Traumatic Posterior Hip Instability and Femoroacetabular Impingement in Athletes

Marschall B. Berkes, MD, Michael B. Cross, MD, Michael K. Shindle, MD, Asheesh Bedi, MD, and Bryan T. Kelly, MD

Abstract

We describe 3 cases of posterior hip instability associated with femoroacetabular impingement. In each case, we obtained a detailed medical history, performed a physical examination, evaluated imaging, recorded intraoperative findings, and clinically followed the patient for 1 year.

Two of the 3 patients sustained a traumatic posterior hip subluxation caused by noncontact injuries. All patients had decreased internal rotation on physical examination, radiographic evidence of acetabular retroversion, a cam lesion, an elevated α angle, and a posterior acetabular rim fracture with associated labral injury. All patients underwent hip arthroscopy and direct repair of the bony acetabular fragment using 3 to 5 suture anchors. One-year follow-up in all cases demonstrated good to excellent results and full return to activities without restriction.

Patients with femoroacetabular impingement may be predisposed to traumatic posterior dislocation or subluxation and a concomitant posterior acetabular rim fracture with labral injury. We propose that FAI predisposed these athletes to posterior hip instability.

The term hip instability is used to describe a disease spectrum ranging from hip subluxation to frank dislocation. Classically, a traumatic posterior subluxation or dislocation results from a significant posteriorly directed force against the knee with the hip in a flexed and adducted position, as commonly occurs in motor vehicle crashes. Hip instability, however, has been reported to occur in various sports, including football, skiing, rugby, gymnastics, basketball, jogging, soccer, and biking.[1] The dislocation or subluxation event often causes injury to the passive constraints of the hip—namely, the bony acetabulum, labrum, and joint capsule.[2-6]

Some athletes with occult femoroacetabular impingement (FAI) may be predisposed to hip instability. Anterior impingement resulting from the engagement of a cam or pincer lesion restricts both the hip flexion and internal rotation necessary for many athletic activities.[7,8] Attempts to increase flexion or adduction during competition or secondary to seemingly innocuous trauma in this setting may result in abnormal levering of the femoral head and posterior instability (Figure 1). In certain cases, a posterior hip subluxation or dislocation event may be the first manifestation of occult FAI in a competitive athlete.

In this study, we report a novel case series of 3 athletes who had occult FAI and presented with posterior instability after low-energy trauma. In all 3 cases, loss of femoral offset and focal acetabular retroversion were found in combination with avulsion of the posterior acetabular labrum and bony rim. We propose that FAI predisposed these athletes to posterior hip instability.

The patients provided written informed consent for print and electronic publication of their respective case reports.

Case Reports

Case 1

A 27-year-old male firefighter presented to our clinic 5 months after sustaining a right posterior hip dislocation while playing football. The exact injury occurred after he

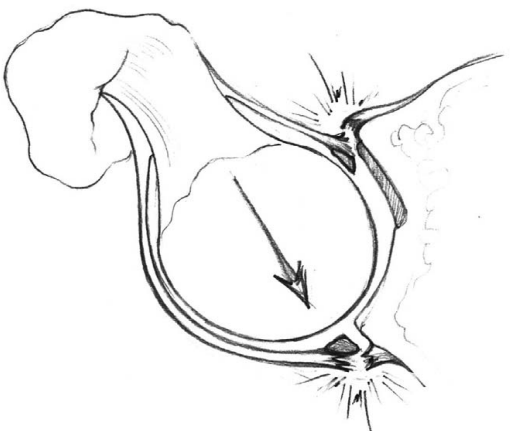

Figure 1. Theorized mechanism of injury for femoroacetabular impingement and posterior hip instability.

Dr. Berkes and Dr. Cross are Residents, Hospital for Special Surgery, New York, New York.
Dr. Shindle is Attending Orthopaedic Surgeon, Summit Medical Group, Morristown, New Jersey.
Dr. Bedi is Assistant Attending Orthopaedic Surgeon, University of Michigan, Ann Arbor, Michigan.
Dr. Kelly is Assistant Attending Orthopaedic Surgeon and Co-Director, Center for Hip Pain and Preservation, Hospital for Special Surgery.

Address correspondence to: Marschall Berkes, MD, Hospital for Special Surgery, 535 E 70th St, New York, NY 10021 (tel, 212-606-1000; fax, 212-606-1477; e-mail, berkesm@hss.edu).

Am J Orthop. 2012;41(4):166-171.

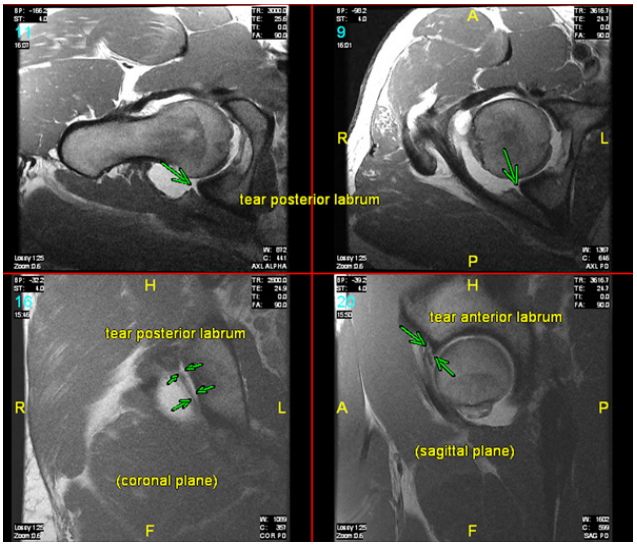

Figure 2. Case 1—axial, coronal, and sagittal magnetic resonance imaging of right hip shows large posterior labral tear, posterior acetabular rim fracture, and anterior labral tear.

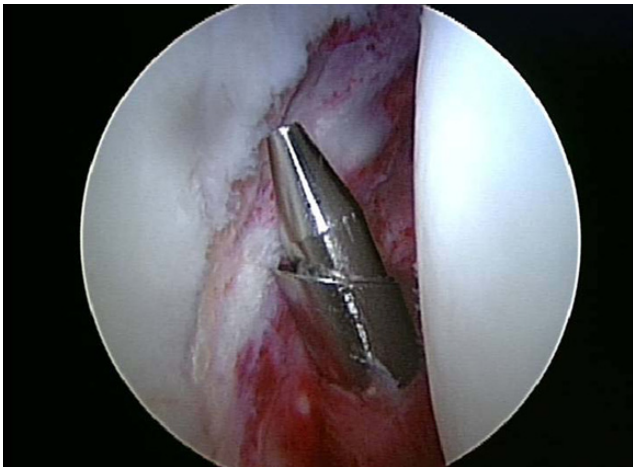

Figure 3. Case 1—arthroscopic view of posterior Bankart lesion.

was tackled from behind during a kickoff return; he did not recall a direct blow to the hip. The dislocation was initially managed with closed reduction in the emergency department at an outside institution approximately 2 hours after injury, and a course of nonoperative treatment. The patient continued to have intermittent groin pain and perceived instability with running and pivoting maneuvers.

On initial physical examination, he ambulated with a nonantalgic gait and had a negative Trendelenburg sign. He had a negative Thomas test and could forward-flex his hips to 120° bilaterally. He had 10° of internal rotation of the right hip and 15° on the contralateral side. External rotation of both hips was approximately 45° and symmetric. He was nontender to palpation. He had pain with flexion, adduction, and internal rotation of the right hip and very minimal pain with the posterior apprehension test. He had no pain to anterior apprehension or to resisted hip flexion. Neurovascular examination of both lower extremities was normal.

Radiographs showed an os acetabuli on the right side and a crossover sign consistent with cephalad retroversion of the acetabulum. An extended long-neck lateral radiograph showed loss of femoral offset secondary to a cam lesion with evidence of synovial herniation pits and sclerosis consistent with FAI. Magnetic resonance arthrogram confirmed findings consistent with a previous hip dislocation with a large tear of the posterior labrum, posterior acetabular rim fracture, and an associated tear of the anterior and lateral labrum (Figure 2). There was a dysplastic bump arising from the anterior aspect of the femoral head–neck junction with elevated α angle of 64° and relative femoral retroversion of 5°. Shear injury to the chondral surface of the femoral head was evident as well. Given the radiographic findings and persistent symptoms, the patient was taken to the operating room so that the FAI and the posterior instability lesions could be arthroscopically addressed.

The patient was positioned supine in traction on the fracture table, and routine hip arthroscopy was performed as described by Byrd.[9] Arthroscopic examination of the central compartment revealed focal, full-thickness delamination of the anterosuperior acetabular cartilage secondary to the cam lesion. The anterior aspect of the femoral head had an impaction fracture consistent with the appearance of a reverse Hill-Sachs lesion. There was a complete posterior labral tear with detachment from the acetabular rim, as well as attenuation of the posterior capsule (Figure 3). The posterior labral tear was in continuity with the anterosuperior labral tear secondary to the cephalad pincer lesion. The edge of the torn labrum was freshened, and it was repaired sequentially starting with the posteroinferior-most labrum (Figure 4A) and working up toward the anterosuperior labrum (Figure 4B). Four suture anchors were placed sequentially in the rim of the acetabulum. The focal acetabular pincer lesion was clearly visualized anterosuperiorly and was resected to eliminate the cephalad crossover sign.

Traction was removed and the hip flexed to enter the peripheral compartment. T-capsulotomy was performed directly over the cam lesion. Clear loss of neck offset with an impaction fracture from the pincer lesion was seen. Thorough decompression of the cam lesion was performed (Figure 5). A large (2×1 cm) loose body was found in the peripheral compartment and excised. Both fluoroscopic and dynamic arthroscopy was then used to confirm restoration of normal offset and clearance with terminal hip flexion and adduction. Although no further impingement was appreciated, the patient subluxed posteriorly with flexion beyond 70° (Figure 6).

The postoperative course was without complications. The patient was placed in a protective brace and given partial weight-bearing restrictions. He was to maintain posterior hip precautions to avoid deep flexion and

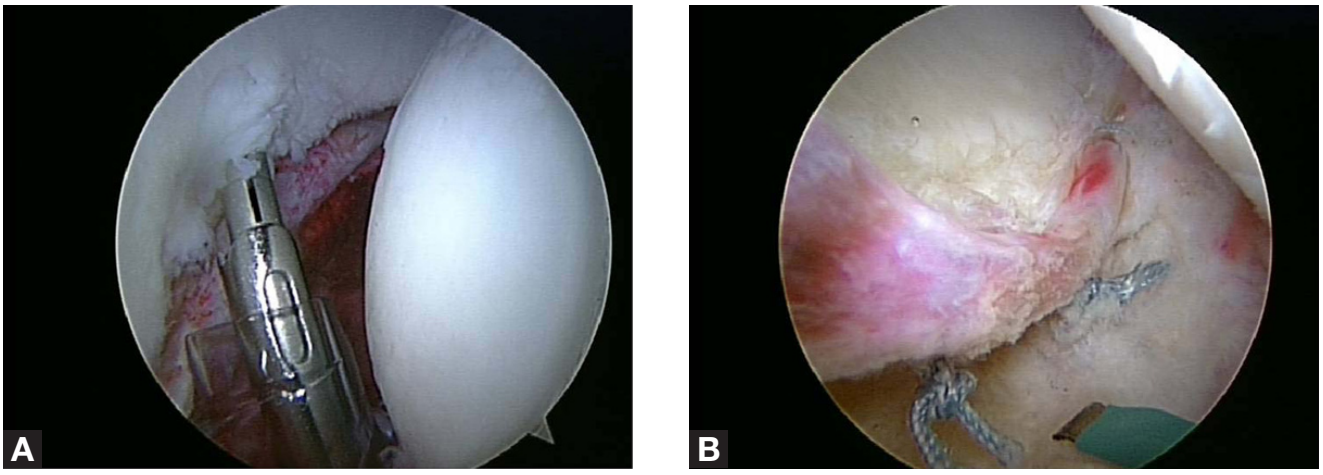

Figure 4. Case 1—arthroscopic photographs of suture anchor repair of posterior labral tear. Torn labrum was repaired sequentially starting with posteroinferior-most labrum (A) and working up toward anterosuperior labrum (B).

internal rotation. More than 12 months after surgery, he was pain-free and without instability.

Case 2

An 18-year-old male high school student presented to our clinic 3 months after sustaining a left hip posterior subluxation injury during a lacrosse game; another player fell on the patient's back while his left hip was flexed. Although plain radiographs showed a concentrically reduced hip, magnetic resonance imaging (MRI) immediately after the injury revealed marrow edema within the left femoral head, an anterior labral tear, and a fracture of the posterior rim of the acetabulum. At that time, an intra-articularly injected anesthetic provided pain relief. Initial management consisted of physical therapy and gradual weight-bearing as tolerated. Over the next several weeks, the patient resumed activities such as running, but rotational maneuvers continued to cause significant pain. No subsequent subluxation or dislocation events were reported. He presented to our clinic because of the persistent pain.

On physical examination, gait was normal. Left hip range of motion (ROM) was 120° flexion, 15° internal rotation, and 45° external rotation. Lower extremity neurovascular examination was unremarkable, and full strength was noted with left hip flexion, abduction, and adduction. The impingement test with flexion, internal rotation, and adduction of the left hip was clearly positive.

Plain radiography at the time of our initial examination showed a well-preserved joint space but evidence of FAI with focal anterosuperior acetabular retroversion and a cam lesion. MRI showed a 12×12-mm loss of normal marrow signal in the subcortical region of the superior femoral head consistent with avascular necrosis. Nonunion of the posterior rim acetabulum fracture and hyperintense signal were consistent with a tear of the anterior labrum (Figure 7). The α angle was 44° and femoral anteversion was 7°.

Given the clinical history and radiographic findings, arthroscopic surgery was recommended to address the impingement, posterior labral lesion, and area of avas-

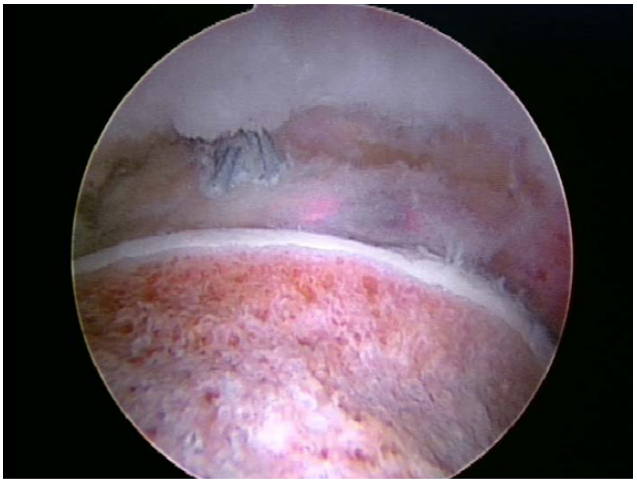

Figure 5. Case 1—arthroscopic view of peripheral compartment after cam decompression with restoration of suction seal.

Figure 6. Case 1—arthroscopic photograph shows posterior subluxation with rotation after repair and cam decompression.

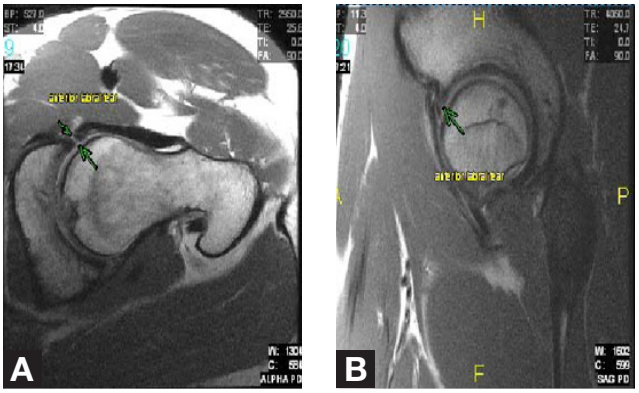

Figure 7. Case 2—axial **(A)** and sagittal **(B)** magnetic resonance imaging shows nonunion of posterior rim acetabulum fracture and tear of anterior labrum.

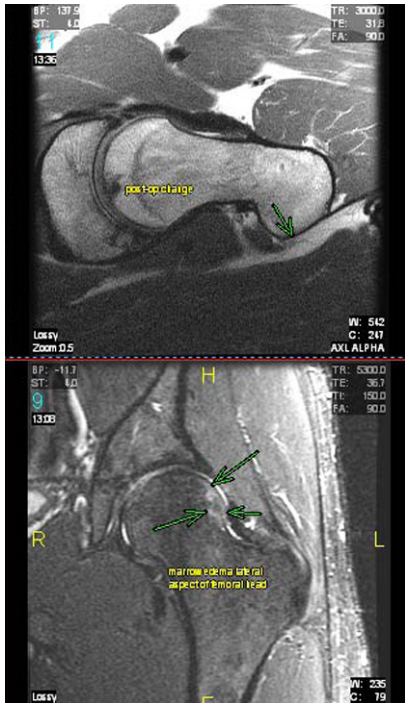

Figure 8. Case 2—magnetic resonance imaging 6 months after surgery shows posterior acetabular rim union and areas of avascular necrosis stabilized relative to before surgery.

cular necrosis. Arthroscopy of the central compartment revealed significant synovitis with a large loose body in association with a ligamentum teres rupture. A nonunited posterior acetabular rim fracture with attached labrum was also appreciated. There were no regions of chondral fracture or subchondral collapse on the femoral head that corresponded to the site of avascular necrosis on MRI. The patient underwent loose body removal, ligamentum teres debridement, synovectomy, pincer resection, anterior labrum debridement, and posterior rim fracture fixation with 3 suture anchors. Core decompression was also performed under fluoroscopic guidance. The cam lesion was subsequently resected in the peripheral compartment to restore normal offset and eliminate impingement. Excellent clearance was achieved with both arthroscopic and fluoroscopic dynamic examination, but some posterior subluxation was noted with hip flexion beyond 50°.

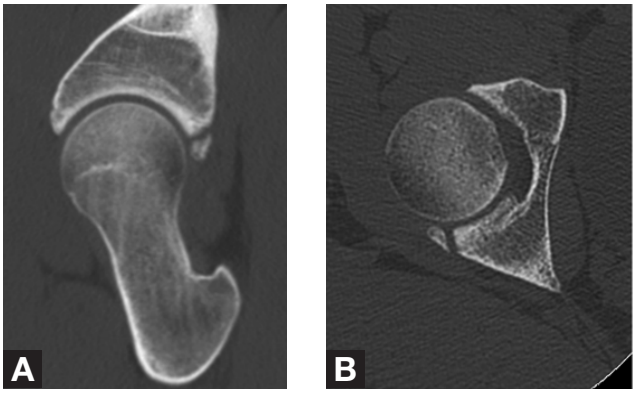

Figure 9. Case 3—axial **(A)** and oblique **(B)** computed tomography shows posterior acetabular rim fracture and nonunion.

After surgery, physical therapy was initiated with progressive weight-bearing and ROM. At 6-month follow-up, the patient had normal ROM, only mild pain at terminal flexion, and no symptoms of instability. MRI showed healing of the posterior rim fracture and areas of avascular necrosis that were unchanged since prior examination (Figure 8). Postoperative changes were evident in the anterior labrum and femoral head–neck junction, where cam decompression had been performed. One year after surgery, the patient was asymptomatic, had no residual pain or instability, and was returning to competitive lacrosse.

Case 3

A 17-year-old male presented to our clinic 3 months after sustaining a noncontact right hip posterior subluxation while playing lacrosse. He had been performing a pivoting maneuver that involved internal rotation of the ipsilateral limb when he experienced a popping sensation and significant pain in the lateral aspect of the hip. Immediately after the injury, MRI showed a large posterior labral detachment. Initial management at another institution was conservative. Pain and instability progressed, however, and the patient was unable to return to play. He was ultimately referred to our clinic because of the refractory pain.

On physical examination, gait was normal. Right hip ROM was 120° flexion, 25° internal rotation, and 45° external rotation. Palpation of the greater trochanter produced minimal pain. There was posterolateral hip pain with internal rotation. Lower extremity neurovascular examination was normal bilaterally, with full strength in the right hip with flexion, abduction, and adduction.

Plain radiographs showed mild superior joint-space narrowing and focal acetabular retroversion with a crossover sign. Dunn lateral views showed loss of neck offset with a cam lesion of the right femoral head–neck junction. Computed tomography (CT) showed nonunion of a fracture of the posterior rim of the acetabulum (Figure 9). The α angle was 44°, and femoral anteversion was 16°.

An anesthetic intra-articularly injected under fluoroscopic guidance provided near complete resolution of symptoms. Given his medical history, physical examination findings, and response to injection, the patient was a candidate for right hip arthroscopic surgery. In the central compartment, intraoperative findings were significant synovitis, an anterior labral tear, and an ununited posterior acetabular rim fracture with attached labrum. Synovectomy, anterior labrum debridement, pincer osteoplasty, and posterior rim fracture fixation with 4 suture anchors were performed. In the peripheral compartment, cam decompression was performed to restore normal femoral neck offset. Dynamic ROM with arthroscopy and fluoroscopy confirmed elimination of impingement and no evidence of posterior subluxation with hip flexion.

After surgery, the patient began physical therapy with protected weight-bearing and ROM. By 6-week follow-up, pain symptoms were completely resolved. Three months after surgery, MRI showed changes in the anterior labrum, stable suture anchors in the posterior acetabular rim fracture, and focal thinning of cartilage on the anterior and superior femoral head. One year after surgery, there were no symptoms or residual pain or instability, and the patient was playing lacrosse at his preoperative level of competition.

Discussion

Dislocation or subluxation of the hip can cause both intra-articular and extra-articular damage.[10-12] Authors have reported cases involving labral entrapment, labral tears, capsular tear, capsular attenuation, chondral injury, ligamentum teres disruption, and fracture of either the femoral head or the acetabulum. Specific injury patterns that mirror instability injuries in the shoulder have been documented. The Bankart lesion is classically described as an avulsion of the anteroinferior glenoid labrum at its attachment to the inferior glenohumeral ligament with obligatory capsular disruption in the shoulder.[13] When the avulsion involves a bony fragment of the glenoid, the lesion is referred to as a bony Bankart lesion. Correspondingly, authors have documented cases of Bankart-type hip injuries. Rashleigh-Belcher and Cannon[14] reported a case of recurrent posterior hip dislocation, characterized by disruption of the posterosuperior acetabular labrum with formation of a pouch between the posterior acetabular wall and the short rotators. Lieberman and colleagues[15] also described a case of recurrent posterior hip dislocation associated with posterior labrum avulsion. This Bankart lesion of the hip was repaired through an open approach by means of labral repair and capsulorrhaphy in addition to a bony allograft buttress posteriorly. Birmingham and colleagues[16] described a case of recurrent posterior hip instability that was caused by posterior capsule disruption and managed with capsular repair using suture anchors and an open approach.

Bony avulsion of the posterior lip of the acetabulum with attached labrum has also been found after posterior hip dislocation or subluxation. MRI findings for 18 consecutive posterior hip dislocations were described by Laorr and colleagues;[5] 6 (33%) of these dislocations had associated acetabular rim fractures. Moorman and colleagues[17] examined 8 American football players with posterior hip subluxations and found that all 8 had posterior acetabular lip fractures, diagnosed by plain radiographs, CT, and MRI. Philippon and colleagues[18] commented on arthroscopic findings after traumatic hip dislocation in 14 professional athletes; 5 (36%) of these athletes sustained acetabular rim fractures, none of which were repaired arthroscopically. Furthermore, 9 patients (64%) had findings consistent with FAI and were treated accordingly, with either femoral head osteoplasty or acetabular rim trimming. This lends further credence to the possibility that FAI predisposes to hip instability. Wang and colleagues[19] reported a case of anterior acetabular lip fracture with associated labral tear after anterior dislocation.

In the present study, we have described a novel series of cases of occult FAI in athletes who presented with posterior instability after low-energy trauma. In all 3 patients, loss of femoral offset and focal acetabular retroversion occurred in combination with avulsion of the posterior acetabular labrum and bony rim. We believe that the anterior impingement caused by the cam and/or pincer lesion restricted hip flexion and internal rotation, resulting in abnormal levering of the femoral head and resultant posterior instability. Given that posterior bony avulsions of the acetabulum do not require frank dislocation and can occur with subluxation alone, we propose that this injury pattern is likely more common than conventional wisdom indicates. Clinicians should increase their suspicion for occult FAI in the setting of posterior hip instability and should be aware of the injury mechanism. In certain cases, a posterior hip subluxation or dislocation event may be the first manifestation of occult FAI in competitive athletes.

The 3 patients in this series sustained posterior hip dislocation or subluxation with refractory pain and/or instability. All 3 were found by radiographic and arthroscopic evaluation to have posterior bony avulsions of the acetabulum with associated posterior labral injuries. In addition, they all had radiographic and clinical signs of FAI. Given our experience and the cases reported by other authors, we propose that this injury pattern is analogous to the Bankart lesion of the shoulder. There are subtle differences in labrum form and function between the shoulder and the hip. In the shoulder, the labrum deepens the glenoid and anchors the anterior ligaments; in the hip, it deepens the socket as well but also creates a suction seal to further contribute to joint stability. Despite these morphologic and functional differences, and the fact that hip instability is much less common than shoulder instability, the hip and the

shoulder have similar mechanisms of failure, with avulsion of the glenoid or acetabular rim as the humerus or femoral head is displaced, respectively. Although lack of level I data precludes making management recommendations, we believe successful outcomes are predicated on recognizing and eliminating both the underlying impingement and the posterior instability lesion. The anatomical lesions that contributed to our patients' hip instability were addressed by restoring normal anatomy through labral repair and posterior acetabular rim fixation. We did not excise any bony fragments. The predisposing element of FAI is addressed with routine osteochondroplasty, when appropriate. Osteochondroplasty can be performed arthroscopically, as it was in these 3 patients, and ultimately result in recovery to preinjury functional levels at 1-year follow-up.

Conclusion

Patients with FAI may be predisposed to traumatic posterior hip dislocation or subluxation with a concomitant posterior acetabular rim fracture and labral injury. The dysplastic bump blocks internal rotation and helps lever the femoral head posteriorly, resulting in subluxation or dislocation. The injury to the posterior acetabular rim and labrum is analogous to the Bankart lesion in shoulder instability. Underlying FAI and acute posterior labral injury can both be successfully addressed arthroscopically. Orthopedists should be aware of the injury pattern and mechanism.

Authors' Disclosure Statement

Bryan T. Kelly, MD, serves as a consultant to A2 Surgical and Pivot Medical, Inc and is an educational consultant to Smith and Nephew. The remaining authors report no actual or potential conflict of interest in relation to this article.

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