Technical Note

Arthroscopic Elbow Debridement Using Anterocentral Transbrachialis Portal

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Abstract: Arthroscopic debridement for elbow osteoarthritis has been widely used as a minimally invasive treatment; however, in some cases, it can be a technically demanding procedure, such as in patients with severe osteoarthritis with large spur formation and severe synovitis. The anterocentral transbrachialis portal is a recently developed portal for elbow arthroscopy, which allows easy and convenient access to the anterior compartment for sufficient debridement. This report describes in detail the anterocentral transbrachialis portal and its usefulness for debridement of the elbow joint in osteoarthritis.

As the understanding of elbow anatomy is advancing and better equipment and surgical skills are being developed, elbow arthroscopy has become a popular and widely accepted treatment option for various elbow disorders.[1] Compared with traditional open techniques, arthroscopic elbow debridement for elbow osteoarthritis (OA) is a minimally invasive, safe, and effective treatment method.[2-4] This method makes it possible to begin rehabilitation early after the operation for the elbow to return to its normal function, as it prevents muscle stripping and dissection of muscular attachments, with better cosmetic results than the traditional technique.[5]

Despite these advantages, in patients with certain conditions, such as severe OA with large spur formation and severe synovitis, arthroscopic debridement for elbow OA is a technically demanding procedure. These conditions complicate resection of the spur, because of unclear visualization and difficulties during arthroscopic maneuvers. In particular, complete resection of the bony spur at an anteromedial facet of the coronoid process and the bottom of the coronoid fossa can be quite challenging using standard anterior portals.

The anterocentral transbrachialis portal is a newly developed arthroscopic portal to access the anterior compartment of the elbow joint directly. This portal is based on the open anterior transbrachialis approach described by Itoh in 1994[6] (Fig 1). The difference between this open approach and the standard anteromedial approach is that in the former, there is no need to expose the median nerve and the brachial artery. Because the open anterior transbrachialis approach is a muscle-splitting procedure, the major neurovascular bundle is retracted with the large bulk of the brachialis muscle. Although it offers a limited operative field, this approach is reported to be convenient for accessing the anterior compartment directly and to perform debridement of the anterior compartment and capsulectomy much more easily compared with the standard anterior approach. Similar to the open transbrachialis approach, the anterocentral transbrachialis portal makes it possible to access the anterior compartment directly without any risk of major neurovascular injuries and facilitates the safe removal of bony spurs and free bodies, compared with using standard anterior arthroscopy portals. Here, we introduce the procedures of this new portal in detail and describe the clinical advantages of arthroscopic debridement for elbow OA using the anterocentral transbrachialis portal.

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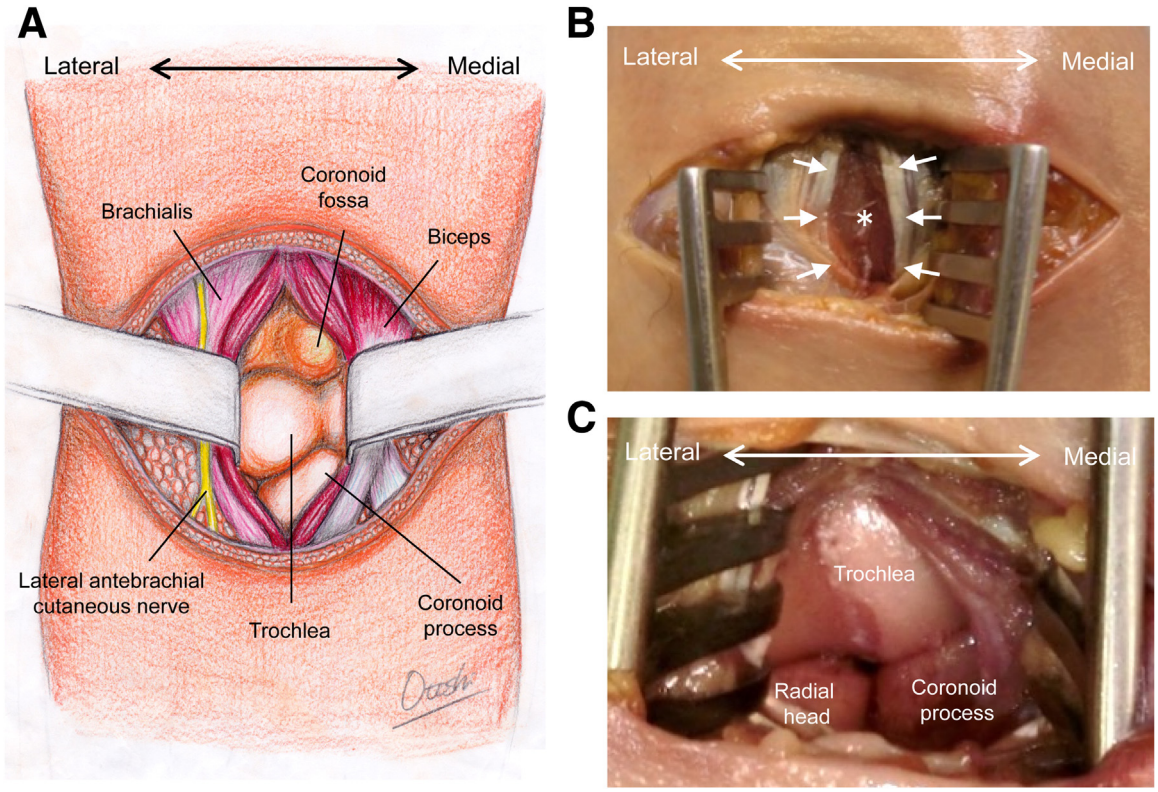

Fig 1. Open anterior transbrachialis approach. (A) Schema of this approach (anterior view of the right elbow joint). (B) Incision of the brachialis fascia (arrows) is performed, followed by dissection of the brachial muscle fiber (*) to reach the joint capsule. (C) The anterior capsule is cut, and the intra-articular structures (trochlea, coronoid process, and radial head) are exposed.

Surgical Technique

Patient Positioning and Preparation

The patient is positioned supine on a surgical table, and an air tourniquet is applied proximally to the upper arm with the pressure set at 250 mm Hg. A slightly elevated surgical arm table is positioned ipsilateral to the surgical table at the level of the patient's upper arm. The upper arm is completely free (arm-free supine position), and there is no need to use a traction device. This position allows access to not only the anterior compartment, but also the lateral and posterior compartments of the elbow joint, without the need for specialized equipment or devices (Fig 2 A-D). The video monitor is positioned in front of the operating surgeon on the side opposite to the affected arm. The patient's skin is sterilized with povidone–iodine, and sterile drapes are applied. The elbow is palpated to identify important anatomic landmarks, and a marking pen is used to outline the biceps tendon, medial epicondyle, olecranon, radial head, and humeral capitellum.

Portal Placement and Debridement of the Anterior Compartment

After inflating the air tourniquet, the joint is distended with 20 mL of saline solution to increase the distance between the capsule and neurovascular structures (Video 1). A standard proximal anteromedial portal is established at 2 cm proximal to the medial epicondyle and just anterior to the intermuscular septum. A standard 4.0-mm, 30° arthroscope (Smith & Nephew) is inserted from this portal into the anterior compartment of the elbow joint. A standard anterolateral portal is established under arthroscopic visualization from the proximal anteromedial portal at 3 cm distal and 1 cm anterior to the lateral epicondyle. After diagnostic arthroscopy, synovectomy is performed to obtain a clear visualization using a 4.5-mm arthroscopic shaver (DYONICS INCISOR Plus PLATINUM blade; Smith & Nephew) or a radiofrequency device (Short Bevel 35, QUANTUM 2 COBLATION system; Smith & Nephew). Thereafter, the anterocentral transbrachialis portal is established as the working portal at the anterior elbow joint. The biceps tendon is palpated through the skin in the elbow-extended position, and a 1.5- to 2.0-cm skin incision is made just lateral to the biceps tendon, along the anterior elbow crease (Fig 3A). Blunt dissection of subcutaneous tissue is carried out to avoid injuring the biceps tendon and the lateral antebrachial cutaneous nerve (Fig 3B). After retracting the biceps tendon medially and the lateral antebrachial cutaneous nerve laterally, an incision of approximately 1 cm is made in

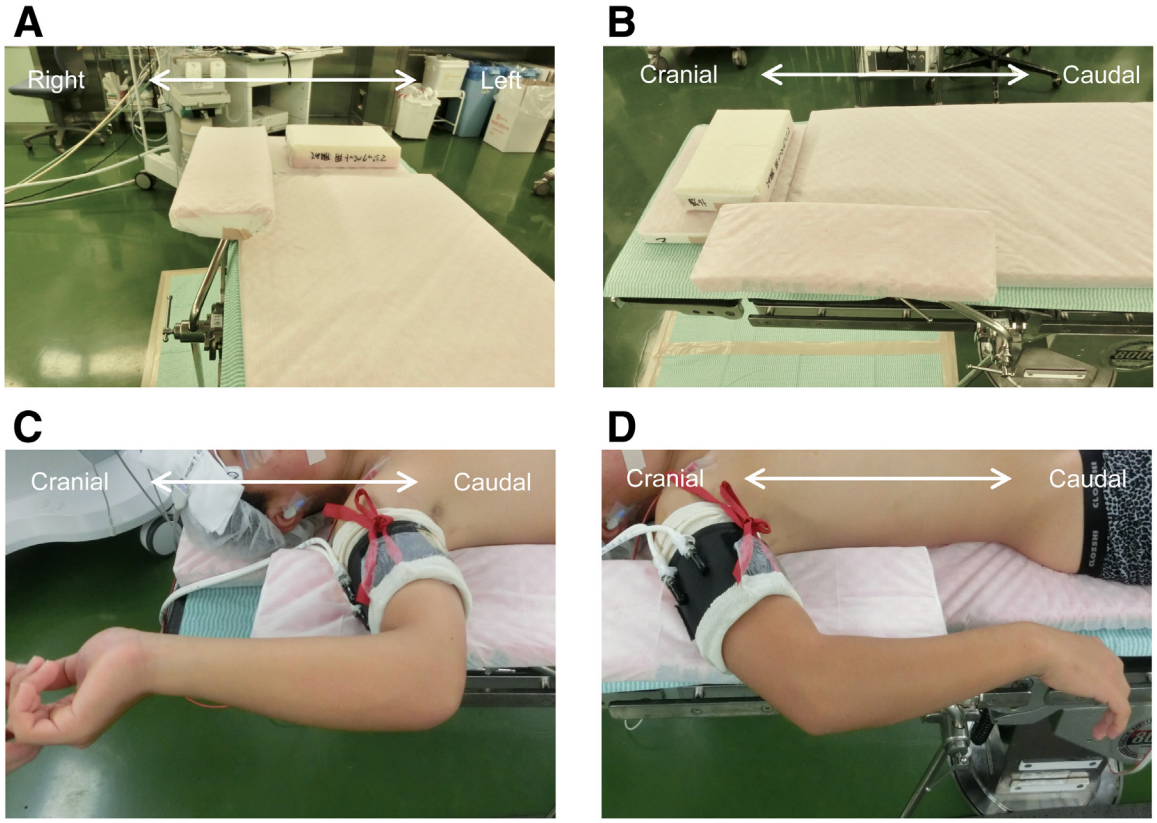

Fig 2. Patient positioning and preparation (right elbow). (A) A slightly elevated surgical arm table is positioned ipsilateral to the surgical table at the level of the patient's upper arm. (B) Right side view of the arm table positioning. (C) The patient is positioned supine on a surgical table. The upper arm is completely free, and there is no need to use a traction device (arm-free supine position). (D) The patients' shoulder is internally rotated when the operator approaches to the lateral or posterior compartment.

the fascia of the brachialis muscle, dissecting the muscle along with the fiber to reach the joint capsule (Fig 3 C and D). An 8.0 × 90-mm plastic cannula (CLEAR-TRAC FLEXIBLE Shoulder Cannula; Smith & Nephew) is inserted to the elbow joint through the brachialis muscle (Fig 3E). Under arthroscopic visualization from the anterolateral portal, the tip of the cannula is guided to the region located just above the coronoid fossa (Fig 4A). Since it is sometimes difficult to penetrate the joint capsule with a blunt-tip cannula, a radiofrequency device is useful to pierce the joint capsule and widen the portal. After fully inserting the cannula into the joint, debridement of proliferative synovium is performed to obtain a clearer visualization around the spur of the coronoid process, coronoid fossa, and radial fossa using a arthroscopic shaver and a radiofrequency device (Fig 4B). Next, the abnormal bony spur of the coronoid process, coronoid fossa, and radial fossa is resected using a 6-mm-wide chisel (Smith Peterson Osteotome, 6-mm wide, straight) and a 4.0-mm abrader burr (DYONICS 4.0mm ELITE Abrader Burr; Smith & Nephew) until the bony impingement is resolved (Fig 4 C-F). Anterior capsulectomy is done if the patient shows moderate to severe flexion contracture. Capsulectomy is started around the anterocentral transbrachialis portal using the radiofrequency device and taking care not to injure the neurovascular bundles, and the capsule is detached from the humerus to achieve complete extension of the elbow. Because resection of the anterior capsule causes low visibility, anterior capsulectomy should be performed after completing resection of the bony spurs in the anterior compartment. Debridement of the lateral and posterior compartments is done subsequently using standard lateral and posterior portals. The patient's shoulder is fully internally rotated, and the elbow is slightly extended. Dual direct lateral portals[7] are established, and the proliferating synovium and synovial plica are debrided around the radiocapitellar joint and lateral ulnohumeral joint using a motorized shaver and a radiofrequency device (Fig 5A). After finishing the procedure in the lateral compartment, the operator moves to the head of the surgical bed, and debridement of the posterior compartment is done using a

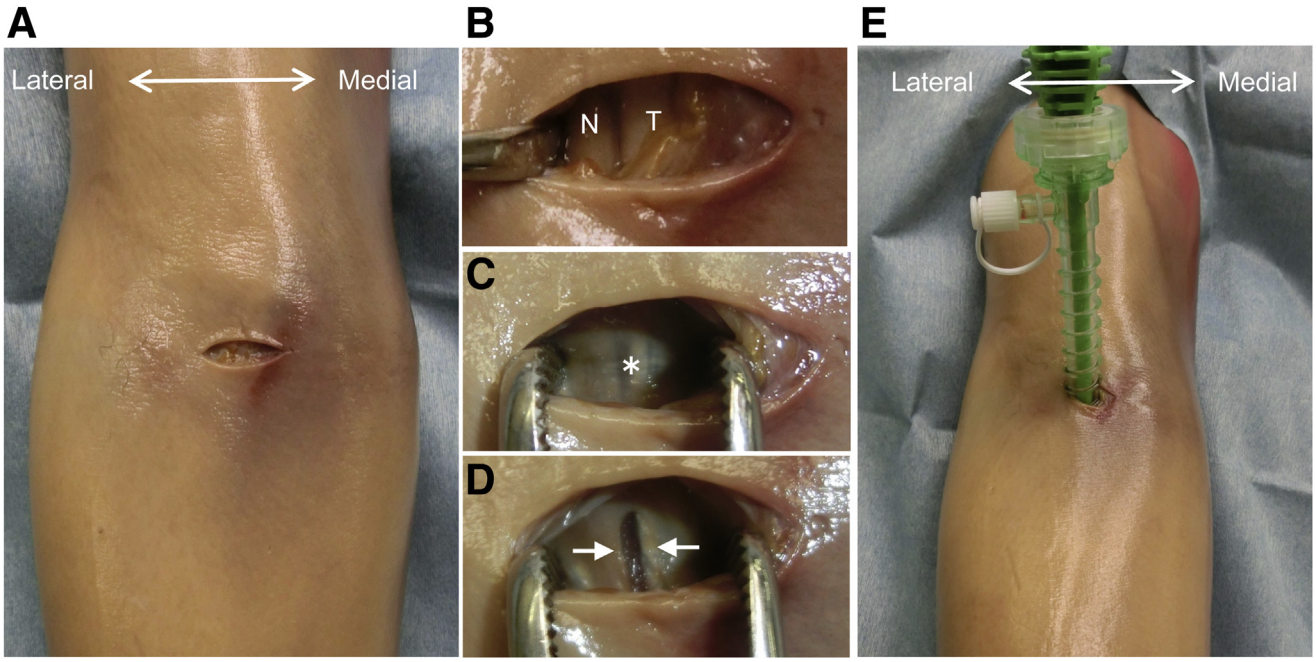

Fig 3. Portal placement (anterior view of the right elbow joint). (A) A skin incision is made just lateral to the biceps tendon along the anterior elbow crease. (B) Blunt dissection is carried out to avoid injuring the biceps tendon (T) and the lateral antebrachial cutaneous nerve (N). (C) The biceps tendon is retracted medially, and the lateral antebrachial cutaneous nerve is retracted laterally (*: brachialis fascia). (D) An incision of about 1 cm is made in the fascia of the brachialis muscle (arrows), and the muscle is dissected along with the fiber to reach the joint capsule. (E) An 8.0-mm × 90-mm plastic cannula (CLEAR-TRAC FLEXIBLE Shoulder Cannula; Smith & Nephew) is inserted to the elbow joint through the brachialis muscle.

posterolateral and posterocentral transtricipital portal[8] (Fig 5B). Posterior capsular release is performed, and, if the limitation of flexion remains after debridement of the anterior compartment, the posterior oblique ligament is detached from the medial epicondyle.

Postoperative Care and Rehabilitation

Compressive, sterile dressing is applied, and the patient is placed in a simple sling. Self-assisted range of motion exercises begin the day after the operation. Patients are allowed to return to light duty or a moderate activity level when they are free from pain. Muscle-strengthening exercises are started at 3 weeks after surgery, and patients are allowed to gradually return to normal daily living and sports activities at 10 to 12 weeks.

Discussion

There are several methodological advantages to using the anterocentral transbrachialis portal for arthroscopic elbow debridement (Table 1). First, because this portal is located just above the anterior elbow joint, it is possible to adequately and easily resect the spur at the coronoid process and coronoid fossa. Furthermore, this portal enables removal of the bony spur at the anteromedial corner of the coronoid, whereas such removal would be difficult using standard anterior, anteromedial, proximal anteromedial, or anterolateral portals. Second, there is little possibility of harming neurovascular structures during the establishment of the portal or due to the use of several arthroscopic devices during surgery. Because this portal penetrates the brachialis muscle, major nerves and vessels can be retracted and are protected by a large bulk of muscle. Furthermore, the use of a cannula also can reduce the risk of soft tissue injuries during surgery and make the maneuver much safer. If a cannula is not used, there is the potential for lateral antebrachial cutaneous nerve palsy caused by repetitive insertion of the arthroscopy burr in the anterocentral transbrachialis portal. Because removal of the devices can easily lead to accidental extraction of the canula, the surgeon should hold the cannula when switching devices.

One of the disadvantages of the anterocentral transbrachialis portal is that it is accessible only in supine position, not in lateral or prone position. The advantage of elbow arthroscopy in supine position is that it permits easy conversion to an additional open procedure such as ulnar nerve decompression.[9] It also provides easy access for airway management, which facilitates the use of either regional or general anesthesia. However, the critical disadvantage of elbow arthroscopy in this position is the limited access to the posterior

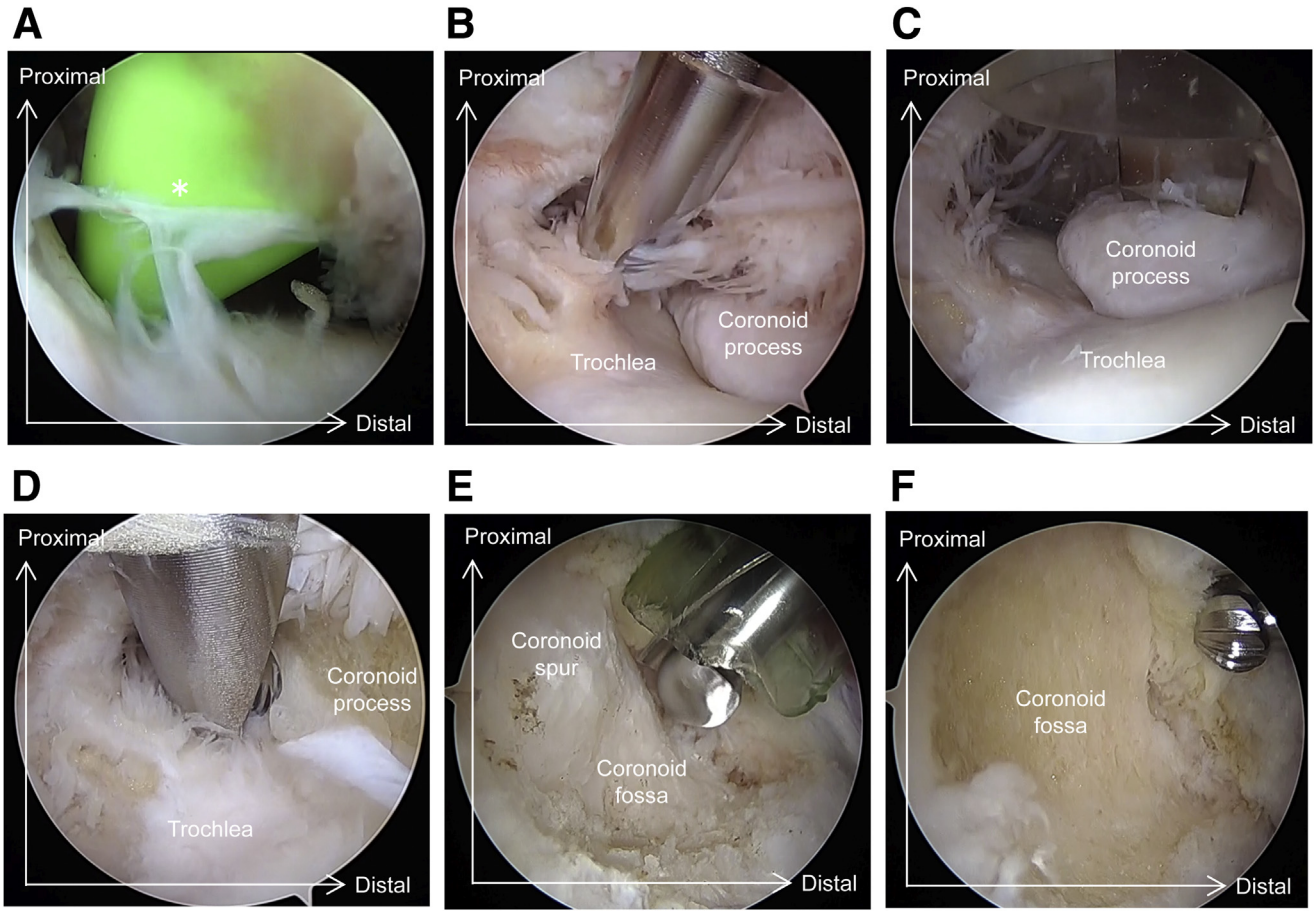

Fig 4. Debridement of the anterior compartment using the anterocentral transbrachialis portal (right elbow). (A) Under arthroscopic visualization from the anterolateral portal, the tip of the cannula (*) is guided to the region located just above the coronoid fossa. (B) Debridement of proliferative synovium is performed for a clearer visualization around the spur of the coronoid process, coronoid fossa, and radial fossa using a 4.5-mm arthroscopic shaver and a radiofrequency device. (C) Bony spur of the coronoid process was resected using a 6-mm-wide chisel (Smith Peterson Osteotome, 6-mm wide, straight). (D) Bony spur of the anteromedial corner of the coronoid process was resected using a 4.0-mm abrader burr. (E) Bony spur of the coronoid fossa was also resected using a 4.0-mm abrader burr. (F) After resecting the spur at the coronoid fossa.

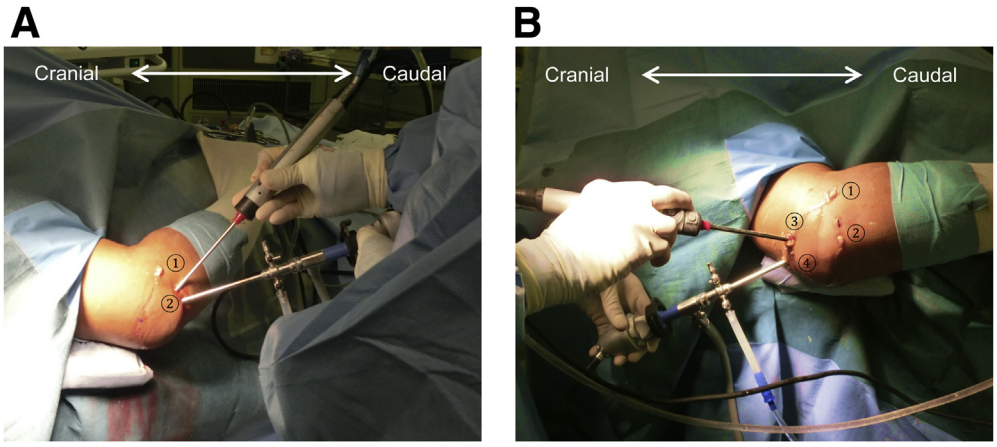

Fig 5. Debridement of the lateral and posterior compartments in supine position (right elbow). (A) Dual direct lateral portals are established (①, ②), and debridement of the lateral compartment is performed in the position that patient's shoulder is fully internally rotated and the elbow is slightly extended. fully internally rotated position. (B) After finishing the procedure in the lateral compartment, the operator moves to the head of the surgical bed, and debridement of the posterior compartment is done using posterolateral (③) and posterocentral transtricipital portal (④).

Table 1. Advantages and Disadvantages

Advantages
• Ability to resect the spur at the coronoid process (especially the anteromedial corner) as well as the coronoid fossa adequately and easily.
• Little possibility of harming major neurovascular structures during establishment of the portal or due to the use of several arthroscopic devices during surgery.
Disadvantages
• The portal is only accessible when the patient is in supine position, not lateral or prone position.
• Possibility of lateral antebrachial cutaneous nerve injury during establishment of this portal.

compartment and the need for special equipment or additional assistance to hold the arm.[10,11] Our technique of arthroscopy in arm-free supine position allows easy access to the posterior compartment without any special device. If access to the posterior portal is complicated because of severe limitation of the shoulder's internal rotation, placing the patient in a slightly head-up position (semi-Fowler's position) can be helpful. An additional problem is the difficulty in penetrating the joint capsule when introducing the cannula into the joint. Because it is sometimes difficult to penetrate the thickened capsule with the blunt tip of the inner cannula, we recommend using a radiofrequency device to penetrate the capsule after inserting the cannula at a sufficient depth to reach the anterior joint capsule (Table 2). In addition, sufficient synovectomy is needed to visualize the intra-articular joint space clearly before inserting the cannula, which makes it possible to establish the portal in a proper position.

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
The anterolateral portal is recommended as a viewing portal for sufficient visualization of the coronoid process and coronoid fossa.	A surgeon who is not familiar with this procedure may harm the lateral antebrachial cutaneous nerve, the medial cubital vein, or the biceps tendon. Extending the anterior skin incision is highly recommended.
Sufficient synovectomy before inserting the cannula makes it possible to visualize the intra-articular joint space clearly and helps to establish the portal in the proper position.	Resection of the anterior capsule during synovectomy may cause low visibility. Anterior capsulectomy should be done after resection of bony spurs is complete.
A radiofrequency device can be used to penetrate the anterior capsule if this is problematic using a standard inner cannula.	Removal of the devices can easily lead to accidental extraction of the canula. Holding the cannula in place will mitigate this problem.

We also recommend extending the anterior skin incision to confirm and identify several important structures, including the lateral antebrachial cutaneous nerve, the medial cubital veins, and the biceps tendon, until the surgeon is familiar with making this portal.

In conclusion, the anterocentral transbrachialis portal is a useful and safe portal for arthroscopic elbow debridement, especially in the anterior compartment. Although this portal is available only in supine position, arm-free supine position can be used to overcome this disadvantage and to allow access to all compartments without any specialized equipment or devices.

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