5 points on

Arthroscopic Treatment of Femoroacetabular Impingement

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Femoroacetabular impingement (FAI) is caused by conflicts among the femoral head–neck junction, the peripheral acetabulum, and the acetabular rim. Two types of FAI have been identified: cam and pincer.[1]

Cam FAI is an out-of-spherical head, caused by a bone metaplastic overgrowth at the head–neck junction, that damages the articular cartilage from overload and shear as it rotates into the socket. The result is a spectrum of degenerative changes in the labrum and in acetabular cartilage.[2] *We have observed softening and blistering of the anterior acetabular articular cartilage in the earliest stages, to labrocartilaginous junctional degeneration and tearing or full-carpet delamination from the bone in the late stages.*

Pincer FAI occurs with acetabular overcoverage, which limits range of motion (ROM) and leads to a conflict between the acetabulum and the femur. The result is more labral damage than acetabular articular changes. Ganz popularized what has become the classic treatment for FAI: open surgical dislocation and trochanteric osteotomy with removal of the offending bone at the head–neck junction, recreating a spherical head in cam FAI.[1] *Trimming of an acetabular rim osteophyte with either removal or refixation of the labrum was later described as a treatment for pincer FAI.*[3,4] *An arthroscopic equivalent to the open treatment has become popular as a less invasive technique with less morbidity and faster recovery.*[5,6]

FAI affects men and women equally, begins in the second or third decade of life, and progresses slowly. Conservative management involves avoiding activities that aggravate the pain. In some cases, surgery may be the only alternative for relief.

1 Indications (examination and imaging may show subtle abnormalities)

Ideal candidates for arthroscopic treatment are young patients without evidence of arthritis. They may experience insidious onset of anterior groin pain or have an injury. Often, FAI is thought to be a groin sprain that never resolved. Some may confuse it with an inguinal hernia or sports hernia. Pain, which may present in other locations about the hip, is aggravated with hip flexion and internal rotation. Patients often complain of positional intermittent pain, sitting intolerance, or a painful pop in the hip. Limping is rare in early stages.

The hip examination may reveal full ROM, except for a reduction in internal rotation caused by bony anterior abutment. A positive impingement test is pain reported when the hip is flexed and internally rotated. Logrolling of the leg may not hurt, and a straight leg raised against resistance often is pain-free.

Plain radiographs show the out-of-round nature of the femoral head–neck junction associated with a bump (Figure 1), a depression, and, often, a fibro-osseous cyst at the physeal line (cam FAI). There may be rim overgrowth, retroversion, or a deep socket (pincer FAI). With or without contrast, magnetic resonance imaging (MRI) has become a standard for diagnosis (Figure 2A); it shows the bone patterns (also visible on radiographs) associated with bone edema at the contact points and the soft-tissue damage of the articular cartilage of the acetabulum and labral tears (Figure 2B).[7,8]

2 Patient positioning (lateral or supine approach)

The procedure can be performed with the lateral approach or the supine approach.

In the lateral approach, the patient is positioned in the lateral decubitus position, and care is taken to pad downside bony prominences and place an axillary roll.[9-11] Anterior and posterior hip positioners are placed much as in total hip surgery, and care is taken to maintain a clear view for the fluoroscopic C-arm, which is placed under the table. The operative leg is held in slight forward flexion

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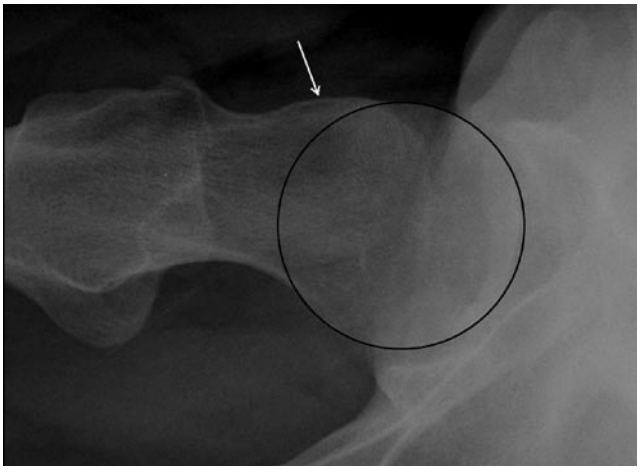

Figure 1. Lateral radiograph of right hip shows cam bump outside circle (arrow).

and abduction to relax the capsule. The leg is then placed in a well-padded lateral hip distractor, such as the OSI™ hip distractor attachment to the Jackson™ table (OSI Systems, Inc., Hawthorne, CA), the Smith & Nephew Hip Distractor™ (Smith & Nephew Endoscopy, Andover, MA), and the McCarthy Hip Distractor™ (Innomed, Inc., Savannah, GA). Distraction is used only when the central compartment needs to be entered, and it is minimized to prevent neuropraxias.

In the supine approach, the patient lies on his or her back on a fracture table or on a supine hip distractor, such as the Smith & Nephew Hip Distractor or the Arthrex™ distractor (Arthrex, Inc., Naples, FL), with a large, well-padded peroneal post. The C-arm is positioned over the hip.[12]

In both approaches, preoperative fluoroscopic anteroposterior radiographs are obtained in external, neutral, and internal rotations and in 80° to 90° flexion view to determine the shape and offset of the head–neck junction and the degree of crowding with the rim of the acetabulum.

The instruments are placed on a Mayo stand, and the cords for the camera, shaver, and radio-frequency device are tidily bundled and organized so they will not get in the way during the procedure.

The hip is prepared and draped so as to expose only the area from the lateral iliac crest to just below the greater trochanter and from slightly medial to the anterior superior iliac spine (ASIS) line to the ischial notch.

3 Portal placement (differs slightly in lateral and supine approaches)

Portal placement is slightly different in the 2 approaches because gravity allows the soft tissues to sag medially from the greater trochanter, and positioning is monitored using a fluoroscope. In most cases, a standard-length arthroscope with a short bridge may be used; for large or obese patients, however, long hip scopes should be available if needed. Typically, 2 or 3 portals are used with occasional ancillary portals (Figure 3). Most often, the anterolateral portal is the first to be placed. This portal is positioned with the hip in distraction and is

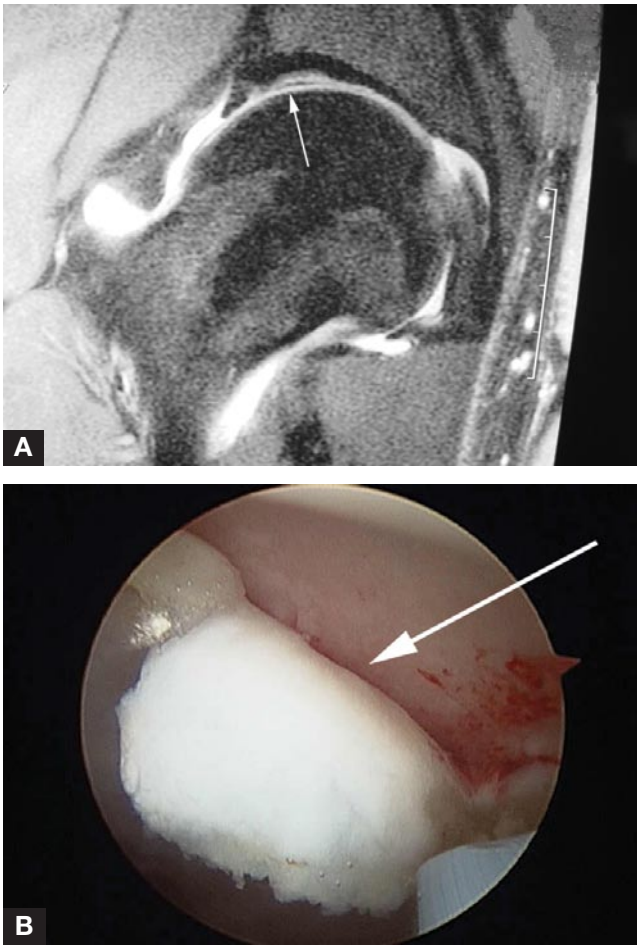

Figure 2. (A) Magnetic resonance arthrogram shows cam bump and subtle delamination defect in acetabular articular cartilage. (B) Arthroscopic view of full-thickness articular defect.

located approximately 1 cm proximal and 1 cm anterior to the anterosuperior prominence of the greater trochanter in the supine approach and 1 cm lateral in the lateral approach.

A 17-gauge spinal needle is placed into the central compartment under fluoroscopic observation, and care is taken to avoid skiving the femoral head and puncturing the labrum. A nitinol wire is threaded through the needle, and the skin is incised with a No. 11 blade adjacent to the wire. A cannulated arthroscopic sheath is placed over the wire and pushed through the capsule into the hip joint, and care is taken not to damage the articular cartilage. The lateral approach usually begins with a 30° scope and the supine approach with a 70° scope. After taking a brief look at the joint, the scope is aimed anteriorly to create the next portal.

The anterior portal is the second to be placed. In the supine approach, it is located at the junction of a line perpendicular to the tip of the greater trochanter and the ASIS lines. The course of entry is 45° cephalad and 30° toward the midline. With the anterolateral portal under observation, the needle is negotiated into the joint through a triangle formed by the anterior labrum, the head, and the capsule. Care is again taken to avoid damaging the head and labrum. The skin incision along the nitinol wire should

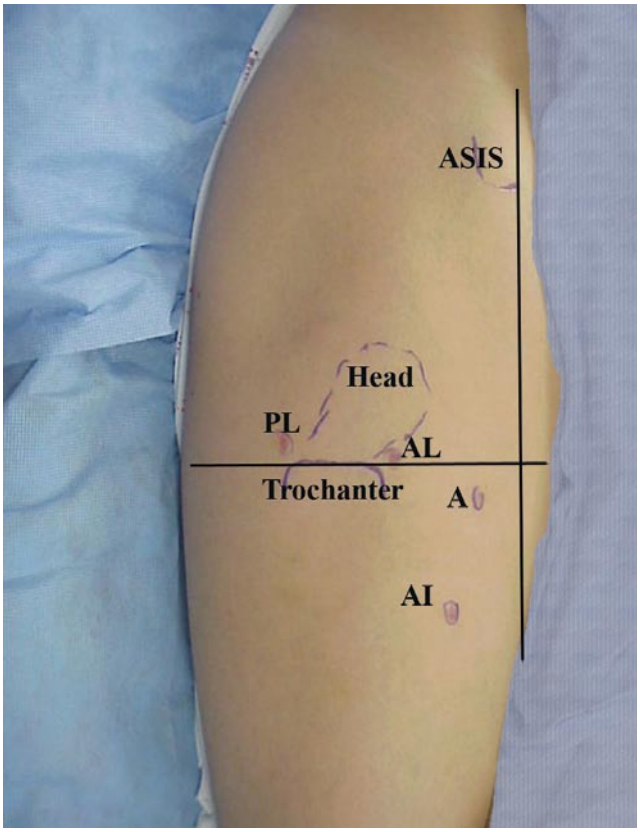

Figure 3. Hip arthroscopic portals (lateral approach). Abbreviations: A, anterior; AI, antero-interior; AL, anterolateral; ASIS, anterior superior iliac spine; PL, posterolateral.

not be made deeper than the dermis, and a blunt instrument should then be used to avoid damaging the lateral cutaneous nerve, which lies in the superficial fat. In the lateral approach, the anterior portal is best positioned at a point 45° and 1 to 2 cm distal from the supine position.

After a cannulated sheath has been placed, instruments may be inserted through a cannula or a slotted (half-pipe) cannula. The working portals are maintained with cannulas or switcher sticks, when not in use, or switching instruments.

If necessary, the posterior portal is created by rotating the scope to the posterior and monitoring placement of the needle into the central compartment. The portal is placed about 1 cm proximal and posterior to the greater trochanter in both approaches.

4 The procedure (with intraoperative "pearls")

Damage to the central compartment is assessed by looking through the anterolateral portal with a probe in the anterior portal. Observations of the articular damage are as follows.

Minimal cam damage. Pillow-softening or mild, wavy blistering of anterior acetabular cartilage on being probed. Labrocartilage junction is intact (Figure 4A).

Moderate cam damage. Blistering with some peripheral separation of articular cartilage from labrum and minor exposure of bone (Figure 4B). Inner border labral tear may be adjacent to cartilage damage. Area of involvement may be in a right hip from 1 to 4 o'clock and from the periphery inward 1 cm.

Severe cam damage. Acetabular articular cartilage carpet delamination with large area of exposed bone from 1 to 2 cm centrally and perhaps presence of osteophytes in notch (Figure 4C). Labrum may be attached, with significant fraying on inner edge.

Mild pincer. Minimal to no acetabular articular damage. Labrum appears normal.

Moderate pincer. Articular cartilage of acetabulum may appear more prominent than labrum at their junction, with softening and fibrillation of junction. Labrum may look flattened (Figures 5A, 5B).

Severe pincer. Labrum appears degenerative and may have fibrofatty infiltration and tears. Labrocartilage junction is severely degenerative, and acetabular articular cartilage is eroded from periphery centrally less than 0.5 cm with exposed bone (Figure 5C).

Most patients have a combination of cam and pincer FAI, with acetabular damage a mixture of the types just described.

Surgery in the central compartment consists of (1) débridement of degenerative or fibrillated tissue, abrasion, and microfracture of exposed bone and (2) labral stabilization either with direct repair or, more often, labral refixation after rim trimming.

Once the central compartment has been treated, the distraction may be let down, as the rest of the work is done in the peripheral compartment.

In the supine approach, the abnormal head–neck bump can be resected either by flexing the hip to 45° for visualization and redirecting the scope to the neck of the femur or by adding an additional anterodistal portal. In most cases, a capsulotomy is needed for visualization and for completion of bone resection. In the lateral approach, the original portals are used, and a capsulotomy along the neck with a rim extension provides the best visualization. No flexion is necessary initially, but, to complete the anteromedial resection, the hip must be flexed and externally rotated.

After a good view of the head–neck junction is obtained, the anticipated border with the head articular surface is identified visually and with an instrument using C-arm fluoroscopy. The resection area is cleared of soft tissue and cartilage, and then a 4- or 5-mm burr is used to begin resection at that junction before circumscribing the head (Figure 6). The resection is carried laterally along the neck, and care is taken to identify and protect the lateral epiphyseal artery. Depth of resection need not be more than the natural cortex of the base of the neck. A line of resection is then carried perpendicular, near the base of the neck, followed by contouring and shaping within the outlined area. Reaching the anterior medial neck near the anterior synovial fold involves flexing and externally rotating the hip and then working back into extension to facilitate the view and burr access.[5,13]

If rim trimming of the acetabulum is needed, the same portals may be used. Our preferred method in the lateral

approach is performing a capsulotomy along the neck of the femur and extending it cephalad to the labrum and lateral to medial to provide good visualization of the labrum anteriorly. Using a Beaver™ blade (BD, Franklin Lakes, NJ) to take down the labrum from the rim before resection has been reported, but the method described next allows for minimal labral detachment.

Concept and technique are based on whether the labrocartilage junction is intact or torn by cartilage loss or delamination. If the junction is intact, rim trimming can be done without labral detachment; with loss of the junctional attachment, however, labral detachment may occur, and it may require refixation. With this method, minimal to no labral takedown is necessary, and therefore the function and blood supply of the labrum can be preserved. If refixation becomes necessary, fewer anchors are needed (Figure 7).

A radio-frequency probe or a Beaver blade is used to separate the rim bone from the external labrum anteriorly from 12 to 5 o'clock on a right hip. The hip is slightly distracted with a small force to move the head out of harm's way in case the burr penetrates centrally. Rim trimming is done with a 4- or 5-mm burr, with the amount of resection depending on the size of the excess rim. Under C-arm fluoroscopy, the amount resected can be controlled; it should not reduce the center-edge angle below 25°. Methodically, the resection is done lateral to anterior, then medial.

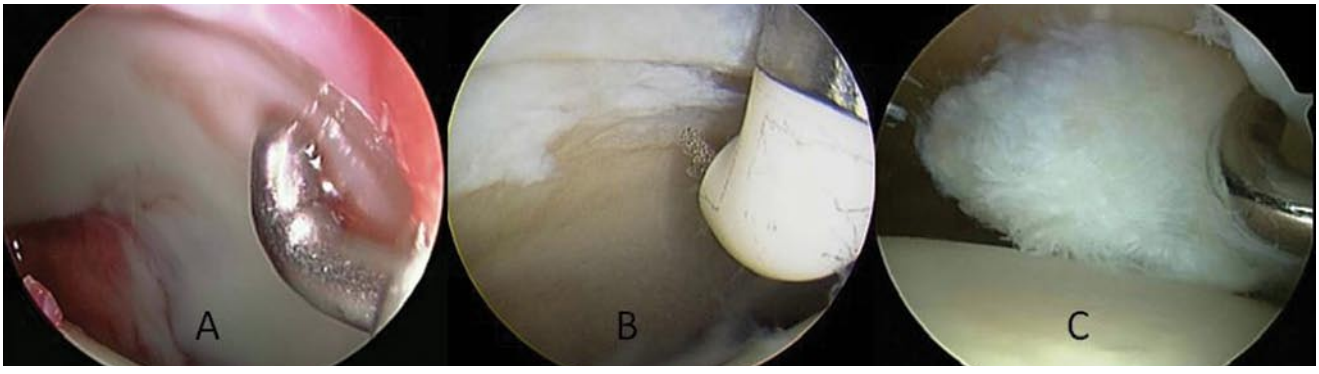

Figure 4. Arthroscopic finding of acetabular cartilage in cam femoroacetabular impingement: (A) blister, (B) labrocartilage separation, (C) full-thickness delamination.

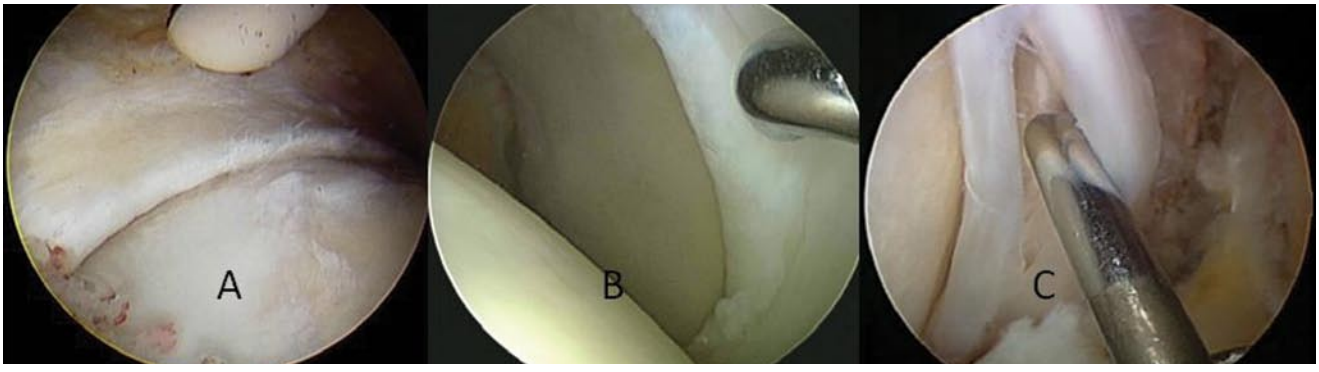

Figure 5. Arthroscopic finding of acetabular cartilage in pincer femoroacetabular impingement: (A) labral flattening, (B) prominence of articular cartilage and early separation from labrum, (C) labral degenerative tear.

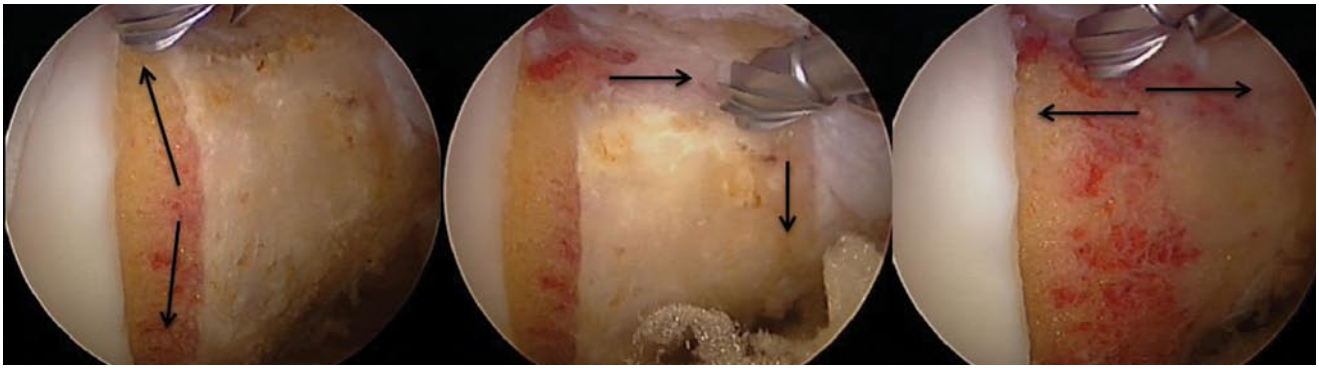

Figure 6. Method of resection osteoplasty: first cut, along head–neck articular margin; second cut, lateral; third cut, at base of neck; fourth cut, contouring between cuts.

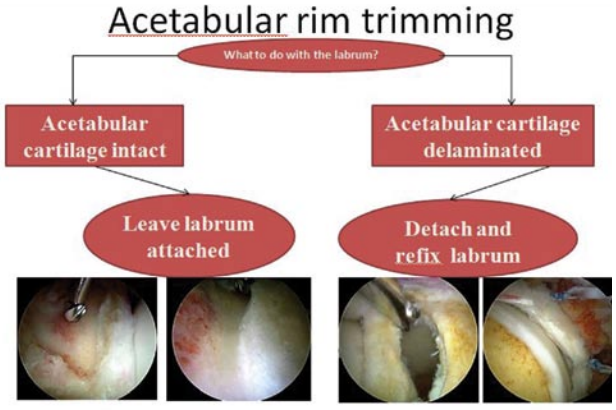

Figure 7. Algorithm for rim trimming and labral refixation.

If the labrum becomes detached during the process, the junction is débrided, and the labrum is reattached to the rim with anchors.

After head–neck bone resection and acetabulum rim trimming, the hip is flexed, rotated, and abducted to determine adequacy of the osteoplasty, first visually and then fluoroscopically (Figure 8). Fine-tuning the resections may complete the case.

The capsulotomy in most cases may be left open, but in patients with laxity or dysplasia the capsule should be reapproximated with side-to-side sutures. After closure, the joint is injected with a long-acting anesthetic, and a bulky dressing is applied to absorb any irrigation fluid that may leak out. With use of outflow-sensing pumps, it is not unusual to use 10 to 40 L of fluid during the case. Patients should be informed that the thigh may be very swollen for a few days.

5 Postoperative rehabilitation (don't overdo it)

There are 2 schools of thought on postoperative treatment: (1) allow for natural healing and self-directed ROM, progressive weight-bearing, and strengthening and (2) use a continuous passive motion machine, a hip brace, an ice machine, and active physiotherapy. Which method to use depends on patient and surgeon expectations. Elite athletes may require extraordinary therapy; weekend warriors may be able to rehabilitate on their own.[14] We have found that, in most cases, ROM returns and pain is reduced with self-rehabilitation in the first month after surgery. If set goals are not achieved, the patient is referred for formal physical therapy.

The patient should use 2 crutches and engage in progressive weight-bearing for 2 weeks (if bone is normal) or up to 6 weeks (if bone is osteopenic). As soon as the day after surgery, ROM exercises are initiated, along with use of a stationary bike, elliptical trainer, and treadmill. Pool exercises start 1 week later, after the sutures are removed. Patients who do not achieve full ROM by 1 month are sent for therapy. Running or cutting sports should not be allowed until the bone is healed, ROM is restored, and the hip is strong and stable. In most cases, these outcomes are expected within 3 months after surgery. Patients should understand that improvement and full recovery may take a year or more, but that desired activities may be resumed before then.

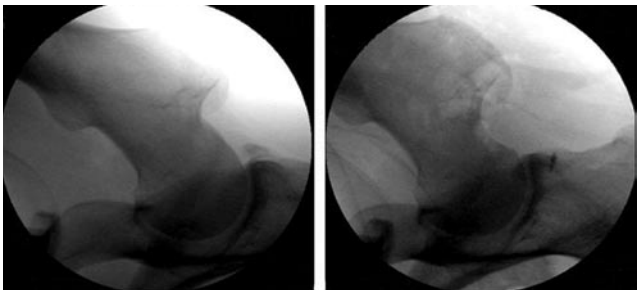

Figure 8. Postoperative fluoroscopic radiographs used to check adequacy of resection.

Of the more than 800 hips we have treated, 3 had femoral neck fractures (2 resulted from poor compliance, 1 from osteopenic bone). There were no deep infections, and adhesive capsulitis with limited ROM was rare. There were no femoral or sciatic neural injuries, but lateral femoral cutaneous neuropraxias occurred in 10 patients because of the proximity to the anterior portal. Five patients experienced symptomatic heterotopic bone, which required surgical removal.

Author's Disclosure Statement

Dr. Sampson wishes to note that he is a paid consultant to the Smith & Nephew Endoscopy Hip Advisory Board.

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