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Abstract

The development of elbow arthroscopy and the advances in technique have evolved as the result of many contributions by surgeons over the last 15 years. Anesthesia can be regional or general. The decubitus can be supine, lateral, or prone in consideration of surgeon preference and location of the pathology. To perform elbow arthroscopy, the normal equipment for knee surgery can be used: a 4 mm scope with a 30° lens. It is mandatory to perform elbow arthroscopy using five portals, three posterior and two anterior, in order to obtain a complete arthroscopic view. It is absolutely necessary to consider the position of the nerves and vessels during all the procedures in order to avoid surgical complications.

Introduction

The use of elbow arthroscopy to diagnose and treat elbow pathologies has been considered in the past as a difficult technique (Ward and Anderson 1993; Ogilvie-Harris and Schemitsch 1993; Morrey 2005; Savoie 2007).

The increase of arthroscopic knowledge and the technologic breakthrough in the last few years have allowed a standardization of the elbow arthroscopy technique. Every surgeon can prefer some peculiar aspects of the standardized technique, but the main guidelines are very similar in expert's papers.

Anesthesia

Anesthesia can be regional or general. Regional anesthesia involves the use of a brachial plexus block, providing excellent postoperative pain control and limiting use of narcotics. Regional anesthesia is also indicated in patients with comorbidities that preclude general anesthesia. The main disadvantage of the regional block is that it does not allow neurological assessment postoperatively. Patients also can become apprehensive and uncomfortable during the

procedures because of the position required. The conversion to general anesthesia may become necessary and difficult using the prone position. The complication rate for interscalene brachial plexus block has been estimated at 1.1 %. Some of the complication can be really serious including respiratory and cardiovascular problems, as well as permanent nerve deficit (Lindenfeld 1990).

Many surgeons prefer to perform elbow arthroscopy under general anesthesia because of the total muscle relaxation and the patient's comfort (Savoie 1996; Steinmann et al. 2006; Rahusen et al. 2006). The disadvantage of general anesthesia is mainly due to potentially greater pain in the early postoperative period.

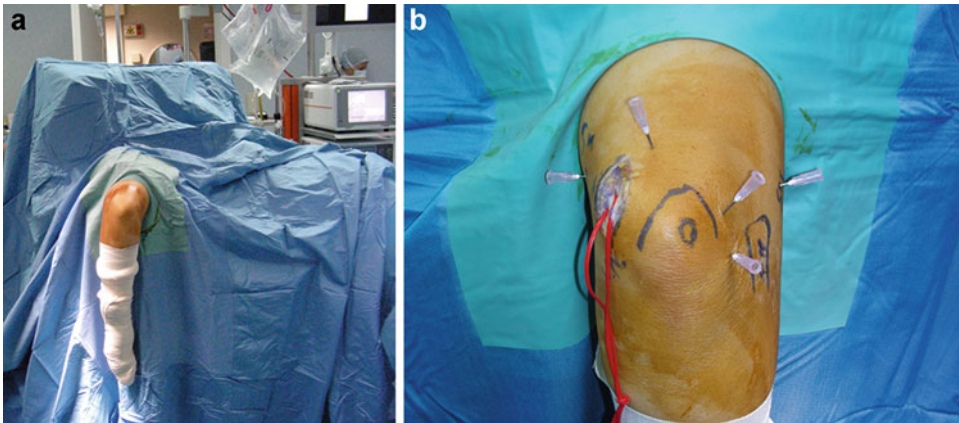
Elbow arthroscopy in simple cases is performed with regional anesthesia, but in more difficult cases, anesthetist identifies nerve trunks by applying electrostimulation and places a catheter without injecting the anesthetic (Pederzini et al. 2013). Patients then undergo general anesthesia. When they wake up, only after a neurological evaluation, peripheral block is performed.

Decubitus

The decubitus can be supine, lateral, or prone in consideration of surgeon preference and location of the pathology. It is mandatory to have well-padded bony prominences and the surgeon must control the complete flexion and extension of the elbow joint without the interference of the operative table.

Described by Andrews and Carlson (1985), in the supine position, the shoulder is abducted at 90° and elbow is flexed to 90° as well. Finger traps are applied and a counterweight is positioned at the arm in order to distract the joint. This decubitus allows a good orientation for the surgeon and provides a direct access to the patient's airway for the anesthesiologists. The eventual conversion to open surgery is easy but the real disadvantage of the supine position is the extremely difficult access to the posterior compartment.

First described by O'Driscoll and Morrey (1992), lateral decubitus (Fig. 1) allows a free

Fig. 1 Lateral decubitus**Fig. 2** (a) Prone decubitus (b) *Pink* needles show posterior portals and supero medial and superolateral anterior portals. The ulnar nerve is isolated

access to the patient's airways by the anesthesiologists. The patient is positioned with the operative extremity upward and the body stabilized with hip positioners. The operative arm is supported by a padded bolster with the shoulder flexed and internally rotated 90° and the elbow in 90° of flexion (Fig. 1). The bolster should be placed high enough to avoid compression of the anterior neurovascular structure. Some troubles are connected to the position of the contralateral shoulder and elbow depending from arm holder used. It is mandatory to avoid compression to the contralateral

upper limb, maintaining the venous access for the anesthetist. It is also important to keep the contralateral upper limb in extension or in flexion close to the body of the patient.

Described by Poehling et al. (1989), in the prone decubitus (Fig. 2a), the patient is positioned prone close to the edge of the operative table on chest rolls. The shoulder is abducted to 90° and the upper arm is supported by an arm holder that allows flexion and extension. The arthroscopic view is similar to the lateral position, but the access to the airway is limited.

Fig. 3 Patient on lateral decubitus. Extrarotation of the hip allows to perform knee arthroscopy in order to take a graft from lateral troclea



Fig. 4 Injection of about 20 cc of normal saline in post-lateral soft spot located between the lateral olecranon radial head and lateral epicondyle



Fig. 5 A fine straight blunt hemostat is used to separate the subcutaneous nerves

Prone position is used by the author to perform elbow arthroscopy from 1996 because it permits an easy access to all the joint compartments. Lateral (Fig. 1) position is used to perform some associated open surgical procedures after arthroscopy avoiding to turn the patient. Lateral decubitus is used in doing arthroscopic mosaicplasty from the knee to the elbow just because in lateral position, the hip extrarotation allows to perform knee arthroscopy without changing the patient decubitus (Pederzini et al. 2013) (Fig. 3).

Setup and Instrumentation

The authors use to position the tourniquet in a not sterile way with the patient supine in order to use the Esmarch bandage in an easy way to block the blood supply. Then, they position the patient as described in sterile way placing an elastic wrap around the forearm to minimize fluid extravasation in the soft tissue. Elbow arthroscopy can be performed using the normal equipment for knee surgery: a 4 mm scope with a 30° lens. A 2.7 mm scope is rarely used in elbow arthroscopy performed in children. To avoid fluid

extravasation in working close to the capsule margin, a non-vented cannula is preferable.

The authors use only one plastic cannula in the anterolateral portal in beginning the procedure inserting this cannula over a Wissinger trocar inserted from medial to lateral. It is mandatory to perform elbow arthroscopy using five portals, three posterior and two anterior, in order to obtain a complete arthroscopic view and to allow the saline extravasation from the portals avoiding high pressure inside the joint (Pederzini et al. 2013). The mechanical arthroscopic pump is also used to keep the pressure under 30 mmHg. Ordinary arthroscopic equipment is used during the procedure like basket, probe, and grasping forceps. Arthroscopic retractors can be useful maintaining the anterior or posterior soft tissue covering the nerves and vessels away from the shaver during the anterior or posterior capsulectomy (Fig. 2b).

How to Perform Elbow Arthroscopy: Technical Aspects

The tourniquet is inflated while the patient is supine to permit the outflow of the blood in an easy way. After positioning the patient in prone or lateral decubitus, it is necessary to first test the elbow range of motion and stability. A marker is

then used to outline the ulnar nerve (Fig. 2b), radial head, epicondyles, and the tip of the olecranon. It is mandatory to palpate the ulnar nerve in order to understand if it partially dislocated in flexion–extension. If there are any doubts about the position of the nerve, a small (2 cm) incision would help to isolate the nerve to avoid any eventual damage (Fig. 2b). It is very important arthroscopically to consider two aspects of the elbow joint: anterior and posterior. The posterior compartment includes posterolateral area and the under tricipital recess.

Posterior Compartment and Ulnar Nerve

The procedure routinely starts from posterior compartment with an injection of about 20 cc of normal saline in posterolateral soft spot located between lateral olecranon radial head and lateral epicondyle to enlarge the joint keeping away and less close to the joint the anterior nerves and vessels (Fig. 4). The fluid backflow after removing the syringe confirms the intra-articular fluid placement. A posterolateral portal is then created by 11 mm blade cutting only the skin and a fine straight blunt hemostat is used to separate the subcutaneous nerves (Fig. 5). After this, a blunt trocar is necessary to penetrate the joint. This



Fig. 6 Assistant's fingers over the ulnar nerve in order to feel the shaver vibrations and pushing over the nerve

sequence (skin incision–hemostat) must be followed in every single skin incision. It is still controversial which portal must be created at first. It may depend on the pathology treated to the habits of the surgeon, but is preferable to follow the same sequence (start posterior and then go anterior) in every single case in order to become confident with the arthroscopic anatomy (Pederzini et al. 2013). Starting posteriorly, after the identification of the radial head, a second posterior portal is made 1.5 cm above the first using a needle from outside to inside to join an intra-articular area under direct visualization that allows to debride or resect posterior osteophytes in the proximal radioulnar joint. Sometimes, it is necessary to switch the scope in this more distal portal using the shaver in the first portal to perform a more accurate synovectomy or other surgical procedures. A third posterior portal is successively made under direct visualization in the under tricipital recess. This can be done trans the triceps or close to the medial margin of the triceps itself. Every single maneuver in the posterior fossa must be done respecting the ulnar nerve area. An assistant maintains a finger over the nerve in order to feel the shaver vibrations (Fig. 6) and pushing over the nerve can indicate where the nerve is under direct arthroscopic visualization. In case of ulnar nerve release, quite common as first step of arthroscopic stiff elbow arthrolysis procedure, an accessory portal can

easily be done in the subcutaneous tissue and a retractor is positioned to protect the nerve (Fig. 7). Using the shaver in the posterior compartment close to the ulnar nerve, it is mandatory to put the suction off. It is recommended to release the ulnar nerve in stiff elbow in case of flexion and extension deficit, in order to facilitate the procedure but also to avoid excessive traction on the nerve during the rehabilitative protocols that start in day 1 after the procedure (Pederzini et al. 2013). The ulnar nerve release is usually the first step of the procedure to avoid the risk of traction in testing the ROM during the procedure and this allows to perform a small posteromedial



Fig. 7 Arthroscope in posterolateral inferior portal, fluid from posterolateral middle portal, a retractor can be introduced in the posteromedial accessory portal



Fig. 8 A fine curved hemostat is inserted in the joint at 45° respect the humeral epiphysis

Fig. 9 Push the trocar or a Wissinger rod just over the radial head against the lateral capsule



Fig. 10 Interosseous nerve palpated after anterior capsulectomy

arthrotomy at the end of arthroscopy, to resect medial osteophytes opening the joint in case these are too large, or too close to the ulnar nerve. Periosteal elevators can be used in detaching the posterior capsule, while a fine scalpel is sometimes useful to resect the hypertrophic tip of the olecranon.

Anterior Compartment

The senior authors (O'Driscoll and Morrey 1992; Rupp and Tempelhof 1995; Reddy et al. 2000; Kelly et al. 2001) always start from medial to



Fig. 11 Pre-op x-ray show non union of the radial head with the screws not fixing the fracture

lateral. Some authors (Lynch et al. 1986; Nguyen et al. 2006) start from lateral, but the opportunity to palpate the ulnar nerve suggests avoiding the lateral approach at first where the posterior



Fig. 12 Arthroscopic removal of the screws

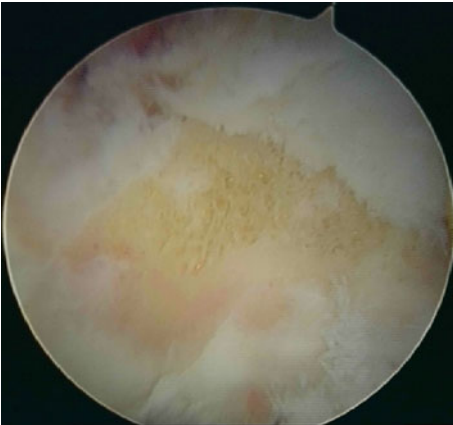


Fig. 13 Residual radius after the resection

interosseous nerve is not easily palpable. The ulnar nerve palpated and skin incision on the supero-antromedial portal made, a fine curved hemostat is inserted in the joint at 45° respect the humeral epiphysis (Fig. 8). Then, a blunt trocar is inserted in the same direction and the scope is positioned to check by a quick view the intra-articular aspects. Pushing the trocar or a Wissinger rod over the radial head against the lateral capsule, an inside-outside maneuver is performed and a plastic cannula is positioned over the rod in the superolateral portal (Fig. 9). The anterior compartment is then observed, keeping the scope medial and the probe or shaver lateral. The observation of the radial head, the trochlea, the



Fig. 14 Post-op x-rays show the amount of the resection

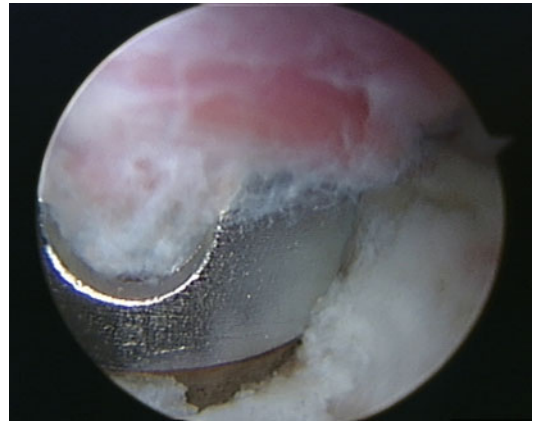


Fig. 15 Dedicated instrument to fill the lesioned area with a knee graft

coronoid tip and coronoid fossa, and the anterior capsule is carried out. On the lateral side of the anterior compartment, the origin of the extensor muscles is examined. Working anteriorly, always remember that just anterior to the capsule in front of the radial head, the posterior interosseous nerve lies (Fig. 10). It is mandatory to avoid to be anterior to the lateral capsule with any instruments, and in

case of anterior capsulectomy starting from lateral to medial, resect the capsule itself with a basket forceps avoiding the shaver (Pederzini et al. 2013). If cleaning of the arthroscopic view is needed, put suction system off. The anterior capsule removed can determine an increase of extension, but the brachialis muscle lies just anterior to the capsule to protect the median nerve and the artery.

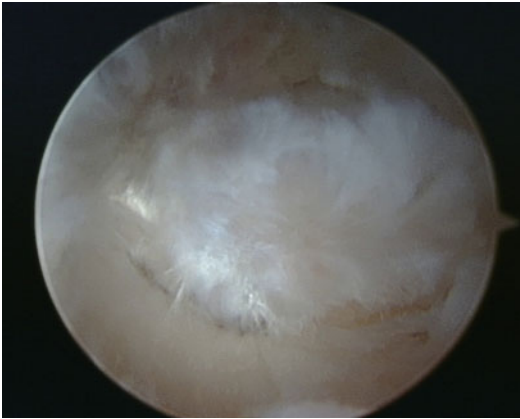


Fig. 16 Graft positioned at the level of the cortical bone

A rough debridement of this muscle can increase the bleeding after the procedure.

Rehabilitation Protocol in Stiff Elbow

The day after the surgery, the rehabilitation protocol begins with a very slow CPM, four times a day for 40 min with the help of two suction drains and a perinervous anesthetic catheter. On day 2, use CPM four times a day for 40 min, plus 60 min of physiokinesitherapy and self-active movements four times a day for 30 min. The third day starts with catheter removal and continues with CPM, FKT, and self-active movements. On day 4, the drains are removed and CPM, FKT, and self-active movements continue. On day 5, once discharged, the patient goes back home with a 20-day long reeducational program combined with indomethacin for 15 days. The splint is removed after 20 days. After 1 month, patients get their first follow-up visit and rehabilitative program continues for 3–5 months (Pederzini et al. 2013).



Fig. 17 Four months MRI shows a perfect bone incorporation of the graft

Tricks in Arthroscopic Radial Head Resection

In case of incorrect fixation of a radial head fracture or a malunion of a radial head fracture, a stiff elbow can be observed (decreased flexion–extension and pronosupination) mainly due to radial head problems.

X-ray and 3D CT SCAN can confirm the lesion and can indicate radial head resection.

Arthroscopic resection of the radial head (Figs. 11, 12, 13, and 14) can be performed using three posterior portals and two anterior portals. The resection is carried out beginning from the posterior margin with a small burr. This often offers the opportunity to resect the main part of the abnormal radial head and to finish the procedure from the anterior approaches in order to avoid small bony particles left in the joint that can irritate the synovium. During the procedure, pronation and supination can facilitate the resection. Occasionally, screws from the previous fixation can be removed. A thorough washing out is necessary at the end of the procedure. In few cases, performed arthroscopic arthrolysis after a previous radial head resection with residual lock of pronosupination is probably due to a too limited resection and fibrosis. In these cases, a complete thick white fibrous tissue was found and resected in between radial head and capitulum humeri, and then, a more adequate bony resection was carried out. In this case, after completing the posterior fossa debridement, the anterolateral portal was indicated by a needle positioned in the space left from the removed radial head after the initial posterior debridement.

Tricks in OCD Surgical Technique

OCD can be a cause of pain in the elbow with limited ROM. These young patients, usually athletes complaining about pain and dysfunction, limit their activity becoming unable to participate in sport.

Frequently located in the posterior part of the capitulum at 90° of flexion, a complete detachment

of the bone plug can occur. Removal of the bone plug and microfracture is mandatory in order to eliminate catching and popping, while the possibility to bone graft the lesion is still controversial.

In some cases, an arthroscopic mosaicplasty has been performed taking the graft from the ipsilateral knee, putting the patient in lateral decubitus, and extrarotating the hip performing knee arthroscopy (Fig. 3). The 6.5 mm cylinder graft taken from the lateral knee trochlea was inserted in the elbow injured area carefully checking the angle of the drilling and of the insertion of the bony–chondral cylinder. Arthroscopically, the perpendicular insertion of the cylinder allows a complete coverage of the OCD area (Figs. 15 and 16). Four months later, MRI (Fig. 17) shows a nice bone incorporation of the graft. Postoperatively, the CPM started in day 2 and passive exercises

Day 4 post-op. Patients came back to normal activity in 4 months.

Conclusion

Elbow arthroscopy has been developed as a technique and the opportunity to become a new step in treating elbow pathology. From the technical point of view, some aspects must be respected:

- (A) Use lateral or prone decubitus.
- (B) Incise the skin only and spread the tissue with a fine hemostat.
- (C) Perform at least four portals in any single procedure allowing fluid extravasation. (Do not use cannulas. Might be only one in the anterolateral portal.)
- (D) Take time in order to have a perfect view. (Use the pump no more than 50 mmHg.)
- (E) Consider the position of the nerves and vessels during all the procedures.
- (F) A small arthrotomy can be useful in any time of the operation (medial osteophytes).

Cross-References

- ▶ [Elbow Anatomy](#)
- ▶ [Sport-Related Elbow Problems](#)

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