

The Needle-and-Knife Technique



A Safe Technique for Anterolateral Portal Placement in Elbow Arthroscopy

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Investigation performed at the Mayo Clinic, Rochester, Minnesota, USA

Background: Safe and effective portal placement is crucial for successful elbow arthroscopy. Various techniques for anterolateral portal placement in elbow arthroscopy have been described, yet radial nerve injuries are commonly reported.

Purpose: To report on the technique and safety of anterolateral portal placement by the needle-and-knife method and its clinical applications.

Study Design: Case series; Level of evidence, 4.

Methods: A retrospective review was completed of patients who underwent an arthroscopic procedure in the anterior compartment of the elbow and anterolateral portal placement. Patients were evaluated immediately postoperatively and at subsequent visits and were monitored for signs of radial nerve injury.

Results: A total of 460 patients met the inclusion criteria, of which 309 (67%) underwent the needle-and-knife technique. There was 1 case (0.3%) of temporary radial nerve palsy. For the remaining 151 patients who underwent anterolateral portal placement by other techniques, there were 2 cases of temporary radial nerve palsy (1.3%). There were no cases of the needle-and-knife technique being unsuccessful or abandoned in lieu of a different technique. Use of the needle-and-knife technique increased over time with experience and practice. Initially, contraindications to this technique included impaired view of the lateral side of the anterior compartment of the elbow caused by severe intra-articular scar (65%), extensive synovitis (10%), or large osteophytes or loose bodies (10%). For the remaining patients (15%) who did not have portals placed via the needle-and-knife technique, alternate techniques were used for teaching purposes.

Conclusion: The needle-and-knife technique is reproducible and easy to perform by a clinician instructed in its use and trained in elbow arthroscopy. Its main advantage is that it permits the surgeon to safely slide the knife along the lateral supracondylar ridge, releasing the scarred capsule and thereby increasing the available space in which to work. Enlarging the working space inside scarred and contracted elbows cannot be accomplished by distending the capsule.

Keywords: anterolateral portal placement; elbow arthroscopy; needle-and-knife technique; elbow

Advances in techniques and instrumentation have expanded the indications for elbow arthroscopy as a safe and effective treatment for multiple elbow pathologies.^{2,3,19,22} Elbow arthroscopy is technically challenging and has a degree of risk for nerve injury.^{13,17,18,21,25} Safe and effective portal placement is crucial for successful elbow arthroscopy. Sometimes, particularly in elbows with significant scarring and contracture, entry into the joint can be difficult and portal placement challenging. The anterolateral portal is directly anterior to the radiocapitellar joint articulation. At that level in the arm, the radial nerve lies directly anterior to the center of radial head. In cadaveric studies, the distance from the portal to the nerve was

reported to range from 0 to 30 mm.^{1,6,8,16,23-25} The radial nerve shifts medially (further from the portal) during flexion and laterally during extension.¹¹ This distance is the lowest with the arm in extension and midpronation and greatest in 90° of flexion and pronation.²⁴ It also increases with joint insufflation. Radial and posterior interosseous nerve injuries caused by placement of the anterolateral portal have been reported.^{5,7,10,12}

The purpose of this study was to report on the technique and safety of anterolateral portal placement by the needle-and-knife technique and its clinical applications.

METHODS

After internal review board approval, a series of patients who underwent elbow arthroscopy by a single surgeon (S.W.O.D.) during a 9-year period (2004-2012 inclusive)

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were reviewed retrospectively. All patients with anterior elbow arthroscopy were documented, with particular attention to those who underwent anterolateral portal placement and had postoperative nerve complications. The inclusion criteria were the requirement for anterior elbow arthroscopy with placement of an anterolateral portal. The exclusion criteria were the exclusive use of posterior compartment elbow arthroscopy and/or no anterolateral portal placement.

Postoperative follow-up was performed in recovery, on day 3 prior to discharge, and at each subsequent follow-up visit. The patients were asked about any sensory disturbance in the forearm and hand. The physical examination included testing light-touch sensation and motor nerve function in the distributions of the ulnar, median, and radial nerves. Specific to the radial nerve, finger, thumb, and wrist extension were tested in addition to the sensation of the dorsal first web space and the dorsal aspect of the forearm.

Needle-and-Knife Technique for Creating the Anterolateral Portal

The locations of all arthroscopic portals were as described by Yamaguchi et al.²⁶ With a few exceptions, arthroscopic surgery in the anterior compartment of the elbow was performed after any necessary procedures in the posterior compartment were completed. Prior to the insertion of any instruments into the anterior compartment of the elbow, skin incisions were made for the anterior portals. The anterolateral portal was placed immediately anterior to the articulation of the radial head with the capitellum, which was identified by palpation while the forearm was rotated. Its proximal-to-distal location was first localized by palpating the articulation posteriorly, where it is substantially easier to feel than anteriorly (see the Video Supplement for this technique). The arthroscope was placed in the proximal anteromedial portal. A retractor should be used as necessary through the proximal anterolateral portal to retract the capsule anteriorly to expose the radiocapitellar joint and lateral capsule.

A spinal needle was inserted through the skin incision for the anterolateral portal and into the joint (Figure 1). As a routine, no attempt was made to feel for bones with the needle. However, in tighter spaces, we routinely pointed slightly posteriorly to hit the side of the capitellum and “walk forward” onto the capsule. The orientation of the needle was adjusted until it lay directly anterior to the radiocapitellar articulation, pointing toward the tip of the arthroscope. The needle remained inside the joint and rested in the desired position and direction for the scalpel

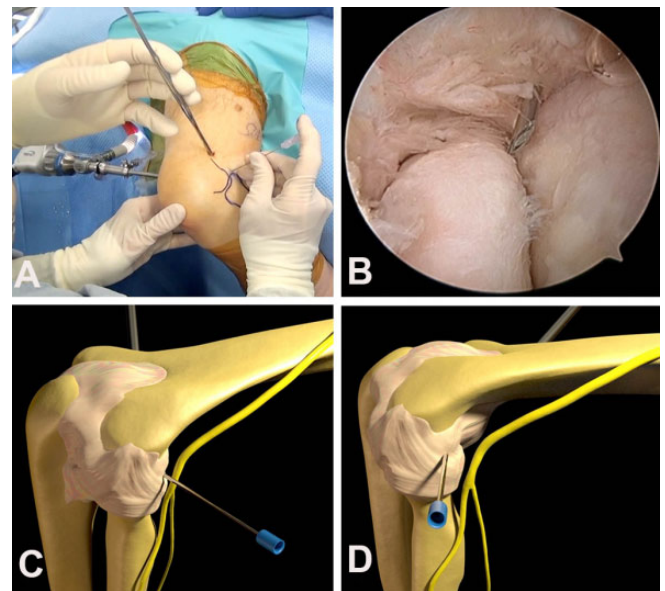


Figure 1. (A) Intraoperative photograph of insertion of spinal needle into the anterolateral portal oriented such that the needle lies directly anterior to the radiocapitellar articulation and points toward the arthroscope. The arthroscope is placed in the anteromedial portal, and the retractor is placed in the proximal anterolateral portal. (B) Arthroscopic view of needle positioning. (C) Animation of needle positioning relative to the radiocapitellar articulation. (D) Lateral animation view showing needle position relative to the radial nerve. Used with permission of LBOFXR. All rights reserved.

blade. The assistant was asked to hold the needle and maintain that position and orientation.

The surgeon then took a scalpel with a No. 11 or No. 15 blade and placed the knife adjacent and parallel to the needle outside the elbow, with the blade rotated into the sagittal plane and the sharp edge oriented proximally. After confirming that the position of the needle inside the joint was still correct, the operating surgeon then mentally fixed, in 3-dimensional space, the precise position and orientation of the needle. On command, the assistant withdrew the needle straight out of, and away from, the elbow in line with its original direction. The operator then moved the scalpel forward into the position occupied by the needle, sufficiently advancing it into the elbow to penetrate the capsule (Figure 2). At that point, the operator looked at the monitor to see the position of the knife blade within the joint. If the capsule was lax, which is not the case for contractures, fluid

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Ethical approval for this study was obtained from the Mayo Clinic Institutional Review Board (IRB: 10006838).

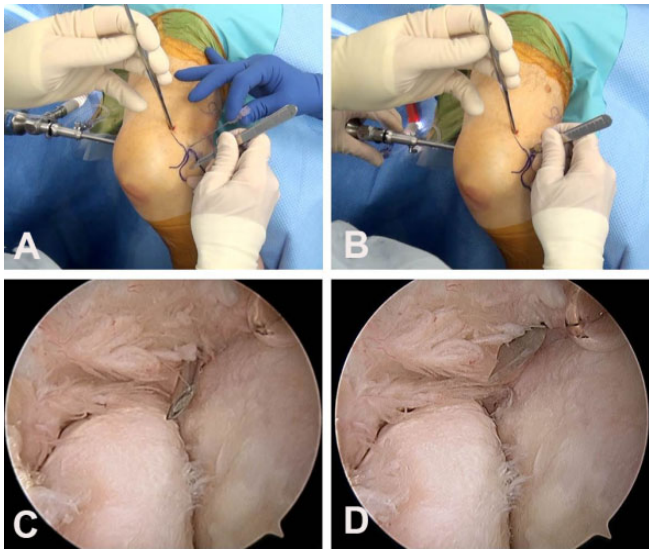


Figure 2. (A) The scalpel is positioned adjacent and parallel to the needle. (B) The needle is withdrawn and replaced by the scalpel in precisely the same position and orientation in 3-dimensional space. Arthroscopic views show the needle (C) being replaced by the scalpel blade (D) inside the joint. The scalpel should be positioned parallel to the needle, with the blade rotated into the sagittal plane and the sharp edge facing proximally. Used with permission of LBOFXR. All rights reserved.

insufflation of the joint was used in most cases, immediately before insertion of the scalpel blade.

In the case of capsulectomy or osteocapsular arthroplasty, the scalpel blade was directed proximally to release the anterolateral capsule and scar tissue off the lateral supracondylar ridge. It was then returned to its original position and rotated 180° so that the blade could be used to release the lateral capsule down to the level of the lateral collateral ligament. The ligament, however, was not released.

RESULTS

Of the 460 elbow arthroscopies performed during the study period, 309 (67%) had the anterolateral portal established by the needle-and-knife technique. This group of patients had 1 temporary radial nerve palsy (0.3%), which occurred in a tennis elbow debridement. There were 2 temporary radial nerve palsies (1.3%) in the 151 cases in which the needle-and-knife technique was not used. A retractor had been used in each case, and it was presumed that the temporary palsies were due to retraction. All radial nerve palsies occurred prior to February 2007.

Use of the needle-and-knife technique increased as the study period progressed. It was used less frequently in the early period of study but increasingly over time, and it became a standard procedure in years after (Figure 3). There were no cases in which the needle-and-knife technique was unsuccessful nor any in which it was attempted and abandoned.

There were 151 cases (33%) in which the needle-and-knife technique was not used to establish the anterolateral portal, usually because (1) the technique was not routinely employed early in the period studied or (2) sometimes intra-articular pathology impaired visualization of the lateral capsule from inside the lateral joint (65%), extensive synovitis (10%), and osteophytes and/or loose bodies (10%). However, in the remaining 15%, the anterolateral portal was created first or was created using the switching stick.

DISCUSSION

We used the needle-and-knife technique to establish the anterolateral portal in 309 of 460 consecutive elbow arthroscopies in which the procedure included work in the anterior compartment. Out of respect for the possibility of iatrogenic radial nerve injury, we employed this technique only for its advantages in the early years. However, as our confidence grew in how we could perform it without increasing risk to the patient, its advantages became even more apparent. Eventually, it became a standard procedure and our preferred technique and remains so.

There was 1 temporary radial nerve injury in the 309 cases in which the needle-and-knife technique was used to establish the anterolateral portal; however, there were 2 transient radial nerve palsies in the group of 151 cases in which it was not used. There were no further injuries after February 2007.

We have come to believe that this technique can be considered safe under the following conditions. First, the operator needs to be fairly advanced in his or her skills or must execute the technique under direct instruction and supervision of someone who is. Whereas the senior surgeon (S.W.O.D.) did not allow residents or fellows to perform the needle-and-knife technique part of the operation in the early years, he did eventually develop confidence in instructing and supervising its execution by surgical trainees. The key part of executing the needle-and-knife technique is to consider the goal to be placement of the scalpel in the exact same position and orientation that had been occupied by the spinal needle before it was removed. That is why we use a long spinal needle and not a shorter needle meant for a syringe. The shorter needle does not give as much visual reference for establishing its exact location in space as does the longer spinal needle. It is also why the assistant withdraws the needle in a straight path away from the elbow in line with its original position instead of withdrawing from the skin and then altering the orientation of the needle.

The advantages of using this portal are several. First, it is rapid once mastered. Second, after insertion of the knife into the joint, the blade can be used to release the capsule and scar tissue from the lateral supracondylar ridge right down to the collateral ligament. This greatly facilitates anterior capsulectomy and osteocapsular arthroplasty by dramatically improving the space available in which to work and thereby saves substantial time in surgery. Third, by creating a larger opening through the lateral capsule than what would be accomplished retrograde over a

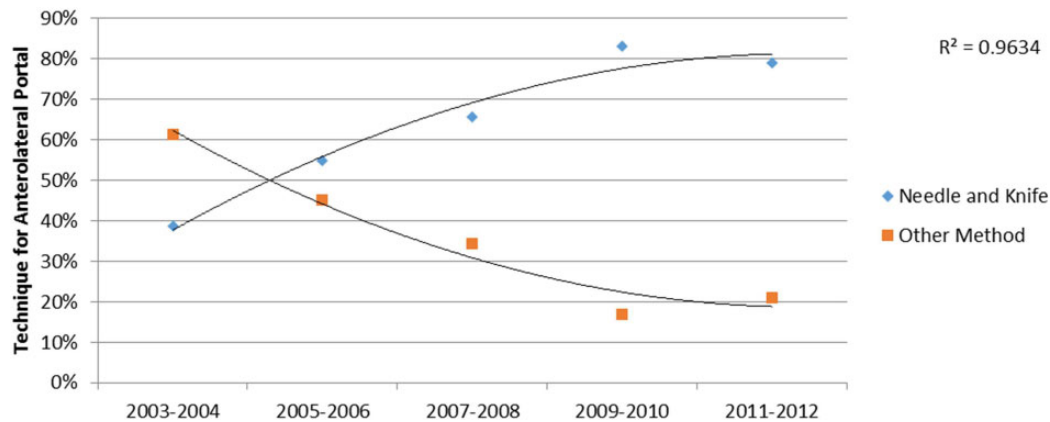


Figure 3. Graph showing the shifting trend in techniques employed to establish the anterolateral portal from 2003 to 2012. The needle-and-knife technique increased in use from 40% to 80% of cases during the study period. Used with permission of LBOFXR. All rights reserved.

switching stick, instruments can be rapidly and easily inserted and removed through this portal without the use of a cannula.

In fact, the idea for this technique was specifically born out of its anticipated advantages. For years, the senior author had inserted a scalpel into the lateral portal after completing the anterior capsulectomy, to release the lateral capsule proximally along the lateral supracondylar ridge and distally down to the level of the lateral collateral ligament. We consistently observed that performing the capsular release along the supracondylar ridge permitted the anterior soft tissues to be retracted further away from the elbow, thereby increasing the space in which to work. As the second step in elbow arthroscopy is to “create a space in which to work,”⁴ we decided to move this maneuver to the second step in elbow arthroscopy and take advantage of the increased space earlier in the operation.

Obviously, the idea of inserting a scalpel blade into the joint so close to the radial nerve should raise concern in a surgeon’s mind. Indeed, the radial nerve has been injured during placement of the anterolateral portal.^{5,7,10,12} Mercer et al¹⁷ reported an injury to the radial nerve distal to the extensor carpi radialis longus branch during elbow arthroscopy for loose body removal. They attributed the cause to portal placement. Various cadaveric studies measured the distance between the radial nerve and the instruments placed in the anterolateral portal and documented it to be as close as 2.0 mm to the instrument, with some studies reporting that the radial nerve was hit 50% of the time upon insertion of instruments into the joint.^{1,6,8,15,16,23-25} Elbow flexion and joint insufflation displace the nerve away from the bone but only minimally in stiff joints with a scarred, contracted capsule.^{11,14,18,20,24} Respect for this risk was the reason why the senior surgeon did not initially permit a resident or fellow to do this part of the procedure.

As with most surgical procedures, safeguards on risk prevention develop and become standard. Several of these merit repetition here. First, the location of the anterolateral portal was established by palpation, not by marking

the skin. Swelling displaces the skin and the marking for the portal, making it possible to put the portal in the wrong place. To palpate the radiocapitellar joint through any swelling that developed during the posterior compartment arthroscopy, one should compress the soft tissues anterior to the radiocapitellar joint to displace the edema fluid, just as one learns to test for pitting edema in the leg. Second, the skin is incised before placing the needle, for 2 reasons. This establishes exactly where to place the scalpel blade on the skin so that only the correct angle of the scalpel needs to be reproduced. Also, it eliminates any distraction while the needle tip or the blade is passed through the skin itself. Third, a long spinal needle is used rather than a shorter, standard needle. This gives a better perspective on the location and orientation of the needle and intended path for the knife. Fourth, the surgeon moves the needle around inside the joint until it rests in a desired position and direction for the scalpel blade as it enters. This not only establishes the correct direction but also results in “muscle memory” for the surgeon, owing to the movements of the needle in 3-dimensional space. The benefits of this step are not to be taken for granted. In other words, if one had a skilled assistant, it would not be wise to have him or her insert the needle or move it into the correct position, because this would prevent the registering of that muscle memory for the surgeon inserting the scalpel blade. Fifth, the assistant is instructed in what to do before withdrawing the needle, including the need to withdraw the needle in a straight line out of the elbow and far enough to be out of the way of the surgeon’s hand. This movement helps the operating surgeon firmly register in his or her mind the intended path of the blade into the elbow. Finally, it is important that the task be thought of as putting the knife blade exactly where the needle was, rather than “inserting” the knife into the joint. It has been our experience that this is best done by the operator fixing his or her eyes on the needle, not the monitor, until the tip of the knife has penetrated the capsule or at least is just about to.

The findings of this study are relevant to the training of surgeons and the acquisition of specific technical skills.

Claessen et al⁶ documented that surgical trainees had a high rate of technical errors in placing the anterolateral portal for elbow arthroscopy in cadavers. On the basis of our experience, we believe that it is important to provide trainees with a comprehensive understanding of the technique.

CONCLUSION

We conclude that the needle-and-knife technique for placement of anterolateral portals is safe and effective if the surgeon is trained in the technique and if the view from the proximal anteromedial portal permits visualization of the radiocapitellar articulation and the lateral capsule, as seen in Figure 1B. It is reproducible and easy to perform by someone instructed in its use and trained in elbow arthroscopy. Its main advantage is that it facilitates anterolateral portal usage and enlargement of the available space in which to work inside scarred and contracted elbows where it is not possible to distend the capsule.⁹

A Video Supplement for this article is available at <http://journals.sagepub.com/doi/suppl/10.1177/2325967118817232>.

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