Hip Arthroscopy: Applications and Technique

Joseph C. McCarthy, MD, Brian Day, MD, and Brian Busconi, MD

Abstract

Hip arthroscopy is infrequently performed in North America. The anatomic constraints of the joint and the lack of equipment specifically designed for this application have contributed to the lack of surgical experience. Because of the potential for significant neurovascular injury, familiarization with precise portal placement is essential. In properly selected patients, hip arthroscopy allows diagnosis of a variety of disorders. The authors believe this technique has a significant role in the treatment of acetabular labral tears, loose bodies, chondral injuries to the joint, and septic arthritis.

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Although arthroscopy is the most frequently performed orthopaedic procedure in North America[1] and hip pain is a very common clinical symptom, arthroscopy of the hip joint has been infrequently performed, for a combination of reasons. The hip joint is less accessible than other joints due to its extensive muscular and capsular investments. The femoral head itself is deeply recessed within the acetabulum and cannot be visualized without traction. The surrounding neuromuscular structures can be injured by inaccurate placement of a portal.[2] Furthermore, equipment specifically designed for this procedure has been quite limited.

There are both diagnostic and therapeutic applications of hip arthroscopy. When clinical, laboratory, and radiologic investigations have not led to a diagnosis of a probable intra-articular problem of the hip joint, arthroscopy is often helpful. The therapeutic applications of hip arthroscopy include removal of loose bodies, resection of a torn acetabular labrum, and biopsy of recurrently symptomatic synovium. Preliminary evidence suggests that arthroscopic removal of loose bodies is a cost-effective method of treatment.

Rehabilitation following hip arthroscopy is substantially shorter than that following open hip procedures. The arthroscopic procedure is performed on an outpatient basis, requires no formalized physical therapy and less analgesic medication, and makes possible an earlier return to work than the corresponding open operation.

Applications of Arthroscopy

Evaluation of Hip Pain

Although the origin of functional hip pain is multifactorial, most cases will dissipate with conservative treatment. When a patient's hip pain becomes intractable, is accompanied by reproducible physical findings, and does not respond to appropriate nonoperative measures, including rest, use of nonsteroidal anti-inflammatory drugs, ambulatory support, and physical therapy, hip arthroscopy may be of significant value.[3] The most common physical finding associated with an intra-articular disorder is a painful unilateral inguinal click as the hip is extended from the flexed position. Hip-flexion contracture, loss of joint motion, and anterior hip pain on resisted straight-leg raising also occur with joint derangement.

Most conditions affecting the hip joint can be diagnosed on the basis of the findings from a comprehensive patient history, pertinent physical examination, and appropriate radiographs. These clinical entities include hip fracture and/or dislocation, osteoarthritis, osteonecrosis, ossified loose bodies, and soft-tissue conditions such as iliotibial-band tendinitis and inguinal hernia. When hip pain persists despite normal findings on radiographs, computed tomographic (CT) scans, and magnetic resonance (MR) imaging studies, however, arthroscopy can lead to a definitive diagnosis in as many as

Dr. McCarthy is Associate Clinical Professor of Orthopedic Surgery, Tufts University, Boston, and Active Staff Member, New England Baptist Hospital, Boston. Dr. Day is Associate Professor, Department of Orthopedics, University of British Columbia, Vancouver. Dr. Busconi is Instructor in Orthopedic Surgery, University of Massachusetts, Worcester.

Reprint requests: Dr. McCarthy, 125 Parker Hill Avenue, Boston, MA 02120.

40% of cases.[4-6] Unexpected degenerative arthritis, chondral defects, nonossified loose bodies, synovitis, labral lesions, and synovial chondromatosis have all been diagnosed in these circumstances.

Since a number of intra-articular entities can defy diagnosis even with sophisticated radiologic modalities, how does the orthopaedist determine which patients would likely benefit from arthroscopy? To answer this question, we retrospectively reviewed the findings in our first 94 patients with intractable hip pain who underwent hip arthroscopy. Relevant symptoms and specific physical findings were compared with operative findings and then subjected to Fisher's exact test and Pearson's correlation coefficient to identify significant associations.[7] The presence of loose bodies within the hip joint, whether ossified or not, correlated with locking episodes ($r = 0.845$, $P = 0.00$) and anterior inguinal pain ($r = 1$, $P = 0.00$). Acetabular labral tears detected at surgery correlated significantly with symptoms of anterior inguinal pain ($r = 1$, $P = 0.00$), painful clicking episodes ($r = 0.809$, $P = 0.00$), transient locking ($r = 0.370$, $P = 0.00$), or giving way ($r = 0.320$, $P = 0.0024$) and with the physical finding of a positive Thomas extension test ($r = 0.676$, $P = 0.00$). The finding at surgery of a chondral defect of the femoral head or acetabulum statistically correlated with anterior inguinal pain ($r = 1$, $P = 0.00$) but no other specific finding; no patient with such a lesion had a diagnostic radiologic finding.

It is interesting to note that in this retrospective review, the false-negative rate for all radiologic testing (plain radiography, bone scanning, MR imaging, CT, and arthrography) was 80%. When we excluded those diagnoses that were evident on plain film (e.g., loose bodies and stage III or IV degenerative joint disease), accurate diagnosis of unremitting hip pain by any radiologic modality was accomplished only 4% of the time.[7] The most commonly overlooked cause of pain was acetabular labral lesions, for which there is currently no reliable radiologic means of diagnosis. In our selected group of 94 patients with intractable hip pain, 52 (55%) had acetabular labral injuries, all of which were well visualized at hip arthroscopy.

It is important to remember, however, that hip arthroscopy should not be performed simply because of nonspecific pain. Patients who are candidates for hip arthroscopy must have reproducible symptoms and physical findings that are functionally limiting, even though they may have nonspecific radiologic findings, such as fluid seen on a T2-weighted MR image.

Synovitis

Inflammatory synovitis of the hip may be difficult to diagnose. Although arthroscopy may not lead to a specific diagnosis in all cases, it may prove helpful in obtaining additional information. Biopsy specimens can be obtained for both histologic and microbiologic examinations. The extent of the synovitis and the state of the articular surfaces can be determined.

Synovectomy performed with use of arthroscopic techniques may also be useful; however, a total synovectomy may not be possible in all cases.[5,6,8-10] Because open synovectomy of the hip joint requires dislocation of the femoral head, there has been reluctance to use it in early cases of inflammatory synovitis of the hip joint. With improvement in techniques for hip arthroscopy, the role of synovectomy may increase.

Septic Arthritis

Hip joint arthroscopy allows one to obtain specimens for definitive culture and sensitivities as well as pathologic examination. With the available power instruments, it is also possible to remove necrotic debris from the joint. After debridement, suction drains may be placed through the cannulae to achieve maximum drainage. Blitzer[11] has reported excellent results in a small series.

Loose Bodies

Arthroscopy offers the least traumatic method of removing loose or foreign bodies from the hip joint. Loose bodies are easily seen when lodged in the acetabular fossa (Fig. 1). Posttraumatic osteochondral fragments and loose bodies associated with osteochondritis dissecans or synovial chondromatosis may be removed.[12,13] Foreign bodies, including wire and cement debris associated with a dislocated hip prosthesis, have also been identified and, in some cases, removed arthroscopically.[14,15] One of the earliest reports of hip arthroscopy described its application in a patient with a dislocated hip prosthesis.[16] Goldman et al[17] have reported on a combined miniarthrotomy-arthroscopy technique for removal of a posteriorly situated bullet from the hip.

Osteoarthritis

The role of arthroscopy in the treatment of arthritis remains con-

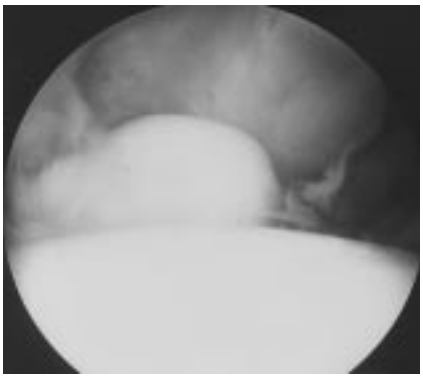

Fig. 1 A loose body can be seen in the acetabular fossa.

troversial. It certainly allows visualization and documentation of osteoarthritis at a stage before significant radiologic changes have occurred. Recognizing staging mismatches between radiographic and arthroscopic findings may help to determine the feasibility of early treatment, such as osteotomy. Lavage has been reported to give significant, but often temporary, relief of symptoms.[10,18] Arthroscopic debridement of the hip joint may have a role in the treatment of osteoarthritis that has failed to respond to nonsurgical treatment and is not yet advanced enough to justify joint replacement. This is especially likely in young patients and in those with associated mechanical symptoms, such as catching and locking. Hawkins[19] has reported the improvement of symptoms after arthroscopic debridement for osteoarthritis of the hip joint, especially in younger patients.

Torn Labrum

The torn acetabular labrum is a relatively newly recognized entity. The clinical features include pain, clicking, and catching. There may be associated pathologic changes, including acetabular dysplasia.[20] Some tears are considered congenital; in other cases, there may be a history of trauma. Radiographs may show a cyst in the lateral roof of the acetabulum in patients with acetabular dysplasia; the diagnosis can be confirmed with arthrography and arthroscopy. The role of arthroscopy in the diagnosis of these lesions has been discussed by Suzuki et al,[21] who found the ruptures to be posterior or posterosuperior. In contrast, the senior author (J.C.M.) found 98% of labral tears to be in the anterior half of the joint (Fig. 2).

Excision or debridement of the torn fragment of the labrum is helpful when there is an isolated tear. If there is an associated pathologic condition, such as advanced osteoarthritis, acetabular dysplasia, or a chondral defect of the acetabulum larger than 1 cm, treatment of the labral lesion alone is less likely to have a predictable or lasting effect.

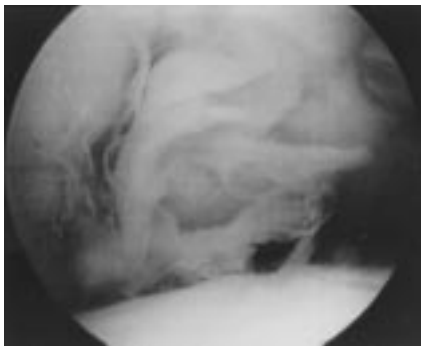

Fig. 2 A displaced torn anterior acetabular labrum can be seen just above the femoral head.

The source of hip pain in a patient who also has acetabular dysplasia may be multifactorial. The lack of lateral and anterior acetabular coverage may produce pain due to accelerated wear or instability; acetabular osteotomy is the treatment of choice in this setting. In addition, labral tears occur more frequently in dysplasia. For this reason, both procedures may be instrumental in alleviating the patient's pain.

Ligamentum Teres Defect and Synovial Folds

Whether injuries of the ligamentum teres and soft-tissue "plical" folds cause hip pain is unknown. Certainly many of the intra-articular folds seen at arthroscopy are normal, as are most of the plical folds seen in the knee joint. Resection of normal folds is clearly not appropriate, and the question of when or if these folds in the hip joint become pathologic is as yet unanswered. We perform resection only in those rare instances in which folds clearly impinge between the femoral head and the acetabulum.

Pediatric Indications

Indications for arthroscopy of the hip in children have been discussed by Gross.[22] Developmental dysplasia of the hip, Legg-Calvé-Perthes disease, and septic arthritis are possible applications of the technique. Arthroscopic debridement of the hip may, when combined with open reduction, allow a less traumatic surgical procedure in a patient whose hip cannot be reduced by closed methods. In patients suffering from the late sequelae of Legg-Calvé-Perthes disease, arthroscopy has been found to be of value in the treatment of loose bodies and chondral flaps.[23]

Avascular Necrosis of the Femoral Head

Although some consider avascular necrosis a contraindication to hip arthroscopy, others have noted its diagnostic value in that setting.[8] The appearance of the articular surface of the femoral head can be considered when making a decision as to whether an osteotomy or a bone graft might be appropriate treatment in a given case. Currently, we would consider arthroscopy only for those patients with osteonecrosis who, despite conservative care or core decompression, have unremitting pain and findings consistent with a loose body or chondral flap lesion.

Operative Technique

Anatomic Approaches

The significant neurovascular structures that surround the hip, including the femoral nerve and artery anteriorly, the lateral femoral cutaneous nerve anterolaterally, and the sciatic nerve and gluteal vessels posteriorly, make accurate portal placement imperative.

Anterior (Anterolateral) Portal

The entry point for the arthroscope is at the junction of a horizontal line directed laterally from the symphysis pubis and a vertical line directed inferiorly from the anterior superior iliac spine (Fig. 3, A). An 18-gauge spinal needle is advanced toward the femoral head along a line 45 degrees medial and 45 degrees proximal to this point.[1] Following distention of the joint with normal saline, the arthroscope is positioned into the joint along the spinal needle pathway. The arthroscope passes close to the lateral femoral cutaneous nerve, and a neuropraxia can occur. Deeper, the ascending branch of the lateral femoral circumflex artery is at risk. The femoral nerve and artery are within 3 to 4 cm and should not be at issue unless portal misplacement occurs (Fig. 3, B). This approach allows visualization of the anterior femoral neck and superior retinacular fold and the ligamentum teres. A 70-degree arthroscope is necessary for visualization of pathologic changes along the anterior labrum or acetabulum.

Anterior Paratrochanteric Portal

This portal is located 2 to 3 cm anterior and 1 cm proximal or distal to the greater trochanter. Puncture of the joint capsule occurs close to the intertrochanteric line. This approach allows visualization of the anterior femoral neck and head as well as the intrinsic capsular folds. Synovial fronds beneath the zona orbicularis and the raised lip of the labrum are well seen. However, because of the high degree of obliquity of the approach and the thickness of the capsule, the arthroscope can be directed too far anteriorly and can potentially damage the femoral neurovascular bundle (Fig. 4).

Proximal Trochanteric Portal

This portal is relatively safe. The entry point is just proximal (within 2 to 3 cm) to the tip of the greater trochanter, and the arthroscope is advanced medially and slightly superiorly, directed toward the center of the hip joint. If the arthroscope is not aimed directly at the femoral head, there is a risk of slipping off anteriorly and damaging the femoral neurovascular structures. The zone of

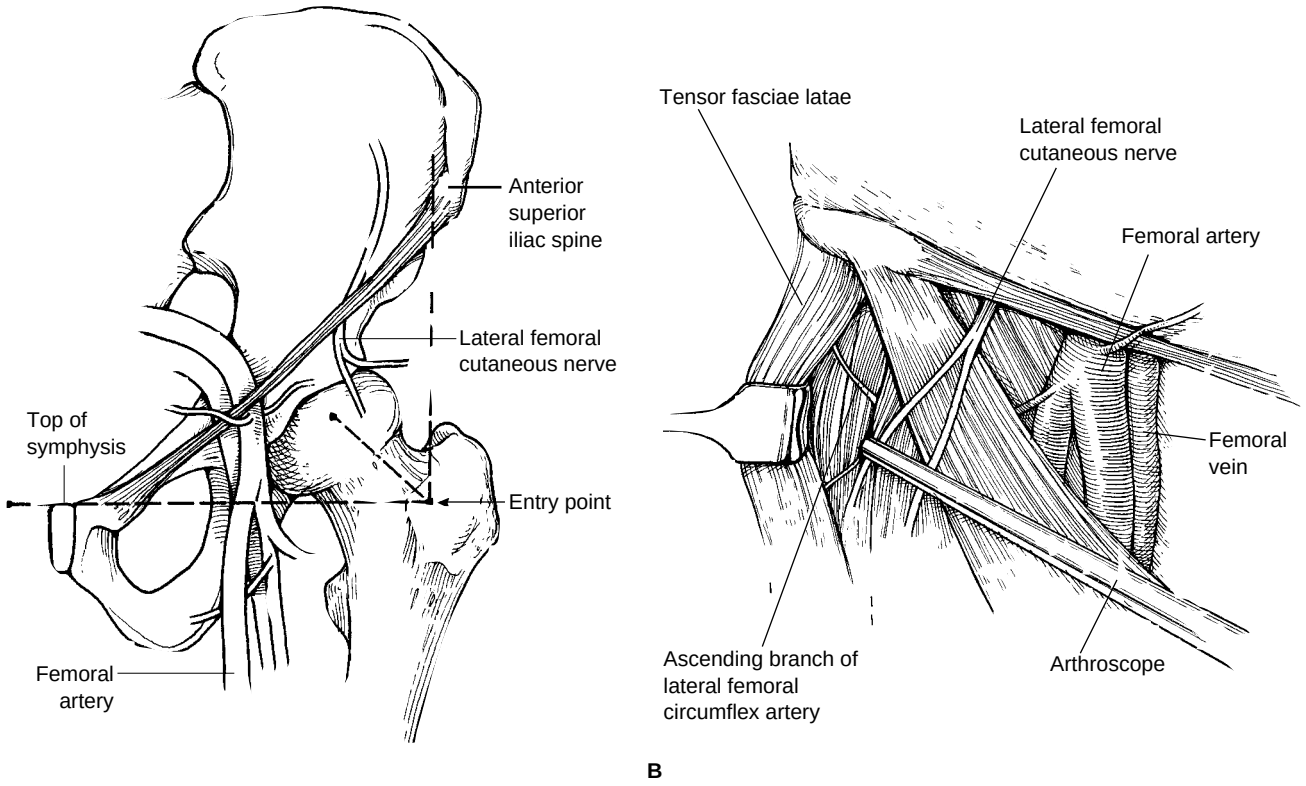

Fig. 3 Anterior (anterolateral) portal. **A,** The entry point for the arthroscope is at the junction of a horizontal line directed laterally from the symphysis pubis and a vertical line directed inferiorly from the anterior superior iliac spine. An 18-gauge spinal needle is advanced toward the femoral head along a line 45 degrees medial and 45 degrees proximal to this point. **B,** View shows the proximity of the anterior portal to the ascending branch of the lateral femoral circumflex artery.

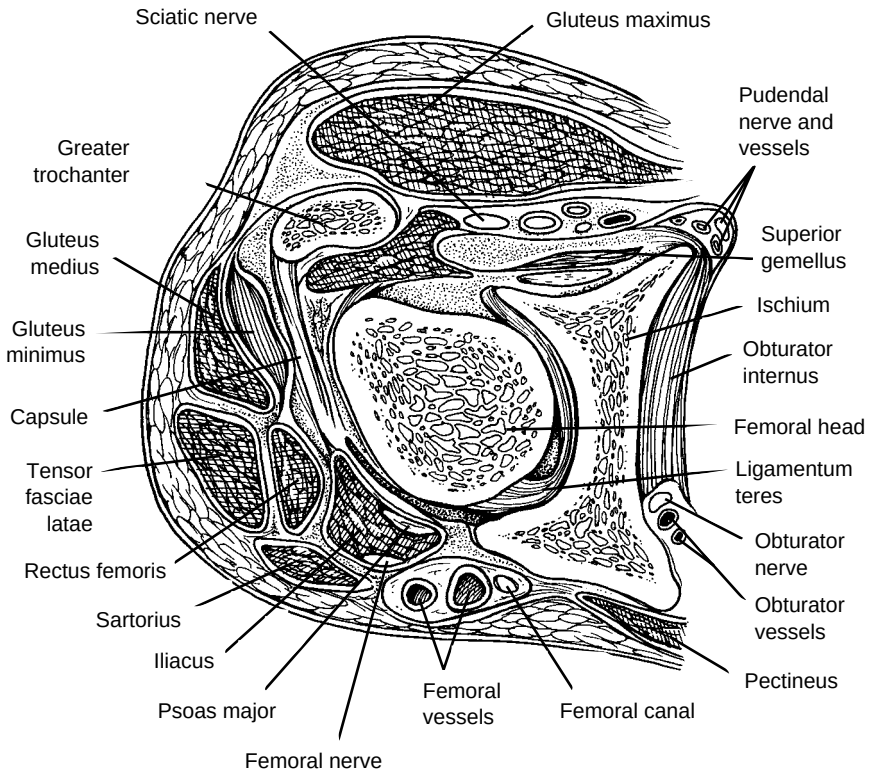

Fig. 4 Transverse section of the hip joint at the level of the paratrochanteric portal.

2 cm or so in the area proximal to the tip of the trochanter is commonly used in combination with other portals to allow triangulation. The acetabular labrum, the femoral head, and the fovea can be well visualized through this portal.

Posterior Paratrochanteric Portal

This is a valuable portal, but it is potentially hazardous if one does not bear in mind the important adjacent structures. The approach is made 2 to 3 cm posterior to the tip of the greater trochanter at a level that corresponds to the anterior paratrochanteric portal (Fig. 5). The hip should not be externally rotated because the sciatic nerve, which is nearby, is brought into danger with this maneuver. This offers one of the best views of the ligament of Weitbrecht and is also valuable for visualizing the posterior capsule and the inferior edge of the ischiofemoral ligament, which is seen as a thickening of the capsule.

Posterior Portal

This approach should be used only with the aid of a miniarthrotomy. The sciatic nerve and the superior gluteal vessels are nearby and must be identified through a small incision. The short external rotators must then be divided under direct vision near their insertion. The combination of an arthroscopic and an open (miniarthrotomy) approach is much less traumatic than a formal open arthrotomy and allows visualization of areas that might otherwise be visible only with dislocation of the hip joint. Foreign bodies have been removed with the use of this approach.[17]

Relative Safety of Approaches

The anterior paratrochanteric and proximal trochanteric approaches are relatively safe. The posterior paratrochanteric and anterolateral approaches are also safe, but one must pay particular attention to surgical technique with special concern for neurovascular structures. The posterior approach requires a small incision for safety.[24]

Distraction

Some distraction is necessary to visualize the important intra-articular structures,[1,4,5,7,10] but there is great individual variation in the force required to achieve an adequate arthroscopic examination. The force that is necessary to obtain sufficient distraction of the hip joint has been reported to range from 25 lb (approximately 112 N) to 200 lb (approximately 900 N). The latter is clearly an inappropriate degree of force to apply to a hip joint and has been found necessary only in nonanesthetized volunteers.

The force required to distract the hip joint is reduced by the relaxation of muscle tone that is a result of adequate anesthesia and by release of the resting intra-articular negative pressure, which can be achieved by joint-capsule puncture and injection of normal saline solution. As air enters the hip joint during arthrocentesis, the force required to distract the joint becomes less because there is no longer a vacuum. Eriksson et al[10] estimated that approximately half of the total resistance in nonanesthetized patients was related to the vacuum present within the joint. The other restraints to joint distraction, namely, the intra- and extra-articular soft tissues, vary significantly from individual to individual.

Generally, much of the anterior aspect of the hip joint can be examined with only minimal traction. With the hip in up to 45 degrees of

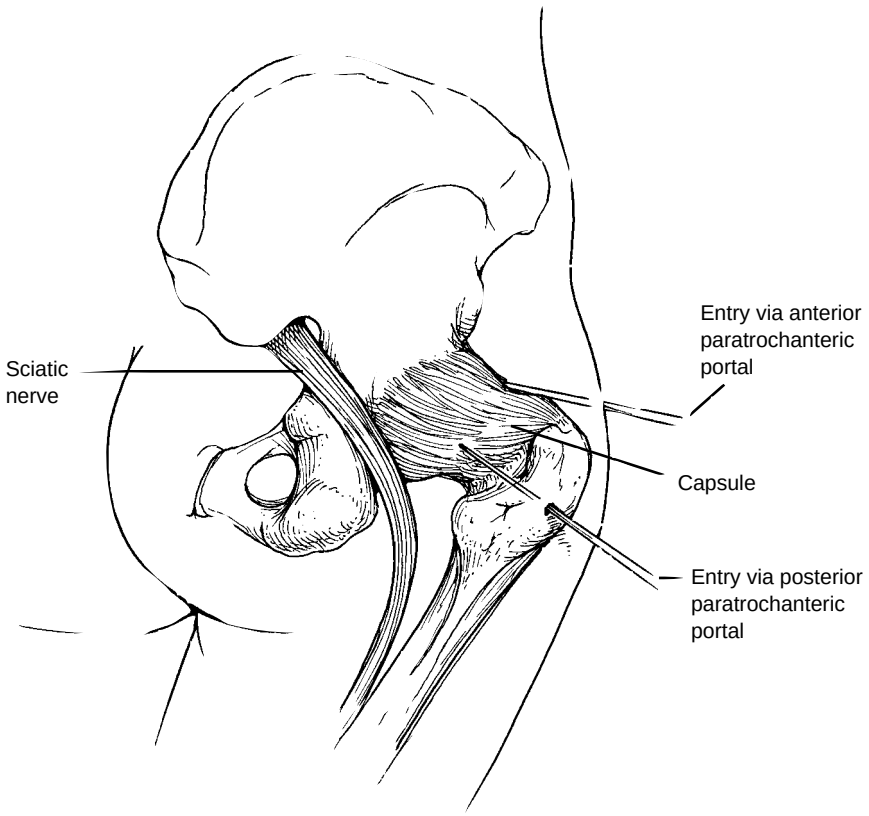

Fig. 5 Anterior and posterior paratrochanteric portals.

flexion and 30 degrees of internal rotation, there is a relatively redundant anterior capsule, making entry and visualization of this portion of the hip joint relatively easy. Traction can then be applied as necessary, with every effort being made not to apply forces in the higher range for prolonged periods. In most individuals, the greatest portion of the procedure can be carried out with a traction force of 50 lb (225 N) or less. Distraction can be achieved with a standard orthopaedic table, as used for hip fractures, or with other specialized distraction devices and limb manipulators. It is important that traction force be applied laterally as well as distally to obtain a vector along the line of the femoral neck. The image intensifier should be used to determine the appropriate femoral head position (Fig. 6).

Positioning and Instrumentation

Supine Position

The position and setup of the table and image intensifier in this approach are similar to those used in the standard treatment of hip fractures. The hip joint is first examined with the image intensifier in the anteroposterior and lateral positions. Traction is applied in order to determine the amount of force required, bearing in mind that less force will be necessary after arthrocentesis. Ideally, a method of measuring distraction force should be incorporated into the table. The perineal support should be placed so as to apply some lateral force as well.

For the initial penetration of the hip joint, it is recommended that the hip be held in a slightly flexed and internally rotated position. This allows relaxation of the anterior capsule and facilitates insertion of the arthroscope. The anterior paratrochanteric or lateral portal should be the first attempted. With all portals, the trocar and cannula are directed toward the femoral head. Insertion of the arthroscope should be begun with a blunt trocar. As soon as the hip joint capsule is reached, the blunt trocar should be exchanged for a sharp trocar. When joint penetration has been obtained, the sharp trocar should in turn be replaced with the blunt trocar for intra-articular manipulation. Entry into the joint is guided with use of the image intensifier. Once the hip joint has been entered, it is inflated with approximately 25 to 50 ml of saline administered through a 16-gauge, 6-inch spinal needle. Once the saline has been injected into the joint, confirmation of distraction can be obtained with use of the image intensifier. Both 30- and 70-degree telescopes should be available.

Most of the intra-articular structures in the hip joint can be visualized by varying the angle of the arthroscope and the portals used. Occasionally in large patients, a standard drainage cannula of the type used in other joints will be unsuitable, and it may be necessary to use a wide-bore spinal needle or even a cannula from another arthroscopy set. Because of the forces required to manipulate the arthroscope in the hip joint, smaller arthroscopes, including the newer narrow-gauge arthroscopes, are not suitable. As in the shoulder joint, bleeding can interfere with visualization unless adequate flow is obtained. Although gravitational flow is adequate, use of an

infusion pump is quite helpful. It is important throughout the procedure to be aware of the traction force that is being applied and, if necessary, to release the traction intermittently.

Lateral Position

The lateral position has a number of advantages for visualization of the hip joint and is our preferred approach. Popularized by Glick,[4,5] the lateral decubitus position allows direct access to the joint along the superior femoral neck. When combined with the trochanteric portal, lateral positioning allows the arthroscope to pass through less muscular tissue and through an area in the capsule that is thinner than the anterior iliofemoral ligament. A considerable proportion of pathologic changes in the hip are found in the anterior half of the joint. The lateral approach allows visualization of this area with use of a 30-degree arthroscope, whereas an anterior approach would necessitate a 70-degree lens.

Fig. 6 Distraction of the hip joint. Drainage cannula and sheath are shown in place.

Similarly, treatment of a labral injury is much more easily accomplished via a lateral approach. Distraction can be achieved with use of a fracture table and lateral positioning similar to that used for femoral rodding. It is preferable, however, to use a specialized hip distractor that allows both lateral and distal traction as well as a tensiometer to monitor the distraction force.

The technique in the lateral approach is otherwise similar to that described for the supine position. The hip is abducted between 20 and 45 degrees, and traction is controlled both by measurement of the force and by use of the image intensifier to confirm adequate distraction.

Contraindications

Hip arthroscopy is difficult to perform in conditions that limit traction on the leg. These conditions include protrusio acetabuli, stage IV osteoarthritis, and ankylosing spondylitis.

Some consider avascular necrosis a contraindication to hip arthroscopy. Villar[18] has noted possible progression of avascular necrosis after hip arthroscopy. Certainly, the intra-articular pressure changes at arthroscopy and the requisite distraction forces have the potential to further compromise the blood supply of the femoral head.

Complications

Complications of hip arthroscopy are unusual, but it must be borne in mind that there are many vital neurologic and vascular structures at risk. Rodeo et al[2] have reviewed the neurologic complications due to arthroscopy. Most of these are caused by direct trauma to cutaneous nerves or by traction injuries. Transient neuropraxia to both the pudendal and the sciatic nerves also has been documented. Pressure necrosis of the foot, scrotum, or perineum is another potential complication. Avoidance of these complications is possible if close attention is paid to the force and duration of traction. Intermittent release of the traction is important, and the use of a well-padded perineal post is essential.

Complications related to the intra-articular manipulation of instruments include scuffing of the articular surfaces and breakage of instruments. For this reason, all arthroscopic instruments should be passed through metallic sheaths.

Other potential complications, such as postoperative infection, have not been reported and are probably as rare as they are with other arthroscopic procedures. The possibility that arthroscopy might accelerate avascular necrosis of the femoral head has already been mentioned, but this is a theoretical rather than a documented complication.

Summary

Hip arthroscopy is a challenging but exciting modality for the diagnosis and treatment of hip disease. Previously, the anatomic configuration of the hip joint, the paucity of equipment tailored to the procedure, and concerns about potential complications limited the number of cases performed. However, better understanding of appropriate portal placement and experience with short periods of traction have made it possible to visualize the intra-articular structures of the hip joint in virtually every case.

Hip arthroscopy can be performed on an outpatient basis and has a shorter period of rehabilitation than would be necessary after open hip arthrotomy or reconstruction. The procedure makes possible accurate diagnosis and treatment of

acetabular labral tears and loose bodies. Because the procedure is still embryonic in its development, the surgical learning curve is longer than for other arthroscopic interventions. Further advancements are necessary in optical equipment, manual and motorized instruments, and simple, reliable traction devices specific for this procedure. Refinements in patient selection and the increased availability of specific outcome data will help to define the role of hip arthroscopy in orthopaedic practice.

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