

# Hip Arthroscopy:

## TREATING FEMOROACETABULAR IMPINGEMENT

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with contributions by  
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**HISTORY** Hip arthroscopy is a rapidly-evolving field in orthopedic surgery.<sup>1</sup> Similar to arthroscopic knee and shoulder surgery, hip arthroscopy involves an arthroscope inserted into the hip joint space. Its history is brief. Minimally used in the late 1980s, due to limitations in the understanding of the joint pathology and techniques, hip arthroscopy has seen a surge in technical developments since the mid 1990s and has enabled surgeons to begin treating a variety of painful hip conditions.<sup>2,3</sup>

**A**s the understanding of arthroscopic anatomy, indications, potential complications and techniques has evolved, hip arthroscopy has become a successful treatment method for a variety of hip pathologies.<sup>2,3</sup>

Arthroscopic hip surgery can address a variety of painful hip conditions, including labral tears, loose bodies, ligamentum teres femoris injuries, capsular laxity, chondral deformities, coxa saltans (clicking hip), and femoroacetabular impingement.<sup>2,4,5,6</sup> While it does not allow for a 360-degree view of the joint, like the more commonly-used open procedure, most pathological structures can be visualized and repaired using the arthroscopic approach. This procedure is preferable for repair because, if performed correctly, it is less invasive, less traumatic, and has a shorter recovery time than open surgery.<sup>7,8</sup> Patients of all ages and activity levels tend to prefer an arthroscopic operation because of this. Hip arthroscopy is especially popular with athletes because it may allow for a quicker return to competition.

### LEARNING OBJECTIVES

- ▲ Review the relevant anatomy for this procedure
- ▲ Examine the set-up and surgical positioning for this procedure
- ▲ Compare and contrast the osteoplasty-cam procedure and the acetabuloplasty-pincer procedure.
- ▲ Assess the indications for femoroacetabular impingement
- ▲ Evaluate the recovery and rehabilitation process following FAI

## ANATOMY OF THE HIP

The hip is a ball and socket joint. The arrangement of bones, ligaments and muscles allow for a variety of movements and a large range of motion. The hip joint consists of the bones of the pelvis and the femur, ligaments and tendons, muscles, nerves and blood vessels. Three fused bones; the ischium, ilium, and pubis provide the frame of the pelvis. The head of the femur fits into the acetabulum formed where the three parts of the hip bone converge. The bony surfaces are lined with articular cartilage which allows for smooth movement of the bones in the joint.

Covering the rim of the acetabulum is a fibro-cartilaginous structure called the labrum. The labrum helps to create a suction seal for the joint surfaces. This labrum has several purposes, including aiding joint stability and helping to control the ingress and egress of synovial fluid. If the socket or acetabular contour is too deep, or the head/neck junction of the femoral head is irregular, this excessive bone growth can cause impingement of the labrum.<sup>6</sup>

Three large ligaments support the hip capsule and keep the hip in place. Anteriorly, the iliofemoral ligament is attached at the iliac spine of the hip bone to the inter-

hamstrings: biceps femoris, semitendinosus and semimembranosus, and the gluteus maximus. The piriformis, obturator internus, obturator externus, the superior and inferior gemellus muscles and the quadratus femoris muscle function as lateral rotators of the hip. The adductor muscles include the adductor longus, adductor brevis and the adductor magnus with the pectineus and gracilis muscles.<sup>9</sup>

Innervation is primarily provided by the femoral nerve anteriorly and the sciatic nerve posteriorly.<sup>10</sup> The obturator nerve also passes through the hip. The femoral nerve innervates the flexor muscles of the thigh, the extensor muscles of the leg and the skin of the medial and anterior aspect of the thigh. The sciatic nerve supplies the posterior and lateral aspects of the thigh. The lateral cutaneous nerve affects the skin of the lateral, anterior and posterior aspects of the thigh.<sup>9</sup>

The blood supply to the hip is from the femoral arteries that run anteromedial in the thigh. The femoral artery has a deep branch called the profunda femoris, which supplies blood to the hip joint capsule.<sup>10</sup> Within the ligamentum teres is a smaller vessel that supplies blood to the femoral head. The blood return is through the great saphenous and femoral veins.<sup>9</sup>

Twenty-seven muscles cross the hip that control movement and help propel the human body.<sup>6</sup> The majority of these muscles originate on the pelvic girdle and insert along the femur.

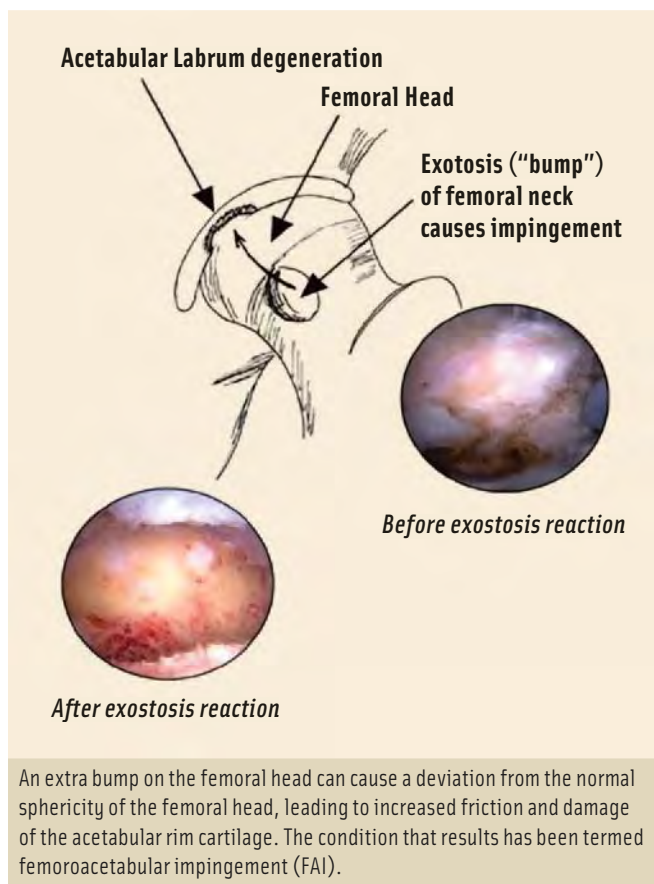
## FEMOROACETABULAR IMPINGEMENT (FAI)

Many times, it is abnormal anatomy that causes impingement. In cases where there is a wide lip of bone on the socket, or over-coverage in one area, this bone pinches against the labrum and the femoral head-neck

trochanteric line of the femur, the pubofemoral ligament is attached at the pubic part of the acetabular rim to the neck of the femur, and posteriorly, the ischiofemoral ligament is attached at the ischial wall of the acetabulum to the neck of the femur. These ligaments form the hip joint capsule, which is filled with synovial fluid that lubricates the articulating bones of the joint and allows the hip to move freely. A smaller ligament, the ligamentum teres, attaches from the fossa of the acetabulum to the head of the femur.<sup>9</sup>

Twenty-seven muscles cross the hip that control movement and help propel the human body.<sup>6</sup> The majority of these muscles originate on the pelvic girdle and insert along the femur. Major flexors include the four muscles of the quadriceps muscle: the rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius along with the sartorius muscle. Extensors include the three muscles that form the

junction. An extra bony growth on the femoral neck causes a deviation from the normal sphericity of the femoral head. This also leads to increased pinching and damage to the labrum and acetabular rim cartilage.<sup>6</sup> Femoroacetabular impingement (FAI) is a painful hip condition where the labrum of the acetabulum becomes impinged between an abnormally-shaped femoral head-neck junction and/or a deep or overhanging rim of the acetabulum during flexion, adduction and internal rotation.<sup>4,9</sup> The pain may be caused by the repetitive tearing or crushing of the labrum, or through bone-on-bone contact of the femoral head-neck junction and the acetabulum.<sup>9</sup> There are two types of FAIs: cam impingement from the femur and pincer impingement from the acetabulum.<sup>3,8,9,10</sup> While these may occur independent of each other, it has been shown that combined impingement occurs in 86 percent of the cases.<sup>4</sup>



## DIAGNOSIS

Preoperative planning is important for identifying patients who will benefit from arthroscopic hip surgery. While some patients with hip pain respond to more conservative treatments, such as therapy, rest and non-steroidal anti-inflammatory drugs (NSAIDs), some have pain that can only be treated by surgery.<sup>2,6</sup> In patients with persistent symptoms, a carefully-elicited history and physical examination may suggest various anatomical and pathological processes.<sup>2</sup> A challenging goal of the physical examination is to determine if the pain is of intra-articular or extra-articular origin.<sup>4,2</sup> In order to discover this, “[t]he history should include the qualitative nature of the discomfort (clicking, catching, stiffness, instability, decreased performance, and weakness), the location of the discomfort, onset of symptoms, and any history of trauma or developmental abnormality.”<sup>4</sup>

Extra-articular causes of hip pain, including sacroiliac joint pathology, stress fractures, trochanteric bursitis,

occult hernias and tendon injuries (iliopsoas, piriformis, rectus hamstring or adductor) occur more frequently than intra-articular causes of hip pain.<sup>2,11</sup> Lateral thigh pain is typically due to trochanteric bursitis, and posterior buttock and sacroiliac pain is usually due to spinal or sacroiliac conditions.<sup>2,6</sup>

Since most hip joint pathology is found within the intra-articular region, distraction is necessary to achieve arthroscopic access.<sup>1</sup> Determining the signs and symptoms that suggest intra-articular pathology are essential in differentiating patients who may benefit from hip arthroscopy.<sup>2</sup> The presence of groin pain and /or anterior thigh pain extending to the knee is a significant indicator, especially if the pain is activity related.<sup>2,8,9,10</sup> In the case of FAI, presenting pain is commonly felt when the hip is flexed, adducted and internally rotated (the FADDIR test.)<sup>1,4</sup> During these movements, the labrum becomes impinged between the bony structures. Repetitive movements cause tearing or crushing of the labrum which can be quite painful.

Radiographic imaging, three dimensional imaging from computed tomography (CT) scans, and magnetic resonance imaging (MRI) are useful in determining the pathology of the hip. Many times, bone irregularities of the acetabular rim are noted on a radiographic image. The three dimensional imaging from a CT scan can give detail on bone growths and calcified loose bodies in the joint and show abnormalities to the head neck junction of the femur.<sup>2,6</sup> MRI studies are best for soft tissue problems.<sup>6</sup> Therefore most tendon and labral tears can be viewed with an MRI scan or with an MR arthrogram.<sup>6</sup>

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## SURGICAL POSITIONING

Patients undergoing arthroscopic hip procedures are placed in the supine or lateral position.<sup>1,2,3,7</sup> Both positions are equally effective. The choice is made by surgeon preference. For some surgeons, the supine position may be advantageous for ease of positioning, while lateral position may be preferable for obese patients.<sup>1,2,3</sup> When patients are placed

in a supine position, a custom leg distraction device is attached to the operating table. The patient is positioned against a wide peroneal post with feet in distraction boots securely taped in place with three-inch silk tape. The ipsilateral arm is placed across the chest and the contralateral arm is placed on an arm board. Complete relaxation is necessary to achieve distraction and the patient is completely paralyzed to prevent any movement during the procedure so that when sharp objects are placed within the joint harm is not caused by sudden movements.<sup>7</sup>

The patient's operative leg is placed under traction to open up the joint, providing space to work.<sup>1,3,6</sup> This is visualized under fluoroscopy.<sup>1,6</sup> The lower limb is placed in slight flexion (approximately 10-20 degrees) with the foot maintained in neutral to slight internal rotation.



The patient is placed in the supine position, with the operative leg in traction.

The peroneal post is pushed against the medial portion of the thigh of the involved leg, keeping the post away from the branch of the pudendal nerve that crosses over the pubic ramus.<sup>1,2,3,7,8</sup> Distraction is achieved carefully until the “vacuum phenomenon” is seen on the X-ray.<sup>3,8</sup> Adequate visualization requires the femoral head to be distracted from the acetabulum with a goal of seven-10 mm between their articular surfaces.<sup>2,7,8</sup>

The patient is prepped from waist to knee on the affected leg and from the midline of the abdomen to as posterior as possible using alcohol first, then with a Chloraprep® solution. Draping involves four adhesive drapes placed first at the iliac crest, mid-thigh, as anterior and as close to the peroneal post as possible and, finally, as posterior as pos-

sible followed by an isolation drape. The adhesive portion of this drape is placed over the incision site and the remainder is placed over the patient.

#### SCRUB NOTES

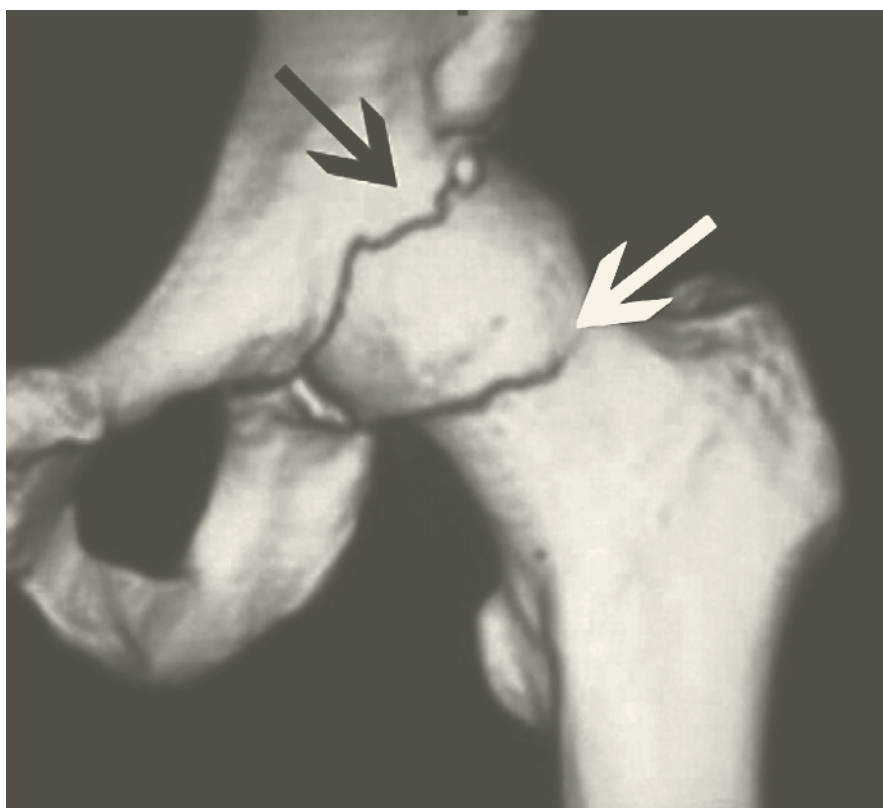
The surgical technologist stands toward the patient's head, and the first of two Mayo stands is placed over the patient's chest. This Mayo stand holds the cords necessary for the procedure: a long, 70-degree arthroscope with camera, light cord, and fluid inflow, as well as an arthroscopic shaver with suction and a radio frequency Ablator wand. The second Mayo stand abuts the first and holds the necessary instrumentation: a #11 blade for the initial incisions, a long, narrow-handled, curved beaver blade; two specially-designed, long spinal needles; a flexible guide wire; two hip trocars, 4.5 mm and 5.0 mm; two cannulated switching sticks; two slotted cannulas for exchanging instrumentation; and an arthroscopic probe.

#### SURGICAL PROCEDURE

The first step in the procedure includes placing portals using spinal needles and a flexible guide wire. Two portals are typically used: an anterior and an anterolateral.<sup>4</sup> The anterolateral portal is placed laterally over the superior margin of the greater trochanter at its anterior border.<sup>1</sup> This portal is established first, as it lies most centrally within the safe zone for arthroscopic hip surgery and penetrates the gluteus medius.<sup>1,2</sup> “The anterior portal is placed at the site of intersection of a sagittal line drawn distally from the anterior superior iliac spine and a transverse line across the tip of the greater trochanter.”<sup>1,2</sup> This portal penetrates the sartorius and the rectus femoris.<sup>2</sup> Other portals may be used as necessary, including posterolateral or distal lateral accessory ports. When placing the anterolateral portal, one must be extremely careful of the lateral cutaneous nerve, and when establishing the posterolateral portal, one must consider the posterior neurovascular bundle.<sup>3,7</sup> The femoral artery and nerve lie well medial to the anterior portal and the sciatic nerve lies posterior to the posterolateral portal.<sup>1</sup>

Specially-designed instruments are used to reach the depth of the hip joint, including a long spinal needle and a flexible guide wire.<sup>3</sup> Special care must be taken to avoid





**FIGURE 1.** Three-dimensional computed tomography reconstruction of the hip revealing extensive anterolateral cam impingement (white arrow) and pincer impingement (black arrow).

penetration of the acetabular labrum or causing damage to the femoral head.<sup>1,3</sup> As the surgeon uses the spinal needle to penetrate through the capsule into the joint space, there is a palpable decrease in resistance.<sup>3</sup> However, if the needle is directed into the labrum the resistance felt is greater.<sup>3</sup> Once the surgeon positions the spinal needle, air is introduced into the joint space by removing the stylet. The needle is removed and then redirected to the correct location in the joint space.

Next, the surgeon feeds a guide wire through the spinal needle, and the spinal needle is removed.<sup>11</sup> After the surgeon positions the guide wire in the joint, a cannulated trocar is used to penetrate the joint capsule.<sup>1</sup> Either a 30-degree or a 70-degree long arthroscope can be used.<sup>1,3,4,7</sup> Use of a 70-degree scope allows for a nearly-complete visualization of the joint. Once the scope has been introduced into the joint capsule, it will aid the placement of the other portals. To improve visualization and increase access within the joint, the surgeon may perform

a capsulotomy using a curved beaver blade on a long, narrow handle.<sup>1,4</sup>

During the procedure, an initial diagnostic arthroscopy is performed and the structures of the hip joint are examined.<sup>1</sup> The femoral head is observed for chondral deformities or damage, as well as the surface of the acetabulum, the condition of the labrum and the ligamentum teres. An arthroscopic probe is used to examine the condition of the chondral-labral junction of the acetabulum.

#### LABRAL PATHOLOGY

The labrum is a fibrocartilaginous structure attached to the rim of the acetabulum.<sup>4,10</sup> The rim consists of a triangular shaped “tongue” of bone to which the labrum is attached.<sup>9</sup> The labrum creates a type of suction seal, limiting fluid expression from the joint space, protecting the cartilage layers of the hip and acting as a joint stabilizer.<sup>4</sup> Proprioceptive and noci-

ceptive nerve fibers run through the labrum, so pain is felt when it is impinged by the bony structures of the acetabular rim or the femoral neck.<sup>8,9</sup> The articular surface of the labrum has decreased vascularity.<sup>4,7</sup>

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Two types of labral tears have been identified.<sup>12</sup> A primary tear, or type 1 tear, is a detachment of the labrum from the rim of the acetabulum, commonly caused by a cam impingement. A type 2 tear is an intrasubstance tear of the labrum, typically caused by a crushing of the labrum against the neck of the femur by an overhanging rim of the acetabulum, also called a pincer lesion.<sup>4</sup>

Debridement, or repair of the labral defect, is dependent on the causes of impingement and the severity of the tear. “The goal of surgical treatment of labral tears is to eliminate any unstable tissue by debridement or repair, while preserving as much healthy tissue as possible to allow the labrum to maintain its role as a suction seal and secondary joint stabilizer.”<sup>4</sup> If the labrum is detached from the rim, a repair may be necessary and a suture anchor repair is used. If the labrum remains attached and the majority of the substance is intact, there is a possibility that a debridement with a shaver is adequate.

In order to prevent a possible fracture, a resection of less than 30 percent of the head-neck junction is recommended because this has been shown not to alter the load-bearing capacity of the femoral neck.<sup>4,8</sup>

#### ACETABULOPLASTY-PINCER PROCEDURE

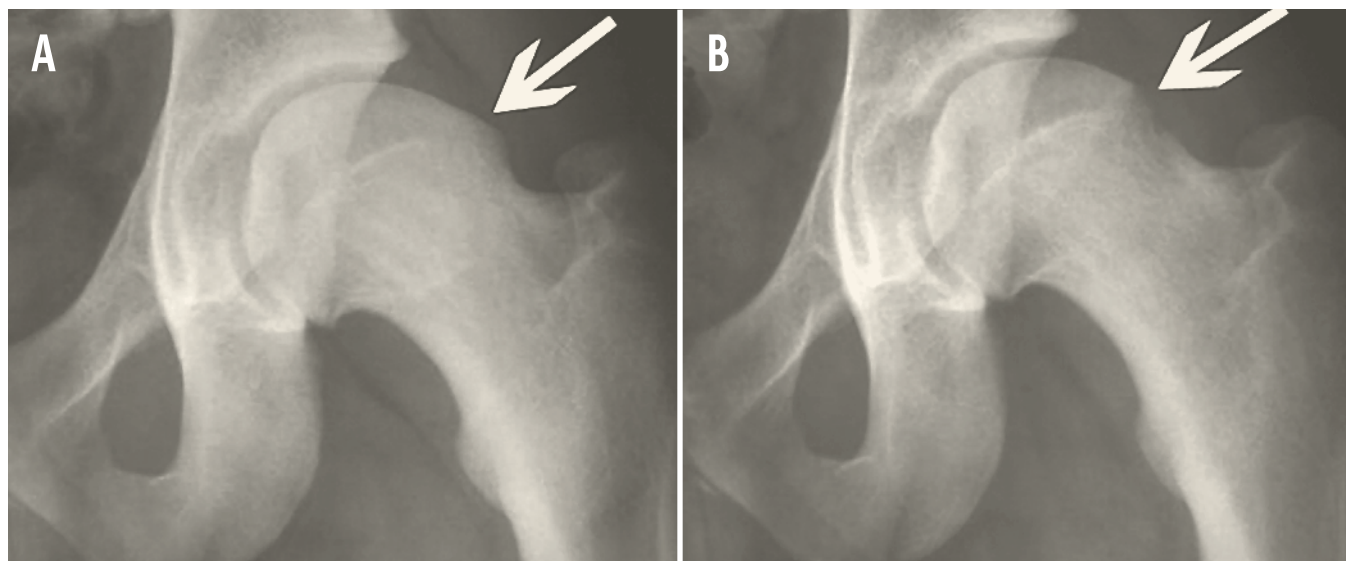
In cases where there is over-coverage of the acetabular rim, or a “deep” acetabular fossa, damage may occur to the labrum caused by its impingement between the rim and the femoral neck during flexion.<sup>1,3,8,9,10</sup> Larger pincer lesions usually result in an intrasubstance tearing of the labrum, necessitating an acetabuloplasty.<sup>4</sup> Depending on the size of the pincer lesion, the labrum may or may not need to be detached from the

rim.<sup>4,9</sup> If detachment is necessary, the labrum is detached using a curved beaver blade on a long handle. The acetabuloplasty is performed using a motorized burr.<sup>8</sup> Progress is monitored with radiographic imaging. It is not recommended to resect greater than 5 mm of acetabular rim as it may cause instability.<sup>4,8</sup> A suture repair is performed if detachment is necessary.<sup>4,8</sup>

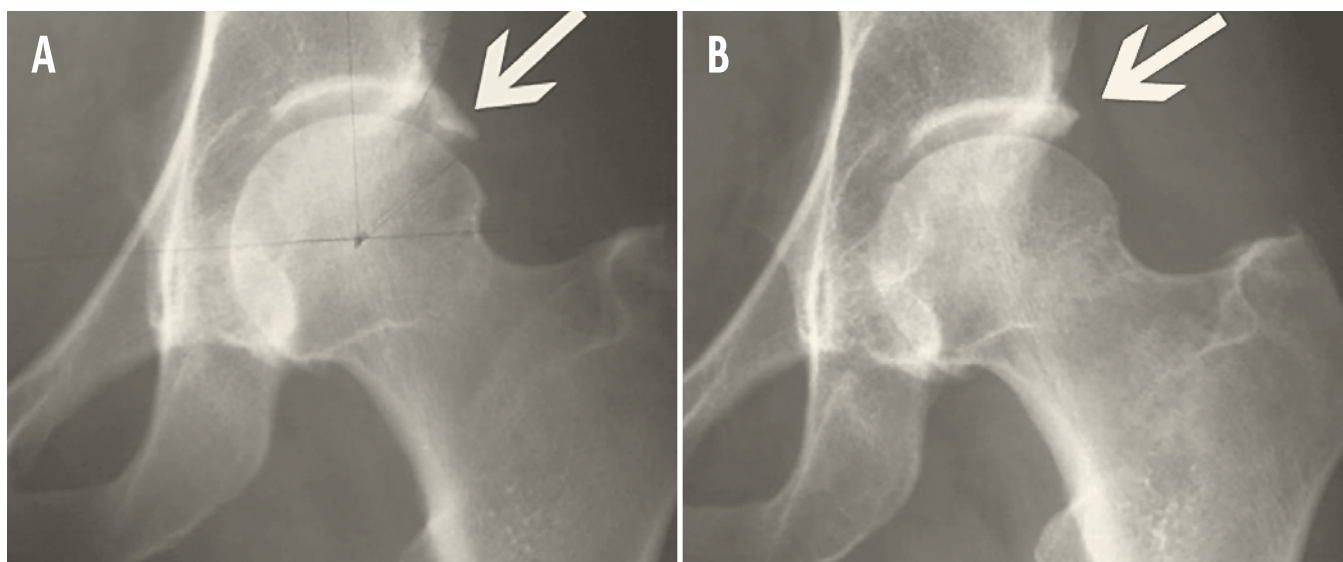
#### OSTEOPLASTY- CAM PROCEDURE

Labral tears, which are associated with cam impingement, are more commonly type 1 tears and affect the transition zone cartilage and articular surface of the labrum.<sup>4</sup> A cam-type impingement is caused by a nonspherical head-neck junction of the femur.<sup>1</sup> Most commonly manifested during hip flexion and internal rotation, this causes an impingement of the labrum between the anterior acetabulum and the femoral neck.<sup>3,8,9,10</sup> “When the aspherical head-neck junction of the femur enters the acetabulum, it displaces the labrum toward the capsule and applies disproportionate load to the adjacent articular cartilage of the acetabulum. This leads to chondral delamination and detachment of the labrum from the acetabular rim.”<sup>4</sup>

Femoral osteoplasty involves recontouring the cam lesion using a motorized burr and fluoroscopy. Traction is removed and a dynamic impingement exam is performed.<sup>6</sup> The hip



**FIGURE 2.** (A) An AP pelvis radiograph reveals a superior area of cam impingement (arrow) in a 21-year-old college wrestler. An aspherical head-neck junction evident on the AP radiograph in addition to the lateral radiograph indicates a more extensive cam lesion. (B) A burr was used to recontour the head-neck junction arthroscopically, and improved offset is evident on the postoperative AP radiograph (arrow).



**FIGURE 3.** (A) An AP pelvis radiograph reveals pincer impingement with a deep acetabulum and secondary ossification of the labrum (arrow) in a 38-year-old equestrian rider with increasing pain with hip abduction. (B) Arthroscopic rim trimming was used to remove this ossified labrum and area of overcoverage (arrow), as seen on the postoperative AP radiograph. The patient's abduction range of motion normalized, and she no longer had pain during horseback riding.

will be flexed, extended, abducted, adducted, internally and externally rotated in order to determine the appropriate positioning.<sup>4,8</sup> Often the area of the cam lesion can be identified by areas of damaged articular cartilage at its location. The surface cartilage is removed using a curette and a motorized shaver. Then a motorized burr is used to reduce the bony prominence. After osteoplasty, joint clearance is assessed by flexing the hip beyond 90 degrees and internally rotating under direct visualization.<sup>4,8</sup> In order to prevent a possible fracture, a resection of less than 30 percent of the head-neck junction is recommended because this has been shown not to alter the load-bearing capacity of the femoral neck.<sup>4,8</sup> Care must be taken not to remove too much bone and compromise the strength and integrity of the femoral neck.

#### DYNAMIC EXAM

A dynamic exam concludes the procedure. Traction has been removed and the hip joint is run through a complete range of motion: flexion, extension, internal and external rotation. The repair and the movement of the femoral head within the acetabulum as well as contact of the labrum are observed arthroscopically. If any signs of impingement remain, the osteoplasty can be refined at this time.

At the conclusion of the procedure, the suction is connected to the trocar and excess fluid is removed from the joint space. A local anesthetic of 20ml 0.5% bupivacaine and 2ml morphine sulfate is injected into the joint to ease postoperative pain. The portals are closed with a 3-0 nylon

suture. Bacitracin ointment is applied, followed by a non-adherent dressing, gauze pads and finally ABD pads are secured with perforated tape. A polar care hip dressing is applied and the patient's hip brace, which has been previously fitted for him or her, is secured.

#### RECOVERY AND REHABILITATION

Postoperative rehabilitation helps to determine and complete the success of the hip arthroscopy. In the early phase of rehabilitation, restrictions include limits on the amount of weight borne by the hip and its range of motion. In uncomplicated cases, crutches are used for approximately seven-10 days.<sup>2,6</sup> In patients requiring repairs or who have extensive problems, the patient may be non-weight bearing for six-eight weeks.

Postoperative rehabilitation also includes continuous passive motion for the first four weeks for two-four hours per day.<sup>2,8</sup> Starting immediately, patients are encouraged to ride a stationary bike with a high seat to avoid pinching. A slow progression to activity avoids over-activation or aggressive loading of the hip flexors, abductors and adductors, as these muscle groups are highly susceptible to fatigue and tendonitis postoperatively.<sup>4</sup> Some patients will begin physical therapy as early as the next day, and some may begin two weeks postoperatively and may continue for four-eight weeks.<sup>6</sup> This recovery usually covers three to four months, though patients may continue to see improvement in their symptoms for up to one year postoperatively.





**FIGURE 3.** (A) Arthroscopic view of left hip with arthroscope in anterior paratrochanteric portal. The femoral head is to the left, and the acetabulum is to the right. This image from a 17-year-old soccer player who had peripheral labral ecchymosis consistent with pincer impingement (white arrow) and a disruption of the labral-chondral junction with early chondral delamination consistent with cam impingement (black arrow). (B) The labrum (black arrow) was detached from the acetabular rim through the area of undersurface tearing with a beaver blade. Rim trimming was performed to the acetabular rim (white arrow) with an arthroscopic bur. (C) The labrum has been repaired/refixed to the acetabulum with 2 suture anchors (solid arrows), and traction has been released, which shows restoration of the normal sealing function of the labrum against the femoral head (dashed arrows).

## CONCLUSION

Hip arthroscopy has evolved greatly in the last decade. Through improvements in equipment and techniques and a clearer understanding of indications and pathology, hip arthroscopy has become an effective means of treating a variety of intra-articular hip conditions. Though it is presently an uncommon procedure for surgical technologists, as this procedure requires highly-specialized training for the surgeons who perform hip arthroscopy, this is a procedure that will become more prevalent in the future.

## ABOUT THE AUTHOR

Margaret Armand, CST, is currently working at Advocate Good Samaritan Hospital in Downers Grove, Ill. After 14 years in early childhood education she made the career change to surgical technology in 2004. She primarily works with the orthopedic surgery team.



## Acknowledgements

Ms Armand wishes to recognize and thank Dr Benjamin G Domb for sharing his expertise, for his support, and encouragement with the writing of this article, Dr Rima Nasser for her editorial contributions, and most importantly her husband and family for their support.

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