewing the volar capsule, the radioscaphocapitate ligament, the long radiolunate, and then the short radiolunate ligaments, as well as the radioscapholunate ligament (ligament of Testut), are seen from radial to ulnar (Fig 8). In the superior portion of the screen, again, the proximal pole of the scaphoid is seen. As the arthroscope is moved ulnarly, the SLIL is visualized, and then the proximal aspect of the lunate is also inspected for articular wear (Fig 9). When intact, the SLIL appears as a continuous white structure forming a smooth cleft between the scaphoid and the lunate (Fig 10). At this point, the 4-5 portal can be created under direct visualization as noted above (Fig 11). To move the arthroscope further ulnar atraumatically, it can be advanced volarly at the level of the SLIL and then gently passed ulnarly beneath the proximal aspect of the lunate. The TFCC then comes into view (Fig 12). With the probe in the 4-5 portal, the hook test and trampoline sign can be performed to assess the integrity of the TFCC (Figs 13-16). The radial insertion, central disk, ulnar attachments, and the volar and dorsal distal radioulnar ligaments can be assessed; also, the pisotriquetral orifice and the prestyloid recess can be appreciated (Fig 17).

Once this portion of the diagnostic arthroscopy is complete, the midcarpal portals are created as described above. From the radial midcarpal portal, the capitate will appear at the superior part of the screen and the scaphoid and lunate at the inferior part of the screen (Fig 18). Moving radially, the scaphotrapziotrapezoid joint can be visualized. Assessment of the SLIL is performed by moving the arthroscope more proximally and centrally. Instability can be gauged by creating a gap between the scaphoid and the lunate with the end of the arthroscope. If the arthroscope does not pass easily between the scaphoid and lunate, the hook probe in the ulnar midcarpal portal is used to estimate inducible gapping between the scaphoid and the lunate (Geissler classification). Looking volarly, the radial limb of the radioscaphocapitate can be seen. As the arthroscope is moved ulnarly, the proximal capitate, distal lunate, and the capitohamate and lunotriquetral joints can be seen. Placing the arthroscope in

Table 1. Potential Complications of Wrist Arthroscopy and Stratigies to Avoid Them

Potential Complication	Strategy to Avoid
Postoperative PIP joint stiffness	Ensure that finger traps (or other traction device) are secured proximal to the PIP joints.
MCP joint pain	Avoid overdistraction of the MCP joints. This can be assessed by the amount of distraction in pounds (<10 lbs.). It can also be assessed by palpating the MCP joints. Once slight distraction is palpated at the MCP joints, distraction should be sufficient.
Iatrogenic articular cartilage damage	Ensure proper distraction of the joint. Preoperatively, study the angulation of the radius and mirror this angulation when placing instrumentation. Consider use of a smaller arthroscopic camera and instrumentation.
Compartment syndrome (particularly a concern when using arthroscopy in the setting of acute/subacute trauma where the wrist capsule is disrupted)	Consider using the "dry" arthroscopy technique
Injury to the dorsal sensory branch of the ulnar nerve	This nerve is an average of 8 mm from the 6R portal and is at risk with establishment of the 6U and 6R portals. Use the "nick-and-spread" technique for portal placement and make a small open incision when tying knots for TFCC repair.
Injury to the superficial branch of the radial nerve	This nerve is an average of 16 mm from the 3-4 portal. Use the "nick-and-spread" technique for portal placement.
Extensor tendon injuries (most commonly EPL and EDM)	Ensure palpation of the "soft spot" prior to portal placement, and if using a 2.7-mm arthroscope, use the "nick-and-spread" technique to ensure clearance.

EDM, extensor digiti minimi; EPL, extensor policis longus; MCP, metacarpal phalangeal; PIP, proximal interphalangeal; TFCC, triangular fibrocartilage complex.

the ulnar midcarpal portal allows assessment of the distal scaphoid, lunate, and triquetrum as well as the proximal capitate and hamate. The lunotriquetral interosseous ligament integrity can also be assessed in a similar fashion to the SLIL. Based on the findings of the diagnostic arthroscopy, a variety of instruments designed for small joint arthroscopy exist to treat the identified pathology (Fig 19). The full setup and technique is demonstrated in Video 1. Potential complications of wrist arthroscopy and strategies to avoid them are outlined in Table 1.

Discussion

Wrist arthroscopy can be a useful tool in one's armamentarium in the diagnosis and treatment of wrist pathology, providing views of and access to the intra-articular spaces of the wrist that are otherwise difficult to achieve without widely open approaches. To be successful with wrist arthroscopy and mitigate iatrogenic injury, a clear understanding of the topographical and 3-dimensional spatial anatomic relationships in the wrist as well as a patient's unique anatomic variances is critical.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: J.A.V.N. is a board member of the American Orthopaedic Association, American Society for Surgery of the Hand, Society of Military Orthopaedic Surgeons, *Arthroscopy Journal*, and *Current Orthopaedic Practice*; is a consultant or advisor for Arthrex and Oak Ridge Institute for Science and Education; and has received funding grants from Axogen, Henry M. Jackson Foundation for the Advancement of Military Medicine, Musculoskeletal Transplant Foundation, and Coulter Foundation. C.W.N. is a board member of the American Academy of Orthopaedic Surgeons, American Orthopaedic Society for Sports Medicine, and Arthroscopy Association of North America; is an employee and editorial board member of *Arthroscopy Journal*; is a consultant or advisor for Arthrex, Vericel, and Guidepoint; and has received speaking and lecture fees from Arthrex and Vericel. All other authors (B.J.V., A.B.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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