Operating Room Setup and Patient Positioning

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Arthroscopy has made it possible to define many of the known lesions related to shoulder disorders and to identify other, new ones. The surgeon must be familiar with these different lesions and with their surgical treatment. Although careful planning of an appropriate therapeutic procedure on the basis of clinical and instrumental examinations is crucial, the surgeon, faced with the arthroscopic diagnosis, is often required to use different techniques from those initially planned. In shoulder arthroscopy, the ideal setup is therefore one that is versatile enough to allow the execution of different surgical procedures. Achievement of this objective depends on careful planning and preparation of the instrumentation.

The surgical team, the anesthesiologist, and the operating room staff all play a part in setting up the operating room: only through teamwork is it possible to ensure optimization of complex and versatile surgical procedures.

Operating Room

General Requirements

The success of the operation depends on correct operating room arrangement and setup. A dedicated, well-equipped operating room staffed by a specialist arthroscopy team constitutes the ideal working environment. Having an area specifically set aside for shoulder arthroscopy means that the surgeon and staff are able to enter the theater knowing that everything will be in its proper place: operating table, arthroscopy column, fluids, stands, etc. Any reasonably sized general surgery or orthopedic operating room can be prepared for shoulder arthroscopy, providing this is done by personnel with specific training and expertise in arthroscopy (Fig. 8.1).

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Operating Table

Shoulder arthroscopy can be performed with the patient in the lateral decubitus position or in the beach-chair position. In both cases, a standard Mayo orthopedic table is used. The Mayo table is positioned in the center of the operating room or at least at 45° angle to the long side of the room (Fig. 8.2).

If the beach-chair position is to be used, the table must allow raising of the patient's trunk with flexion of the hip and knee joints and lateral and longitudinal tilting; furthermore, it must be adjustable in height so that the shoulder can be positioned at the correct level in relation to the surgeon. Access to both the anterior and posterior aspects of the shoulder can be guaranteed by using a special head support or modular elements to support the chest, with removable sections in the shoulder area (Fig. 8.3).

Surgeon's Position

The most versatile position for the surgeon is at the proximal end of the operating table; in assuming it he occupies what is traditionally the anesthesiologist's position. In this position, the surgeon has complete access to the anterior, posterior, upper, and lateral aspects of the patient's shoulder. Each of these areas can become crucial during a surgical procedure and must therefore be fully accessible. The "head-of-the-bed" position is also the most indicated when switching to an open surgical phase: the surgeon has a good view of the entire surgical field, and it is easier for the assistants to retract the tissues.

Anesthesiologist's Position

The anesthesiologist stands opposite the surgeon, proximal to and at an angle of around 45° to the patient's head.

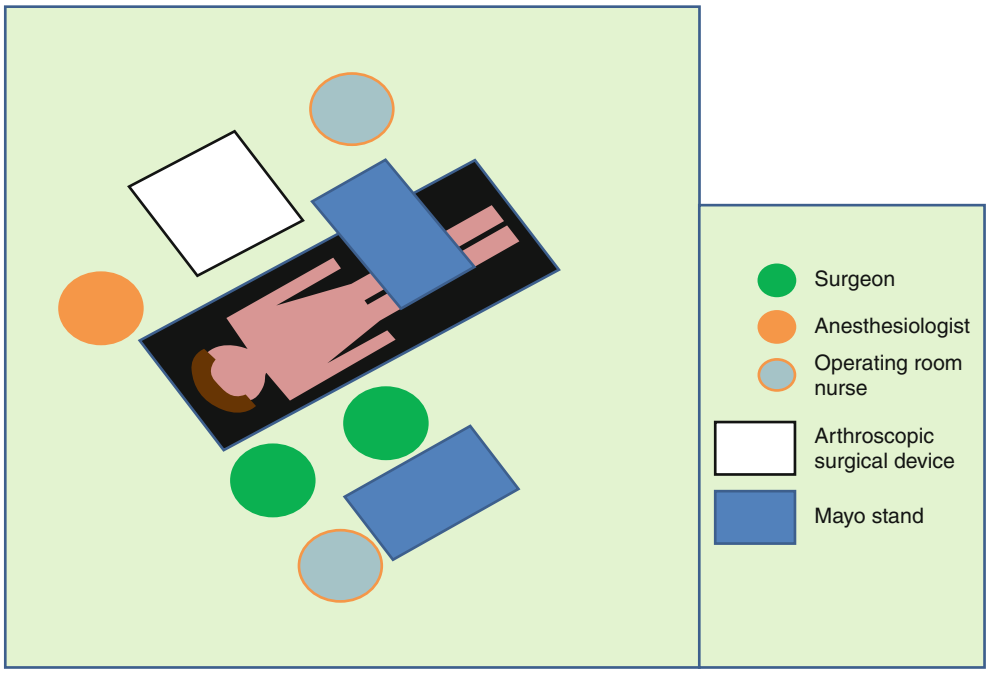

Fig. 8.1 Operating theater arrangement and setup for shoulder arthroscopy

Fig. 8.2 Operative room setup for lateral decubitus position

Fig. 8.3 Operative room setup for beach-chair position

Arthroscopy Unit

The arthroscopy unit is equipped with all the devices that comprise the standard equipment for correct execution of an arthroscopy procedure (see Chap. 7). It is arranged in two columns on two portable trolleys. Arranged on the first trolley, which must be tall enough to allow a good view of the arthroscopic image, are, from top to bottom, the monitor, the video camera, the light source, the motorized system, the radiofrequency system, the video recorder, and the video printer. The second trolley contains the arthroscopy pump together with the holders for the bags of fluid used to distend the joint, which, to guard against the risk of leakage from the system, are kept away from the electrical instruments. If the injection pressure is measured on the fluid delivery line rather than directly on the arthroscope, particular care must be taken over the height at which the arthroscopy pump is positioned, in order to ensure that it can be correctly calibrated in relation to the blood pressure values: it is generally positioned at the level of the patient's chest.

The suction system must be equipped with at least two separate collection bags, so that it is possible to switch to the second as soon as the first is full.

The arthroscopy column is positioned along the opposite side of the table, opposite the surgeon, so that he is easily able to see the images on the monitor and can directly keep all the devices under control. The second trolley (containing the arthroscopy pump and distension fluid bag holders) and the suction system are placed alongside and distally to the arthroscopy column.

Stands

The main stand is situated just behind the surgeon. It contains the surgeon's arthroscopic instruments and the other specific surgical sets (Fig. 8.4).

The first Mayo stand, positioned next to and within easy reach of the surgeon, contains the instruments needed to mark the bone contours, prepare the arthroscopic portals, and introduce the arthroscope: 20 ml syringe of distention fluid, scalpel blade n°11, skin-marker pencil, 19-G spinal needle, cannulas, blunt trocars for the arthroscope sheath and cannulas, switching stick, and Wissinger rod.

The arthroscope, the motorized handpiece, the electrosurgery system electrode, and the infusion and suction tubes are

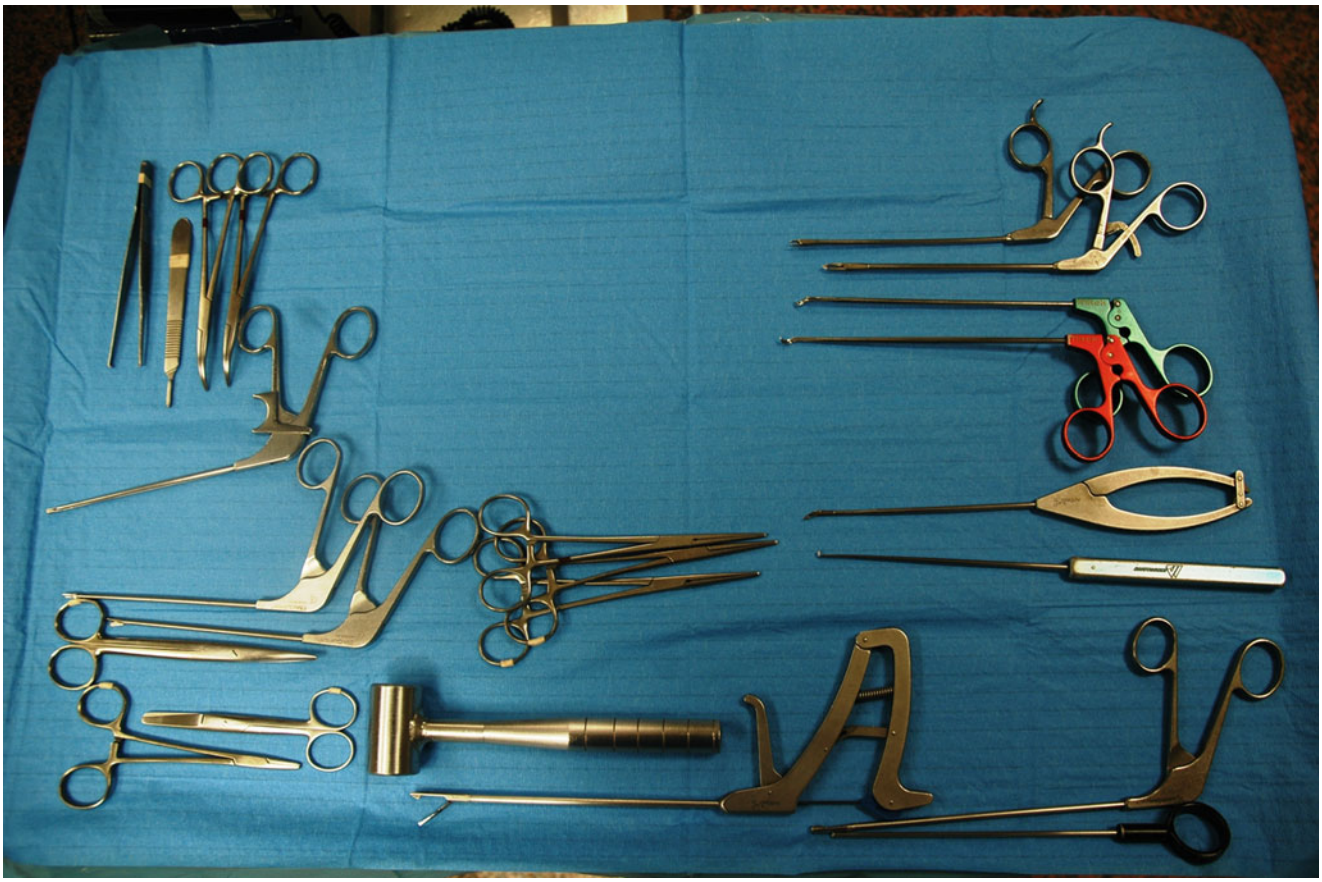

Fig. 8.4 Main stand arranged with surgeon's arthroscopic instruments

arranged on the second Mayo stand, positioned above the patient on the opposite side of the operating table.

Fluid Collection on the Floor

Two rectangular suction mats for collecting waste fluid are placed in an L shape on the floor at the proximal corner of the operating table, under the position of the shoulder to be operated on.

Operating Room Staff

Nothing favors efficient work more than the presence of competent staff who are familiar with the techniques and instruments used. Since surgeons do not always have their own staff available – for most this is a luxury – it is crucially important to establish standardized protocols according to which staff members have their own specific tasks, which they perform in accordance with clearly defined rules and directives. This creates the right feeling, confidence, and spirit among the staff and enables them to work in an environment where everything is optimally set up.

The instrument technician is responsible for preparing the main instrument stand and the two Mayo stands. The scrub nurse arranges and sets up the various components of the room (operating table, arthroscopy column, fluid collection mats), looks after the positioning and preparation of the patient, prepares the instruments and monitors their functionality during the operation, and responds to any requests from the surgical team.

Patient Preparation

In the Department or at Home

The patient comes to the surgical unit from the department, in the case of an inpatient, or from home, if the treatment is being performed as a day-hospital procedure. In any case, the patient is always instructed beforehand not to assume food or liquids after midnight the night before the operation. His body must be thoroughly cleaned with an antiseptic skin

cleansing fluid, paying particular attention to the arm to be operated on (armpit, hand, nails, etc.). The arm in question is marked using a skin-marker pencil; the mark is made on the lateral aspect of the arm.

Trichotomy

Complete trichotomy of the arm, axilla, and ipsilateral hemithorax is performed in the department or in the admission room in the case of a day-hospital procedure. It is necessary to check that this procedure has been correctly performed before the patient enters the operating room.

Checking the Patient's Documentation

Before the patient enters the operating room, the surgeon must check that all the patient's documentation, clinical and instrumental, is present: fully compiled medical records, preoperative examinations, informed consent, and radiological examinations (X-rays, MRI scans, CT scans). A member of the surgical team must mount the most significant radiological images on the negativoscope in the operating room before the start of the operation. Alternatively, electronic material (CDs, DVDs, or images on PACS: picture archiving and communication system) should be uploaded and checked on a computer in the operating room or surgical unit.

Patient Positioning

Positioning the patient is one of the steps in shoulder arthroscopy whose importance is often underestimated, thereby compromising the success of the operation. Correct positioning of the patient on the operating table is important for the patient's safety and also because it guarantees the surgeon optimal surgical access to the glenohumeral joint and subacromial space in order to perform the procedure. Incorrect positioning of the patient can restrict the surgeon's maneuvers and interfere with the handling of the instruments; it can prevent precise placement of the portals and anatomical arrangement of the lines of force for the traction of the limb, and it can facilitate the onset of complications resulting from injuries caused by compression or stretching of nerves.

In addition to guaranteeing excellent exposure of the arthroscopic portals, the position must be such that the patient's respiratory and circulatory function is not compromised, the peripheral neurovascular structures are protected against possible compression injury, and, in the case of regional anesthesia, the anesthesiologist can work in comfort and the patient is comfortable.

Shoulder arthroscopy can be carried out with the patient in the lateral decubitus position or in the beach-chair position. The surgeon indicates the required position beforehand, in the list of surgical specifications. The scrub nurse consults the surgeon personally before the operation to confirm the type of position indicated in the list. It is the surgeon's responsibility to verify the protection of neurovascular structures. The nurse prepares the various supports and accessories necessary for positioning the patient and then coordinates the process.

Lateral Decubitus Position

A U-shaped beanbag surgical positioner (Olympic Vac-Pac; Natus Medical Inc., San Carlos, CA, USA) is placed on the operating table with the base of the U positioned at the level of the scapula, and, on top of it, an anti-decubitus gel pad (Fig. 8.5). The patient is moved onto the table and positioned on his contralateral side. Given that there is a risk of compression injury to the contralateral brachial plexus, an anti-decubitus gel pad must be placed between the operating table and the axilla in an attempt to prevent this complication with under his axilla. If the patient is under general anesthesia, the anesthesiologist monitors the patient's head and coordinates the actions of a nurse and surgeon, one on each side of the table, as they rotate the patient onto his side. The patient's head is positioned on a double pillow. Another pillow is placed between his legs to avoid stress on the hip and knee joints. The bony protuberances of the contralateral elbow, hip, knee, and ankle are protected with a gel pad. Gross and Fitzgibbons [1] modified this position, rotating the patient 30–40° posteriorly, so as to position the glenoid surface on a horizontal plane. This slight but effective modification allows more comfortable maneuverability of the instruments, correct placement of the glenohumeral joint rim in horizontal position, and a more anatomical arrangement of the lines of force during the traction. Because this latter factor allows less force to be applied during the traction, it eliminates the occurrence of traction-induced brachial plexus injuries [2].

Lateral supports for the gluteal region and sternum are positioned. While keeping the Vac-Pac wrap adherent to the patient, a suction device is used to create a vacuum in it, thus stiffening the structure; this is secured in position to the bed using a strap, and the patient is covered with a thermal drape (Fig. 8.6). A 3-Point Shoulder Distraction System (Arthrex, Naples, FL, USA) is then positioned at the distal end of the table on the contralateral side. This allows positioning of the arm in between 0° and 70° of abduction and between 0° and 30° of flexion, making it possible to obtain sufficient distension of the glenohumeral joint and subacromial space. This position was originally described by

Fig. 8.5 Operating table setup for the lateral decubitus position. A U-shaped beanbag surgical positioner and a protective anti-decubitus gel pad are placed over the table

Fig. 8.6 Lateral decubitus position. The beanbag surgical positioner wraps the patient's body. Bony protuberances are protected with pillows and pads

Andrews et al. [3] and involved placing the arm at 70° of abduction and 15° of forward flexion. The 15° forward flexion is mandatory as it reduces the risk of injury due to traction of the brachial plexus [4]. This is a not infrequent complication, and it is a risk that the surgeon should always bear in mind. Several authors have studied its incidence, analyzing it in relation to the position of the limb and the weight applied as traction [5, 6].

A sterile drape is positioned, at a 45° angle, at the level of the patient's head in order to create a barrier between the surgical field and the anesthesiologist's position, and the second Mayo stand is positioned above the patient (Fig. 8.7).

Beach-Chair Position

The need to define an easier, more versatile, and more comfortable position, for both patient and surgeon, has stimulated the imaginations of a number of distinguished specialists. Hence, in 1988 Skyhar et al. [7] coined the term beach-chair position to describe this second position in which the patient is semi-seated with his trunk inclined at an at least 60° angle and his arm free.

Placing the patient in the "beach-chair" position facilitates exposure of the various landmarks. Its versatility is such that it allows a smooth and easy transition from the arthroscopic to the open surgical phase.

Fig. 8.7 Lateral decubitus position. Operative field is complete. The arm is held in traction and a barrier was placed between the surgical field and the anesthesiologist's position

In this position most of the patient's weight is borne by the gluteal region: the patient is positioned on the operating table in such a way that the gluteal region is directly over the pivot point of the operating table. The table is tilted to the Trendelenburg position. The backrest is raised to obtain a 90° sitting position. A wedge pillow or, alternatively, a flat pillow folded in two is placed under the patient's knees to avoid excessive stress on the myotendinous and neurovascular structures. The end of the operating table is tilted to prevent excessive pressure on the back of the foot. A gel pad is placed under the heels to prevent pressure sores. The patient's legs are secured to the table by means of a strap applied over a gel pad. The arm to be treated can be left free in an arm sling (Fig. 8.8).

The fact that the arm does not have to be put in traction is a huge advantage for the surgeon, as the normal anatomy is respected and no strain is put on the various capsular, ligamentous, and tendinous structures. The absence of traction greatly reduces the risk of brachial plexus injury. Furthermore, with the careful help of an assistant, the arm can easily be positioned as needed.

It should nevertheless be borne in mind that the literature contains several reports of brachial plexus and hypoglossal nerve injury due to hyperextension of the cervical spine [8].

A variation of this position allows traction to be applied with the arm in 0° of abduction and 45–90° of elevation. Traction is applied via a leg support positioned at the end of the table. With this variant, the less experienced surgeon avoids the need to pay attention to the correct arm position also during surgery, repeatedly adjusting it to the different surgical steps. In a detailed cadaver study, Klein and Fu [9] established that this type of traction was the least harmful to the brachial plexus.

The contralateral limb is positioned on a support with an anti-decubitus gel pad. The patient's head, supported by a special headrest which is adjusted in height and extension, is turned slightly away from the surgical field and secured with silk tape applied to the forehead. Two lateral dorsal supports are used to stabilize the trunk (Fig. 8.8). The patient is covered from the chest down with a thermal drape. A sterile drape is positioned, at a 45° angle, at the level of the patient's head in order to create a barrier between the surgical field and the anesthesiologist's position. The arthroscopy instruments are arranged on the second Mayo stand, secured to the table above the patient (Fig. 8.9).

Preparing the Surgical Field

The scrub nurse cleanses the patient's arm, shoulder, and hemithorax with iodopovidone.

The surgeon, wearing adequate protection on his feet (rubber boots), after disinfecting his hands and forearms, puts on a sterile disposable reinforced surgical gown. He starts disinfecting the patient's skin with sterile betadine, initially assisted by the scrub nurse who supports the patient's arm during the disinfection of the hand and forearm. When this is complete, an assistant wearing an impermeable stockinette supports the patient's hand while the disinfection of the arm, shoulder, hemithorax (anterior, posterior, armpit), and neck is completed. The instrument technician covers the patient from the chest to the distal end of the table with a sterile full-length drape. The stockinette is unrolled so that it covers the patient's arm and forearm, and a compression bandage is applied to the arm using cohesive elastic bandage. A U-shaped impermeable drape is made to adhere around the shoulder, taking care to leave enough space on the anterior and posterior hemithorax to allow a large and convenient field for the portals. The two arms of the U drape are rejoined at the base of the neck and made to adhere to each other with their ends on the patient's head. An upper extremity patient isolation drape arranged transversely completes the preparation and, with its two upper ends secured by the scrub nurse to two holders, separates off the anesthesiologist's position. It is necessary to cut the incise film around the hole of the upper extremity drape from which the arm is passed to completely expose the surgical field: an adhesive

Fig. 8.8 Beach-chair position. The patient's head, supported by a special headrest, is turned slightly away from the surgical field and secured with silk tape applied to the forehead. Lateral dorsal supports are used to stabilize the trunk

Fig. 8.9 Beach-chair position. Operative field is complete. The arm is held in traction and a barrier was placed between the surgical field and the anesthesiologist's position. The arthroscopy instruments are placed on a Mayo stand above the patient

strip is used to secure the incise film to the underlying skin to prevent fluid strike-through and reduce risk of contamination.

The surgical field is now ready. If the arm has to be placed in traction, care must be taken to avoid compression of bony protuberances and neurovascular structures. The STaR (Shoulder Traction and Rotation) Sleeve (Arthrex) is a useful device; it is a sterile, soft foam traction boot with five Velcro straps: the distal strap is closed first, followed by the others, proceeding proximally. Finally, the distal strap is tightened again. The sleeve is secured to the arm holder by the nurse who then attaches weights to the pulley system.

Once the field is ready and, if necessary, the arm is in traction, the surgeon, using a sterile skin-marker pencil, marks out the bone contours of the shoulder, indispensable landmarks for the correct execution of the arthroscopic portals (see Chap. 10).

Checklists

The *instrument technician* is responsible for preparing the materials and surgical instruments necessary for the procedure.

Necessary Materials for the Surgical Field

- U-shaped impermeable drape
- Upper extremity patient isolation drape
- Impermeable stockinette
- Two full-length drapes (one for the main stand, one for the patient)
- Two Mayo stand covers
- One Fixona bandage
- One 90×150 cm drape to cover the main stand
- Two 75×90 cm drapes to cover the Mayo stands
- One adhesive strip
- One sleeve for traction of the arm
- Reinforced surgical gowns
- Surgical gloves

Surgical Equipment

- One pouch
- Gauze swabs 10×10
- Compresses
- Scalpel blade n° 11
- One 19-G spinal needle
- Two 20 cc syringe
- Cannulas
- Blades for the motorized shaver (full radius blade, acromionizer blade)
- Electrosurgical device (radiofrequency)
- Pump circuit

Instruments

- Basic arthroscopy set
- Surgeon's arthroscopy set
- Other specific sets
- Individually packaged instruments

The scrub nurse is required to:

- Transport the patient to the operating room.
- Consult the surgeon about the type of position required.
- Coordinate positioning of the patient.
  - For operations performed in the beach-chair position:
    - Move the patient onto the operating table.
    - Tilt the table to the Trendelenburg position.
    - Raise the backrest to obtain the sitting position.
    - Place a pillow, folded in two, under the patient's knees and secure them with a strap.
    - Lower the end of the table.
    - Apply the support with anti-decubitus gel pad for the contralateral arm.
    - Block the arm with a band.
    - Apply the support for the arm on the operative side or the leg support for traction at the end of the table.
    - Apply the dorsal supports, the larger on the operative side and the smaller on the contralateral side.
    - Adjust the headrest in height and extension; position the patient's head so that it is turned away slightly from the operative side.
    - Secure the head using silk tape applied to the forehead.
  - For operations performed in the lateral decubitus position:
    - Position the Vac-Pac and anti-decubitus gel pads on the operating table.
    - Move the patient onto the operating table.
    - Position the patient on his contralateral side with an anti-decubitus gel pad under his axilla. If the patient is under general anesthesia, this operation is carried out together with the anesthesiologist and the surgeon.
    - Raise the patient's head on two pillows.
    - Attach the arm sling with gel pad to the operating table.
    - Place a pillow between the patient's legs.
    - Place anti-decubitus gel pads under the patient's knee and malleolus.
    - Wrap the Vac-Pac around the patient.
    - Place supports in the sternal and gluteal regions.
    - Create a vacuum in the Vac-Pac.
    - Fix the traction system to the end of the table, on the other side.

  Once the patient has been positioned:
- Cover the patient with a thermal drape.
- Position the sterile drape.
- Cleanse the limb with iodopovidone.
- Position the two waste fluid suction mats on the floor on the side of the table where the operation is to be carried out.

  Once the preparation of the surgical field is complete:
- Connect up the camera head and fiber-optic cables from the sterile field to the arthroscopic tower.

- Adjust camera color balancing.
- Enter the patient's data in the documentation systems (video printer or imaging system).
- Prepare the 5,000 ml bags of saline, putting them in their holders.
- Receive the sterile pump circuit from the surgical field and connect it with the pump, bags, and suction devices.
- Start the pump.
- Connect up the pedal of the motorized handpiece and place it within the surgeon's reach.
- Connect up the power cable of the sterile motorized handpiece from the surgical field.
- Connect up the sterile electrosurgery system handpiece from the surgical field.

The surgeon must:

- Check the patient's documentation and imaging studies.
- Check that the patient has received prophylactic antibiotics.
- Help to position the patient.
- Check that the positioning of the patient has been performed correctly.
- Check that the peripheral neurovascular structures are properly protected.

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