(ii) Basic knee arthroscopy: a brief history, surgical techniques and potential complications

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Abstract

Knee arthroscopy has proved to be a useful tool in the diagnosis of common knee intra-articular pathologies and has become a mainstay of treatment for meniscal, cruciate and chondral disorders of the knee. The aim of this article is to give a brief history of arthroscopic surgery, explain the safe positioning of the patient on the operating table and how to navigate the knee with an arthroscope, and cover the potential complications.

Keywords arthroscopy; meniscectomy; portal; surface anatomy; triangulation

Introduction

Arthroscopic surgery has revolutionised the way that intra-articular pathology has been treated since its inception in 1912, and arthroscopy of the knee has now become the most commonly performed elective operation in Orthopaedic surgery.

The first recorded arthroscopy was performed in Denmark in 1912, and the term arthroscopy was introduced into the medical vernacular by a Swedish surgeon called Hans Christian Jacobaeus.

The design of modern arthroscopes is based on the work of the Japanese surgeon Kenji Takagi, who developed his first of many designs of arthroscope in 1918. However, it was not until 1931 that he developed an arthroscope small enough for rudimentary surgery within the knee cavity.

The mantle of development of arthroscopic instrumentation moved to Takagi's protégé, Masaki Watanabe, whose arthroscopic designs were adopted worldwide and were used in the training of American Orthopaedic Surgeons. He was the first to truly use arthroscopy as a therapeutic rather than simply diagnostic procedure, performing the first recorded partial meniscectomy on May 4th 1962.

There were disadvantages associated with the arthroscopes of the time; including the risk of the internal light source, an incandescent bulb, short circuiting or even shattering within the knee joint.

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The cold fibre optic light source was introduced in the 1970's, and heralded the transition of arthroscopy into a dependable and safe form of surgery. At the same time, monitors (televisions) were used for the first time to allow the surgeon to visualize the interior of the joint, freeing up the surgeon's hands. This led to the ability to perform more complex surgeries via an arthroscope, including ligament reconstructions.

By the mid-1980's it was accepted that arthroscopic surgery for certain intra-articular complaints was not only on a par with, but was indeed superior to, formal open arthrotomy as patients no longer required extensive incisions that took longer to heal and longer to rehabilitate from.

Indications for use of arthroscopy in the knee include:

- Repair or resection of meniscal tears that are symptomatic of locking, pain or swelling.
- Removal of loose bodies causing impingement, pain locking or giving way.
- Anterior cruciate ligament (ACL) ligament reconstruction.
- Posterior cruciate ligament (PCL) reconstruction.
- Acute arthroscopic lavage of infected knees and painful crystal arthropathy.
- Synovectomy (removal of diseased synovial tissue) in cases of:
  - Rheumatoid arthritis
  - Infections (septic arthritis etc)
  - Pigmented villonodular synovitis (PVNS)
  - Synovial chondromatosis (multiple loose bodies)
- Articular cartilage injuries and defects requiring:
  - Abrasion chondroplasty
  - Mosaicplasty
  - Autologous cartilage implantation (ACI)
  - Osteochondral defect or osteochondritis dissecans fixation
- Lateral retinacular release for lateral patellar overload/pressure syndrome.
- Assessing knee joint for suitability prior performing a unicompartmental knee replacement (UKR) or high tibial osteotomy (HTO).
- Arthroscopic-assisted fixation of tibial plateau fractures.

Assessment of the patient prior to any form of surgery is imperative. This should include a full history of the patient's complaint and any salient past medical history, familial history and co-morbidities. A full examination of the knee joint should be performed, along with examination of the hip joint and, if indicated, the spine. The neurovascular status of the limb should also be recorded.

Relevant investigations include plain radiographs and often an MRI scan of the knee prior to an arthroscopic procedure. CT scans can be of use in planning surgery for bony injuries such as tibial plateau fractures or osteochondral injury.

Preparation for theatre is equally important. One must review the patient just prior to their arthroscopic procedure in case there has been any change in their symptoms and to appropriately consent and mark the relevant limb, ready for theatre.

Preparation and starting the procedure

Once the patient is anaesthetised, the operating surgeon should ensure the patient is appropriately and safely transferred onto the

operating table. An examination under anaesthesia (EUA) should then be performed. The examination under anaesthesia should include testing for effusion, the range of motion of the knee, an assessment of patellar mobility (medial and lateral quadrant movement). Instability tests should include: anterior drawer, posterior drawer, Lachman's (including endpoint), collateral ligament testing and dial test for posterolateral corner instability. Certain tests, such as a pivot shift to test for an ACL rupture, which involves introducing a rotational and valgus load to test the integrity of the ACL, are better tolerated when the patient is anesthetised and relaxed. The findings of the examination are documented in the operative report and these can be correlated with arthroscopic findings.

Following the EUA, the patient must be appropriately positioned on the operating table, with the feet near the end and the ipsilateral thigh and knee near the side edge of the table. On most occasions a high thigh tourniquet is applied, with the tourniquet usually set to 300 mmHg, or at least 100 mmHg above systolic blood pressure. A plastic cut-off drape is applied at this point to stop cleansing fluids getting underneath the tourniquet and causing potential burns when the tourniquet is inflated.

Following application of the tourniquet, a side support is positioned lateral to, and at the level of, the tourniquet. This is used as a buttress to allow for a valgus stress to be applied to the knee when assessing the medial compartment of the knee. Some surgeons use a thigh holder, which allows both a medial and lateral stress to the knee, to assess the medial and lateral joint spaces. The surgeon should then take the ankle and rest it across the contralateral leg with the knee bent to 90° in the 'figure-of-4' position for visualisation of the lateral compartment. Pushing the knee to the table causes the hip to externally rotate, which subsequently adds additional varus force for lateral compartment arthroscopy. These exercises should be performed as a 'dummy-run' to ensure there is the range of movement required before the patient is fully prepped and draped.

The tourniquet is either inflated at this point using an exsanguinator, and draping of the patient proceeds, or the patient is draped and the limb is elevated to reduce blood flow and drain blood from the leg prior to tourniquet inflation.

Draping of the patient forms another important step of the set-up before the first incision is made. Draping is performed in layers. Antiseptic solution is applied to the operative field and surrounding areas up to the tourniquet. An assistant holds the leg during this stage. A further cut-off drape is applied proximally to ensure a sterile field below the tourniquet. An impermeable stockinette or a further drape is placed over the foot to seal it off from the arthroscopic field. The stockinette is held in position by a bandage or sticky operative tape. Finally, an arthroscopy drape is positioned over the foot and up to a level just below the tourniquet. This generally has a hole or diaphragm that seals against the ingress of arthroscopic fluid and prevents it from leaking up under the tourniquet. The foot is then lowered to the table and the table height is adjusted accordingly to the surgeon's preference.

When first starting to perform arthroscopies, it is advisable to mark out the surface anatomy, as the marked regions will become the reference points for portal positions. Marking is made in the position of the first incision, which is usually with the knee flexed to 90 degrees. The palpable borders of the patella, patellar tendon, tibial tubercle, the medial and lateral tibial joint lines, medial and lateral condyles and the head of the fibula should be all marked on the skin. Typically, the lateral joint line is slightly more superior compared to the medial joint line (Figure 1).

Portal incisions can be made vertically or horizontally. Vertical portals are extensile but can cut through the meniscus if not carefully placed. Horizontal portals are more cosmetic but are difficult to modify if they are placed too high or too low as they are non-extensile.

With the knee flexed to 90 degrees and after marking, just lateral to the patellar tendon and 1 cm above the lateral joint line, a number 11 or 15 blade is taken with the blade facing away from the patellar tendon (horizontal portal) or medial meniscus (vertical portal). A 5 mm incision is made through the skin and the joint capsule in the direction of the femoral intercondylar notch. Care is taken not to damage the ligaments or cartilage and to stay above the meniscus.

The arthroscopic cannula with a blunt trocar is then brought into the field and held with the index or middle finger guiding the cannula. The cannula is inserted into the anterolateral portal at an angle parallel to the tibial plateau and directed between the condyles. The cannula is then pushed into the intercondylar notch. It is advisable to ensure that the cannula and the blunt trochar can move freely through the portal that has been made to ensure smooth instrumentation later. Then, the cannula with obturator is withdrawn to be outside of the intercondylar notch and the knee is straightened into full extension. The cannula is then advanced into the suprapatellar pouch under the surface of the patella. There should be no forceful movements. A block in advancing the cannula may indicate the femoral condyles have not been cleared or the cannula is hitting the patella.

Once the cannula is positioned into the joint, the obturator is removed and the arthroscopic camera is locked into the cannula. The fluid flow is then started. It is at this point that the diagnostic arthroscopy can proceed.

The anteromedial portal is the main 'work horse portal'. Most instrumentation will take place via the anteromedial portal. The placement of this portal is paramount in order to reach most of the

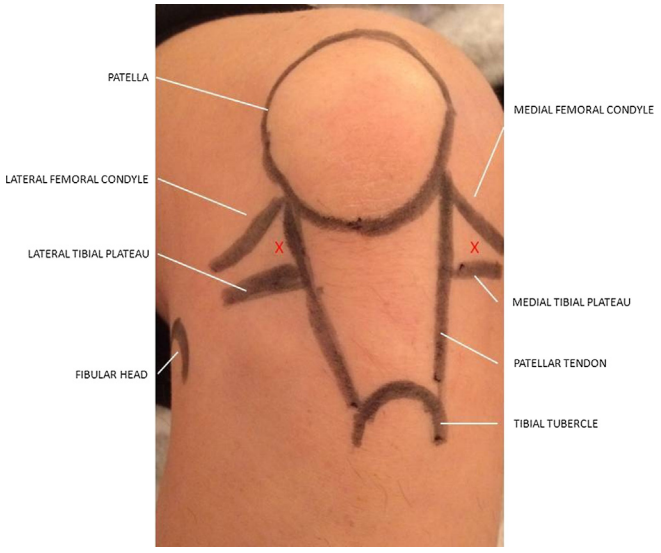

Figure 1 Surface anatomy for anterior portal placement for knee arthroscopy.