6 Arthroscopic Equipment and Set-Up for Elbow Arthroscopy

Richard S. Page, Janina Henze, and Kevin Eng

6.1 Background

Elbow arthroscopy has established itself as an effective surgical procedure, for the management of intra-articular elbow pathology. It brings technical challenges due to the limited space in the joint and the proximity of the neurovascular structures. The procedure requires surgeon experience and the preparation plays a major role in determining the outcome.

Elbow arthroscopy was first described by Burman in 1931 who used the Jacobaeus laparoscope in a joint filled with oxygen or nitrogen gas [1]. In his first publication he stated that the elbow was not a suitable joint for arthroscopy due to the limited space in the anterior compartment. However, after cadaveric studies performed in Dresden, Germany, 1932, Burman revised his opinion. Burman's studies were performed on cadavers and even though he acknowledged the method was still in its infancy. He believed that arthroscopy could become a useful procedure in the treatment of elbow pathology.

After the first description of elbow arthroscopy, only a small number of cases were reported in Germany and Japan [2, 3]. Subsequently, the development of the 1.7 mm endoscope by Watanabe in 1971 made the procedure suitable for small joints [3].

In the 1985, Andrew and Carson continued to undertake further studies and established the additional portals [2]. Following these investigations elbow arthroscopy underwent rapid development, which in turn led to improvements in instrumentation and surgical utilisation.

Elbow arthroscopy has advanced sufficiently for the procedure to be considered safe. The complication rates are described in a number of studies with a range of 1–14%, which is regarded as high in comparison to the knee arthroscopy, with a 1–2% complication rate. However, most of the complications are described as minor with an incidence under 1% [4–6]. A key factor of note for more serious complications is the proximity

R. S. Page (✉)
Department of Orthopaedics, School of Medicine, Deakin University, Geelong, VIC, Australia

Barwon Centre for Orthopaedic Research and Education (B-CORE), Barwon Health and St John of God Hospital, Geelong, VIC, Australia

Geelong Orthopaedics, SJOG Specialist Centre, Geelong, VIC, Australia
e-mail: richardpage@geelongortho.com.au

J. Henze
Barwon Centre for Orthopaedic Research and Education (B-CORE), Barwon Health and St John of God Hospital, Geelong, VIC, Australia

K. Eng
Barwon Centre for Orthopaedic Research and Education (B-CORE), Barwon Health and St John of God Hospital, Geelong, VIC, Australia

Geelong Orthopaedics, SJOG Specialist Centre, Geelong, VIC, Australia

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of the surrounding neurovascular structures, making portal placement critical.

6.2 Planning and Layout

Before the commencement of surgery, a documented clinical history and examination, which includes the range of motion and stability in comparison with the other elbow, is essential. Imaging should be undertaken to clearly define the anatomy and pathology of the patient. As a minimum, basic diagnostic radiographs should be available and for pathologies involving the soft-tissue/ligamentous anatomy, an MRI or occasionally an ultrasound can be helpful. CT scans with 3D reconstruction are preferable to assess the bony pathology with associated loose bodies and osteoarthritis (OA) or following trauma to plan the approach and assist with fixation. In cases of advanced OA with impingement, CT scans in flexion and/or extension can detect further relevant pathology.

The surgeon should stand on the side of the elbow that will be operated on and the monitor should be on the opposite side of the operating table in direct view, visible to the surgical team (Fig. 6.1).

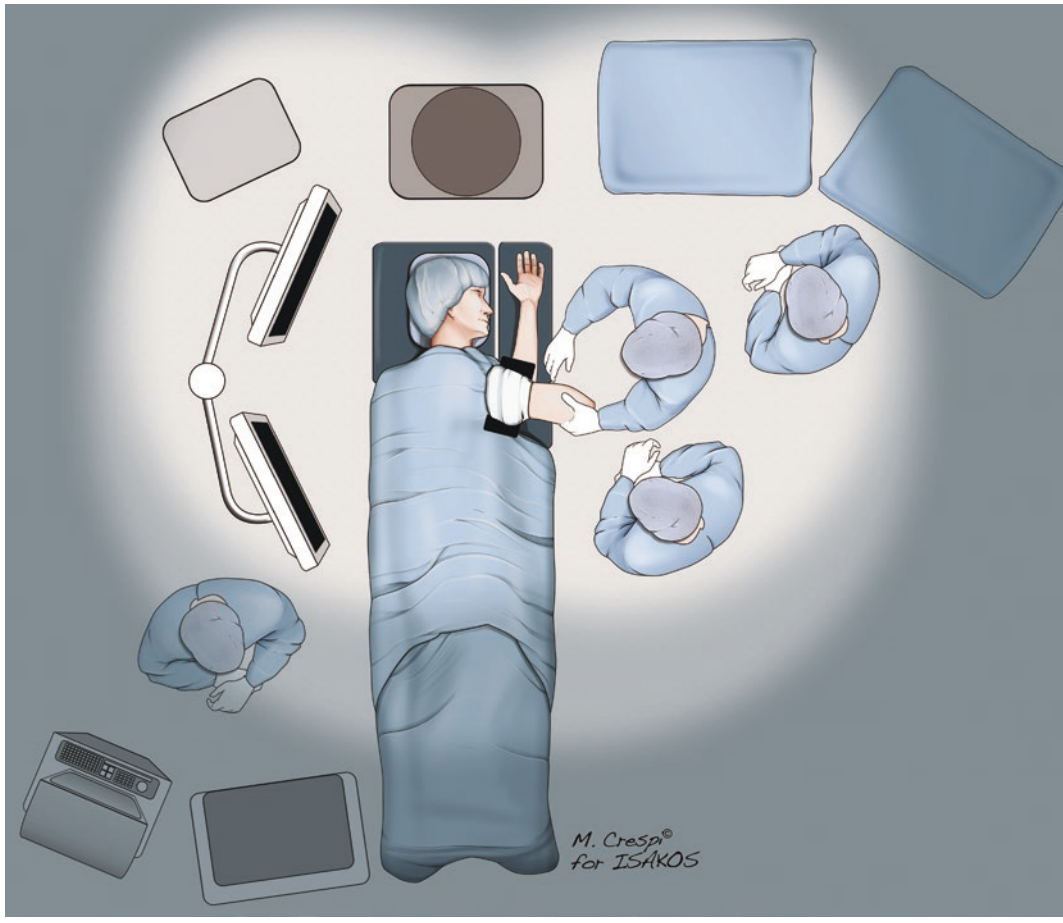

Fig. 6.1 Map of theatre layout for elbow arthroscopy. The surgeon stands on the side of the elbow and the monitors are on the opposite side. The instrument table, suction pump and arthroscopy tower (right to left) are at the head end of the operation table. The anaesthetist and ventilator are at the foot end on the table (M. Crespi © for ISAKOS) from drawings by Dr J Henze

6.3 Anaesthesia

Elbow arthroscopy can be performed under general or regional anaesthesia. Each has their supportive reasons. The patient's position on the table and equipment set-up are crucial factors that must be considered prior to anaesthesia.

- General anaesthesia is more comfortable for the patient whilst covered by the surgical drapes and muscular relaxation can be achieved. General anaesthesia can be combined with local or regional anaesthesia.
- Regional anaesthesia, such as an axillary block, can reduce the risks associated with a general anaesthesia but has two major downsides. Patients must be compliant for the procedure. Secondly it can cloud post-operative neurological evaluation.
- At the end of every procedure, local anaesthesia (e.g. ropivacaine 0.75%) can be injected to the joint and the portal sites to minimise post-operative pain.

6.4 Positioning

There are three main positions that are predominately used for elbow arthroscopy, which are detailed below. The first position employed and popularised by Andrews et al. was the supine position, until Poehling et al. established the prone position [2, 7]. In 1993, O'Driscoll and Morrey developed the lateral decubitus position, the most common in current use [7, 8]. Whichever position is utilised, adequate padding and support for the patient's trunk needs to be used to avoid unwanted movement during surgery and to protect pressure areas and nerves from compression injury [9].

- *Supine position*: The patient is placed horizontally with the face and torso up on the table, whilst the elbow is flexed to 90° fixed to an extension boom or any other limb positioner. This position has some advantages; first the anatomy is set in a natural familiar direction for the surgeon, which assists with intra-articular orientation. No assistance is needed for movement of the elbow held with a limb positioner, the arm can be placed freely in space, it is easier for the anaesthetist to control the airway and positioning is simpler for obese patients (in comparison to lateral or prone positioning). Disadvantages are the requirement for an (potentially) expensive traction device. Some surgeons also describe a feeling of instability in this position [2, 7].
- *Prone position*: The patient is prone whilst the shoulder is abducted 90° from the side of the body, whilst the elbow is hanging freely with a 90° flection. This creates unlimited access to all compartments and provides free movement and manipulation of the arm. The disadvantage is the poor airway access and pressure management particularly of the face. It is also difficult to switch into an open procedure during the surgery [8].
- *Lateral decubitus position*: The lateral decubitus position has evolved from the prone position. This position offers similar advantages to the prone position with improved access to the airway. The patient is placed on the bean bag and is then turned on their side with the operative elbow facing up. The body is held by two body/pelvis supporters, one on each side of the table. The arm is positioned on a padded arm holder or preferably on a short T-bar, to allow elbow flexion and extension. An axillary bolster can be placed under the axilla if desired. It is important that the anaesthetist has access to the airway and IV lines. It may be difficult when switching to an open procedure to access the anterior compartment [7, 8, 10]. However, the majority of the elbow can be accessed via a universal posterior or lateral approaches (Fig. 6.2).

6.5 Equipment

- An example arthroscopy tower and equipment are shown in Fig. 6.3.
- A 4.0 mm arthroscope with a 30° viewing angle is used by most surgeons. In some cases, such as small females and children the smaller 2.7 mm arthroscope may be more suitable (Fig. 6.4).

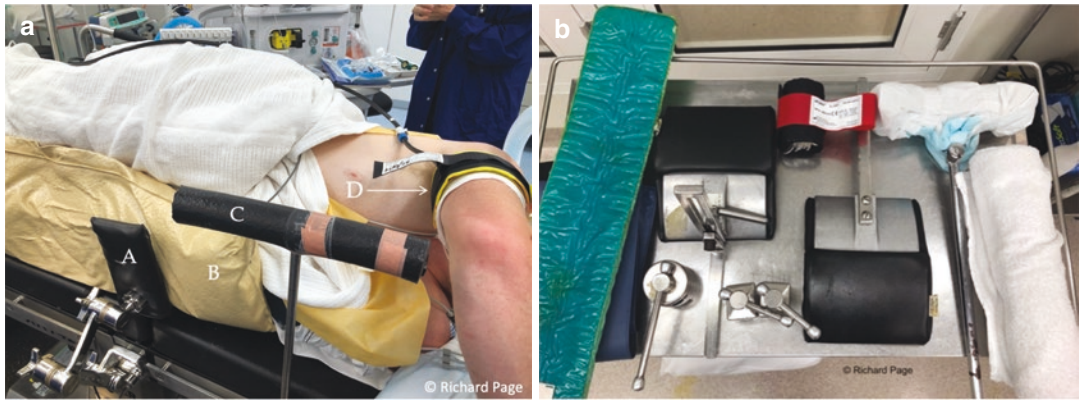

Fig. 6.2 Patient set-up in the lateral decubitus position with the required elements (image **a**), the supporting equipment is laid out on a trolley (image **b**). (A) Side support, (B) bean bag moulded and air vacuum extracted, (C) short T-bar that will support the elbow during arthroscopy, (D) tourniquet placed high up the arm to allow unrestricted portal or open access if required (© Richard Page)

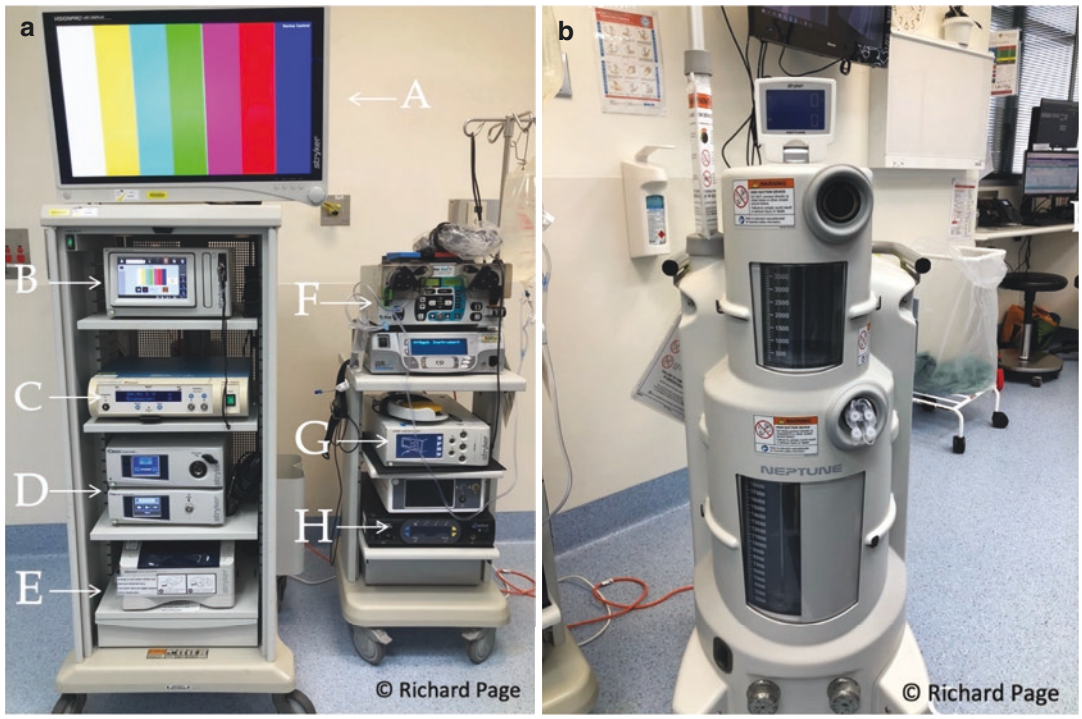

Fig. 6.3 (**a**) Arthroscopic tower with (A) video screen, (B) arthroscopic camera and image management system, (C) small joint shaver system, (D) arthroscopic light source, (E) arthroscopic image printer, (F) fluid management system, (G) power shaver console, (H) radiofrequency ablation device. (**b**) Large-capacity suction device (Neptune fluid suction system) (© Richard Page)

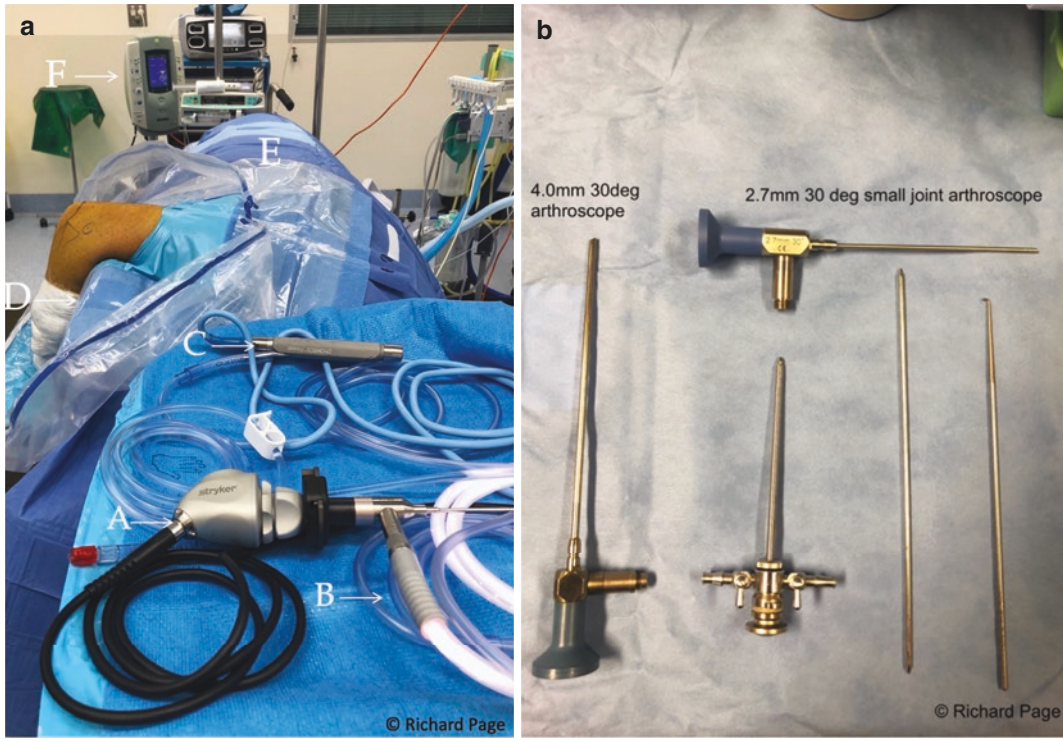

Fig. 6.4 (**a**) Set-up during surgery; the equipment is placed at the head end of the patient on a Mayo stand covered in a sterile drape. The cords are coiled and secured to the drape to minimise tangling. (A) Camera, (B) light source lead, (C) shaver motor and (D) arm draped with elbow over a support. (**b**) Arthroscopes, probe and equipment required for elbow arthroscopy (© Richard Page)

- The rest of the equipment is similar to other large joint arthroscopy sets. Cannulae may be utilised to switch the working and viewing portals in order to minimise trauma to the capsule. They should be compatible with the 4.0 and 2.7 mm arthroscopes, particularly in length.
- A fluid management pump or gravity feed may be used to maintain the intra-articular pressure and guarantee adequate visibility during the procedure. A hand pump that uses a gravity flow, however, has the risk of wide swings in pressure. A fluid management system can produce a more consistent flow and the pressure should aim to be ~35–40 mm Hg. It is advisable to familiarise with the specific pump system in use in advance, as the scale is inconsistent between company devices, and the pump should be regularly calibrated.

6.6 Getting Started

- Once positioned, the medial and lateral epicondyles, the capitulum of the humerus, the olecranon, the radius head and the ulnar nerve are identified and marked. The ulnar nerve is palpated in flexion and extension to ensure that the nerve does not subluxate anteriorly, to a position that would place it at risk during entry via the medial portal. Furthermore, the utilised portals should be identified and marked (Fig. 6.5). The range of motion and stability of the elbow are recorded.
- Prior to the commencement of surgery, the patient identification and operative side are checked as part of the 'Time Out' process as per WHO guidelines [11].
- The first step of the surgery is to inflate the elbow joint with 20–30 mL of sterile saline,

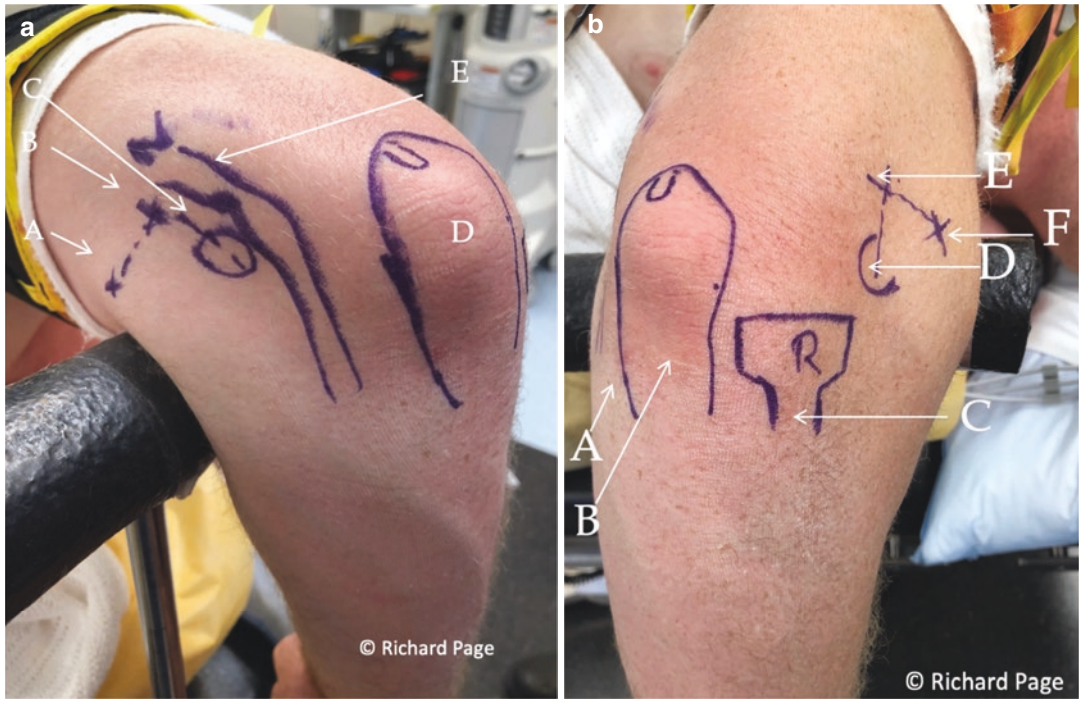

Fig. 6.5 Landmarks of the elbow are demonstrated. (**a**) Medial view of a right elbow is shown in lateral decubitus position: (A) Proximal anteromedial portal (PAMP), (B) medial intermuscular septum (MIMS), (C) medial epicondyle, (D) olecranon, (E) ulnar nerve (N). (**b**) Dorsal view of a right elbow is shown in lateral decubitus position: (A) Medial epicondyle, (B) olecranon, (C) radial head (R), (D) lateral epicondyle, (E) lateral intermuscular septum (LIMS), (F) proximal anterolateral portal (PALP) (© Richard Page)

which is injected through the posterior soft spot in the mid-lateral portal (Fig. 6.6). The fluid increases the joint space and therefore more distance is created between the neurovascular structures, capsule and instruments. Then the surgery can begin with the introduction of the arthroscope into the joint, usually through the medial portal. If a trocar is utilised to assist with arthroscopic entry, the conical not sharp tip should be used to minimise iatrogenic injury (Fig. 6.4 (b)) as shown.

6.7 Tips and Tricks

- The position of the patient and the elbow is important for surgery, especially the flexion of the elbow, which should be tested prior to the draping. Furthermore, for the set-up we recommend a short T-bar that allows rotation and reduces the interference from drapes or edges of the T-bar. This improves the mobility of the arm and access to the different articular compartments.
- Exsanguination of the limb prior to tourniquet inflation reduces intra-articular bleeding and improves visualisation.
- A range of arthroscope sizes and shavers/burrs should be available in theatre (2.7–4.0 mm) for different sized patients and various pathologies encountered.
- Start the arthroscopy with the anterior compartment, to have an overview over the joint first. When switching the portals, a 3 mm switching rod can be helpful.

Fig. 6.6 Inflation of the elbow joint with sterile saline via the posterior soft-spot portal to aid arthroscope entry with minimal trauma. (A) Sterile saline, (B) sterile draping, (C) compression bandage on the forearm, (D) radius head, (F) lateral epicondyle, (E) olecranon (© Richard Page)

Table 6.1 Elbow arthroscopy equipment checklist for the basic set-up

Arthroscope	**To establish portals**
– 4.0 mm arthroscope 30° – Small joint arthroscope 2.7 mm (if needed) 30°	– Forceps mosquito straight – Forceps mosquito curved – Forceps artery curved – Mayo scissor – Scalpel – Dissector Gillies forceps – Elevator Hohmann—small
Special arthroscopy equipment: – Grasper alligator— small joint – Instrument pins – Trocar blunt – Trocar 4.0 round – Trocar 4.0 bullnose – Nibbler bone medium – Cannula – Attachment cannula tap – Cannula nut – Switching rod 3.0 mm x 23 cm – Cage 40 mm × 40 mm – O-ring (arthroscopic seal) – Osteotome small and medium – Shaver blades and burrs (3.5 and 4.5 mm) – Radiofrequency ablation device (small)	**Other:** Suture material Sterile tapes/draping Mallet small

- If difficulty is encountered accessing the anterior compartment (e.g. capsular thickened OA males) then the arthroscope can be introduced initially into the posterior 'soft-spot' portal. Then with traction, space can be created to pass a narrow-diameter scope via the trochlea-capitellar interval to visualise the anterior compartment, whilst a 3.0 mm switching rod is introduced from the antero-superolateral portal into the anterior compartment. This can then be used to introduce the scope cannula anteriorly.
- Utilising additional 'accessory' portals, particularly posteriorly, can assist in accessing loose material, chondral lesions or osteophytes along the joint margins of the posterior compartment.
- A list of basic set up equipment with optional instruments for more advanced elbow arthroscopy is given at Table 6.1.

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