Knee Arthroscopy

a report by
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Arthroscopic surgery has been evolving since the beginning of the 20th century. Between 1921 and 1926, Eugen Bircher published several papers describing 60 arthroscopic knee procedures that preceded an open meniscectomy. This was the first time that arthroscopy was used in a large scale for clinical purposes and Bircher used the Jacobaeus thoracolaparoscope.[1] In the 1950s, Professor Harald H Hopkins developed the rod lens system, which is still used today in the most modern arthroscopes.[2] Throughout the 1970s and 1980s, knee arthroscopy became increasingly popular as a method of treating and diagnosing disorders of the knee. Today, knee arthroscopy is the most common procedure performed among orthopedic surgeons.[3] Initially, knee arthroscopy was used as a diagnostic technique. With the advent of magnetic resonance imaging and other non-invasive techniques, knee arthroscopy is now used for the treatment of various knee pathologies.

Indications for knee arthroscopy include the treatment of meniscal pathology, specified articular cartilage lesions, osteochondral lesions, loose bodies, advanced synovitis, cruciate ligament tears and certain tibial plateau fractures. One of the most common indications for knee arthroscopy has historically been the debridement of the arthritic knee. Recent controversy regarding the efficacy of arthroscopy for knee osteoarthritis has arisen. In a 2002 article by Moseley, et al., the outcome after arthroscopic lavage and debridement of an arthritic knee was no better than with a placebo.[4] One hundred and eighty patients were randomised to receive either an arthroscopic debridement, arthroscopic lavage, or placebo surgery consisting of skin incisions only. One hundred and sixty-five patients completed the study. No difference was recorded at two years follow-up among the groups regarding pain or function. Thirteen days after the publication of the article by Moseley, the Arthroscopy Association of North America issued a statement reporting that patients with mild arthritis in the presence of mechanical symptoms such as locking and catching can benefit from a knee arthroscopy. The limitations of the Moseley study include a patient population that is not representative of all patients undergoing arthroscopic treatment of the knee, as a large number of cases involve disability ratings, secondary gain, and a lack of preoperative documentation of range of motion, mechanical symptoms, or effusions. Therefore, the orthopedic community does not agree with the conclusions drawn by the Moseley study.

Contraindications for the use of knee arthroscopy are few. Damage to the posterior capsule about the knee may allow extravasation of the fluid into the surrounding tissues. This will lead to swelling and may result in compartment syndrome. Therefore, the posterior capsule should be allowed to scar down or be repaired primarily prior to arthroscopy. Other contraindications to knee arthroscopy include: joint ankylosis; local skin infection around the potential portal sites, which may lead to joint sepsis; and a remote infection that may be seeded in the operative site.[5]

There are many advantages of arthroscopic surgery, including reduced post-operative morbidity, smaller incisions, less inflammatory response resulting in less post-operative pain, improved thoroughness of diagnosis, reduced hospital cost, decreased complication rate, and enhanced joint visualisation.[5] Contrarily, the disadvantages to arthroscopic knee surgery are few. Arthroscopy requires the surgeon to work in a confined area with small instruments.

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1. *C W Kieser and R W Jackson, "Eugen Bircher (1882–1956) The First Knee Surgeon to Use Diagnostic Arthroscopy",* Arthroscopy, *19 (7) (Sept. 2003), pp. 771–776.*
2. *H H Hopkins, US Patent 3,257,902, "Optical System Having Cylindrical Rod-Like Lenses", 1966.*
3. *Reference.*
4. *J B Moseley, K O'Malley, N J Petersen, et al., "A Controlled Trial of Arthroscopic Surgery for Osteoarthritis of the Knee",* N. Engl. J. Med., *347 (2002), pp. 81–88.*
5. *B B Phillips (1998), "General Principles of Arthroscopy",* Campbell's Operative Orthopaedics *(Ed. S T Canale), Ninth Edition, St Louis, Mosby, pp. 1,453–1,469.*

Significant damage can be done to the articular cartilage if the surgeon is not skilled and careful. In addition, arthroscopic surgery can be time-consuming early in a surgeon's career.

Arthroscopic surgery requires specialised equipment. The arthroscope is the optical device consisting of a fibre optic cable protected by a rigid metal sleeve with a lens at the distal end. Arthroscopes vary in diameter from 1.7mm to 7mm, with 4mm being the most commonly used in knee arthroscopy. The angle of inclination varies from 0° to 120°. The 30° inclination arthroscope is used most commonly, with the 70° used arthroscope being useful to see around corners such as the posterior knee through the intercondylar notch. In 1976, McGinty and Johnson introduced the use of a television camera for arthroscopic procedures.[6] Prior to the advent of the television camera, the surgeon looked through the end of the arthroscope. The following instruments are used in most arthroscopic procedures: probe; scissors; basket forceps; grasping forceps; arthroscopic knives; and motorised shaving systems. More recently, electrosurgical and laser instruments and radiofrequency energy devices have been incorporated in certain cases.

Patient positioning is critical in arthroscopic knee surgery. The patient is placed supine and a knee examination is carried out under anaesthesia. A tourniquet is routinely placed on the thigh but is not inflated unless troublesome bleeding occurs. Either a leg holder or lateral post is used to apply a valgus stress to open the medial aspect of the knee. The draped limb is angled laterally off the table. A figure four position is required to gain access to the lateral compartment. Another positioning option commonly used in knee arthroscopy is to place the patient supine with the knees just distal to the break in the operating table. The end of the table is dropped to allow the knees to bend free to 90°.

Once the patient is properly positioned, the correct portal placement is determined. Standard knee arthroscopy can be carried out with two portals. The anterolateral portal is used for the arthrosope. It is located 1cm superior to the joint line and either adjacent to or within 1cm lateral to the lateral border of the patellar tendon. The anteromedial portal is most commonly used for the placement of the arthroscopic instruments. It is located 1cm above the joint line and adjacent to or within 1cm medial to the medial border of the patellar tendon. The most commonly used accessory portal is the posteromedial portal. Gillquist popularised the use of this portal for viewing the posterior compartment of the knee and for posterior cruciate ligament (PCL) reconstruction. It is placed with the knee flexed to 90° and palpating the soft spot between the posteromedial edge of the femoral condyle and the medial tibia.[7] Some surgeons use an outflow portal that is superomedial or superolateral to the patella.

Diagnostic arthroscopy should be carried out in the same sequence each time. The knee can be divided into the following compartments for examination: suprapatellar pouch and patellofemoral joint; medial gutter; medial compartment; intercondylar notch; posteromedial compartment; lateral compartment; and lateral gutter. With the arthroscope in the suprapatellar pouch and patellofemoral joint, the surgeon is able to visualise the synovium, patella, trochlear notch, synovial plicae, adhesions, and the quadriceps tendon. Next, the medial gutter is examined for loose bodies and synovitis. The arthroscope is then brought into the medial compartment, and the medial meniscus and the articular cartilage of the tibia and femur are inspected. The intercondylar notch with the following structures is examined next: the anterior cruciate ligament (ACL); PCL; ligamentum mucosum; the meniscofemoral ligaments; and the intrameniscal ligament. The posteromedial compartment can be viewed either through a posteromedial portal or with a 70° arthroscope through the intercondylar notch. The structures in the posteromedial compartment include the posterior horn of the medial meniscus, the distal half and tibial insertion of the PCL, and the posteromedial capsule. The lateral meniscus and popliteus tendon and lateral side of the articular cartilage are examined in the lateral compartment. Finally, the lateral gutter is examined for loose bodies.

Meniscal injury is the most common indication for knee arthroscopy. Meniscal injuries result from both athletics and activities of daily living and can result in

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8. *R W Metcalf, R T Burks, M S Metcalf, and J B McGinty, "Arthroscopic Meniscectomy",* Operative Arthroscopy *(Eds J B McGinty, R B Caspari, R W Jackson, and G G Poehling) (1996), Ed. 2, Philadelphia, PA: Lippincott-Raven, pp. 263–297.*
9. *K D Shelbourne, D V Patel, W S Adsit, and D A Porter, "Rehabilitation after Meniscal Repair",* Clin. Sports Med., *15 (1996), pp. 595–612.*
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11. *F H Fu, C H Bennett, C B Ma, J Menetrey, and C Latterman, "Current Trends in Anterior Cruciate Ligament Reconstruction: Part II. Operative Procedures and Clinical Correlations",* Am. J. Sports Med., *28 (2000), pp. 124–130.*

significant impairment. There are five commonly described tear patterns: vertical longitudinal; oblique; complex; radial; and horizontal.[8] Indications for arthroscopic treatment of meniscal injury include symptoms that interfere with activities of daily living, positive physical examination findings, failure of non-surgical treatment, and absence of other causes of knee pain. Treatment consists of either meniscal repair or debridement. Most meniscal tears require debridement. The success of meniscal repair depends largely on patient selection. In general, candidates for meniscal repair should be young (generally younger than 30), and with tears in the peripheral one-third of the meniscus or within 3–4mm of the meniscocapsular junction. Reparable tears are ideally unstable, longitudinal, or >1cm in length, and without degeneration.[9–11] A stable knee is required for successful meniscal repair. Meniscal repairs are >90% successful when done concomitantly with ACL reconstruction.[12] The reason for this is unknown, but improved access to the meniscus and intra-articular haematoma are proposed mechanisms. Meniscal repair techniques include outside-in, inside-out and all-inside suture repair, and techniques using suture devices and biodegradable arrows.

Knee articular cartilage injuries are also very common indications for knee arthroscopy. The treatment of full thickness injuries is challenging to the orthopedic surgeon. Arthroscopic debridement (chondroplasty) to remove loose flaps and contour the articular surface has been shown to help with pain relief.[13] Because the tidemark is not penetrated, there is no potential for further healing. Abrasion arthroplasty and microfracture techniques involve the penetration of the subchondral exposed bone in order to stimulate a reparative response. The usual result is partial filling of the defect with fibrocartilage that contains Type I fibrocollagen instead of the Type II hyaline collagen produced by chondrocytes.[14] In 1994, Brittberg, et al. introduced autologous chondrocyte implantation (ACI) in order to regenerate normal articular cartilage.[15] The procedure involves arthroscopic harvesting of articular chondrocytes, which are expanded in cell culture and then implanted into the defect. The indications for ACI include a young (age <50 years), active individual, with an isolated femoral chondral defect greater than 2cm^2, who has had an inadequate response to a prior arthroscopic procedure performed for the lesion.[16] For smaller articular defects (5mm^2–2cm^2), the osteochondral autograft transplant system can be used to replace articular cartilage. This technique involves arthroscopically removing the articular lesion by removing a cylindrical osteochondral defect or defects. The hole or holes are then filled with cylindrical plugs obtained from a non-weight bearing area of lesser importance such as the lateral trochlea or the intercondylar notch.[17] Finally, osteochondral allografts can be used to fill larger (2–5cm^2) full-thickness defects.[18] The advantages of allografts are the ability to restore the anatomic contour of the joint, lack of donor site morbidity, and the ability to reconstruct large defects.

Arthroscopic techniques have been applied to ligament reconstruction of the knee, in particular the ACL and the PCL. Arthroscopically assisted approaches have several inherent advantages: smaller incisions, minimal extensor mechanism disruption, fewer adhesions, faster rehabilitation, less pain, and better visualisation of the intercondylar notch and ligament insertion points.[19] Selection of the graft is surgeon- and patient-dependent, with the options including autograft bone patellar tendon bone, autograft hamstrings (semitendinosus and gracilis), or allograft (bone patella tendon bone or Achilles' tendon). ACL reconstruction is usually performed with a 1-incision technique.[20] The results are generally excellent, with 90% of patients having less than 3mm of side-to-side difference on Lachman testing compared with the contralateral side.[10,11]

Arthroscopic reconstruction of the PCL is performed in Grade III PCL injuries, particularly when a PCL injury occurs concomitantly with other ligamentous injuries about the knee. The anterolateral bundle is the strongest component of the PCL complex and is always reconstructed.[21] New techniques have allowed for reconstruction of the posteromedial bundle as well. Autologous graft choices are bone patellar tendon bone, hamstring tendons, and central quadriceps tendon. Allograft tissues that are commonly used include patellar tendon, Achilles' tendon, and tibialis anterior.

Knee arthroscopy has aided in many other procedures about the knee. For example, arthroscopy has made it possible to view the reduction of a surgeon's fixation of a tibial plateau fracture, thereby confirming the restoration of the articular surface. Arthroscopy is used to perform a lateral release in those patients with lateral patellar compression syndrome. Finally, the arthroscope can be used to retrieve loose bodies within the knee joint and to perform synovectomies in patients with pigmented villonodular synovitis.

New techniques on the horizon in knee arthroscopy include computer-assisted surgery to aid with tunnel placement in cruciate ligament reconstruction, arthroscopically assisted unicondylar and total knee replacements, and isolated patellofemoral replacements. Arthroscopic thermal devices have been used to shrink cruciate ligaments or cruciate graft reconstructions that are stretched but not disrupted. Studies are on-going to assess the efficacy of these

techniques. Thermal shrinkage to tighten the medial retinaculum in patella laxity is also being studied. Finally, meniscal allograft transplants are currently being performed in those patients who have undergone a previous total meniscectomy.[22]

In conclusion, arthroscopy of the knee has greatly improved the diagnosis and treatment of pathology about the knee. Knee arthroscopic debridement is currently the most commonly performed procedure by orthopedic surgeons. specialised equipment and advanced training are needed to perform most newer and more complex arthroscopic techniques. Meniscal pathology is the most common indication for knee arthroscopy. Advances in technology have allowed surgeons to perform ligament reconstructions, articular cartilage procedures, and meniscal transplants with the aid of the arthroscope. In the future, knee arthroscopy will assist with minimally invasive knee arthroplasty. The ability to diagnose and treat knee pathology has been greatly improved with the advent of arthroscopic surgery. ■

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