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12 Loose Bodies: Tips and Pearls

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Introduction

Intra-articular loose bodies have been known as a source of articular pain for many years. During the nineteenth century, loose bodies were believed to form either as a result of traumatic breakage of the articular cartilage or from the synovial membrane [1]. However, removal of loose bodies at that time could have been fatal [1]. Today, there are many indications for hip arthroscopy, with loose bodies as one of the most common [2–4]. Moreover, hip arthroscopy is ideally set for the removal of loose bodies [2, 5].

In 1977, Milgram published a study on more than 300 different specimens in which one or more osteochondral bodies were found in surgery; he has classified loose bodies into three groups [6]. The first group included patients with post-traumatic osteochondral fractures, in which articular cartilage was found within the loose bodies, and in some cases, the concomitant chondral defect from which the loose body arose was found. The second class of loose body included those found in the presence of articular surface disintegration with degenerative joint disease and avascular necrosis (AVN); in these cases, articular surface damage was either noted in surgery or radiographically. The last group consisted of patients with myriads of free lose bodies, sometimes hundreds, and a grossly normal joint surface; these cases were presumed to be synovial chondromatosis. In addition to these classifications, Milgram also distinguished between loose bodies and attached osteochondral bodies. Nowadays, the nineteenth century theory is still valid; loose bodies can arise from tissue within the joint, the synovial membrane, or the articular surface. Once a loose body is lodged in the joint, a common sequence occurs: proliferation of bone and cartilage with subsequent resorption by osteoclasts on the surface [7].

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While removal of symptomatic loose objects from the hip joint represents a clear indication for hip arthroscopy, not all loose bodies have to be removed. In some cases listed below, other measures should be taken.

Signs and Symptoms

Patients with loose bodies in the hip may complain of pain around the hip joint along with catching, locking, clicking, and grinding sensations.

Diagnosis

Diagnosis of loose bodies in the hip joint can be difficult; in many cases, concomitant injury may accompany loose bodies in the hip joint. The clinical history is most important for the diagnosis of intra-articular loose bodies. Legg-Calve-Perthes disease (LCPD) as a child may point toward an osteochondritis dissecans (OCD), while a fracture raises suspicion of an osteochondral fragment. Upon examination, the range of motion may be mechanically limited and clicking or catching may be noted.

The presence of a loose body on an imaging modality does not always indicate the source of the symptoms. Diagnostic intra-articular injection of anesthetic agent to the hip joint is often recommended before hip arthroscopy. Pain originating from intra-articular pathology will subside partially or fully following the injection.

Imaging

X-ray is usually the first imaging modality to be used; however, only loose bodies containing bone or calcium can be identified on X-ray [2]. We recommend a series of four views that includes an AP pelvis, Dunn view, cross table, and false profile of both hips. The combination of these X-rays gives a comprehensive view of the proximal femur and acetabulum. In many cases, a loose body can only be noticed on one view,

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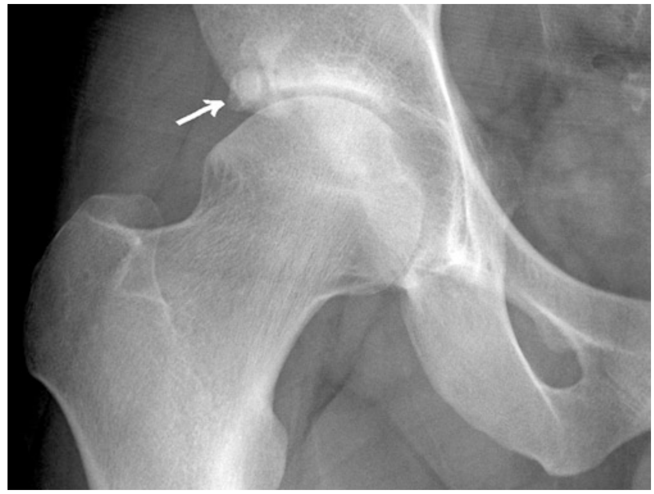

Fig. 12.1 Preoperative view of the right hip view showing unfused fracture of the acetabular rim (*arrow*)

Fig. 12.2 Postoperative view of the right hip after removal of the unfused fragment

while remaining unseen on the others; loose bodies may be in the peripheral compartment or in the acetabular fossa.

Computed tomography (CT) can clearly image and pinpoint the location of loose body fragments in the hip joint; however, visualization of cartilaginous loose bodies may be limited. Magnetic resonance arthrography (MRA) can, however, visualize cartilaginous loose bodies. While MRA has a high specificity, its sensitivity for the detection of loose bodies has been shown to be less than 50% [8]. Nonetheless, MRA is reasonable before hip arthroscopy, as it allows more accurate diagnosis of concomitant injuries such as labral tears. A diagnostic intra-articular injection can be performed with the injection of anesthetic.

Although ultrasound is an excellent tool to assess foreign bodies in soft tissue and extra-articular space, it has limited functionality in the diagnosis of loose bodies inside the hip joint.

Posttraumatic Loose Bodies

Acetabular fractures and femoral head fractures are an etiology for loose fragments in the hip joint. Those posttraumatic fragments are a common cause of loose bodies in the hip joint [5]. The classic management is removal of the fragments. However, the removal of a large fragment might produce a noncongruent weight-bearing articular surface. Matsuda has recently published a case report of arthroscopic reduction and internal fixation of a large osteochondral fragment of the femoral head [9]. Evans et al. [10] have published a case report of a 32-year-old man with a symptomatic traumatic osteochondral defect of the femoral head. One year after the injury, with the failure of conservative treatment, he underwent subsequent arthroscopy using a fresh-stored osteochondral allograft plug via a trochanteric osteotomy. One year after the surgery, the patient is reported to be asymptomatic.

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Posttraumatic Acetabular Rim Fracture: Case Presentation

A 22-year-old male student complaining of right hip pain for 4 years following a football injury where two other players' helmets collided into his right hip. He was diagnosed with a fracture of the acetabulum at that time and was treated conservatively. After having continued pain in the lateral side of the hip, incomplete healing of an acetabular rim fracture was seen on an AP pelvis X-ray (Fig. 12.1). The fragment was surgically resected due to the fact that the center-edge angle without the broken lateral rim measured 24°. At hip arthroscopy, a large chondral lesion was found which warranted a performed microfracture. Next, a small loose body was removed, and the acetabular rim fracture was excised which was followed by femoral osteoplasty. Following surgery, the patient continued to have pain; a residual cam lesion was noted, and a revision arthroscopic osteoplasty was done 1 year later. Even so, the pain did not resolve. At the last follow-up, two and a half years after the first surgery, the patient was still in pain. An updated X-ray showed borderline dysplasia with a center-edge angle of 20° and early arthritis (Fig. 12.2), which was felt to be the cause of his continued pain. This case highlights the potential for poor outcomes with a large acetabular rim fracture. In this setting, if the rim fracture is not reparable, peri-acetabular osteotomy may be considered.

Femoral Head Fracture After Anterior Hip Dislocation: Case Presentation [11]

A 22-year-old male involved in a snowboarding accident sustained an anterior hip dislocation with fracture of the femoral head. The hip was relocated 4 h post-injury, and the patient was referred for evaluation 1 week later. The presence

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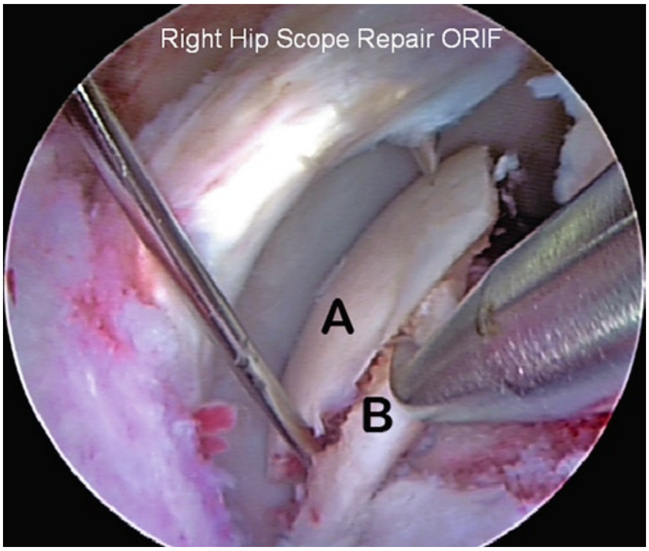

Fig. 12.3 Arthroscopic view of "clamshell" fracture being pried open with microfracture awl prior to arthroscopic osteosynthesis. The two cartilage surfaces of the folded-over fracture are represented by *A* and *B* (Courtesy of Dean Matsuda, MD, with permission from *Orthopedics Today*)

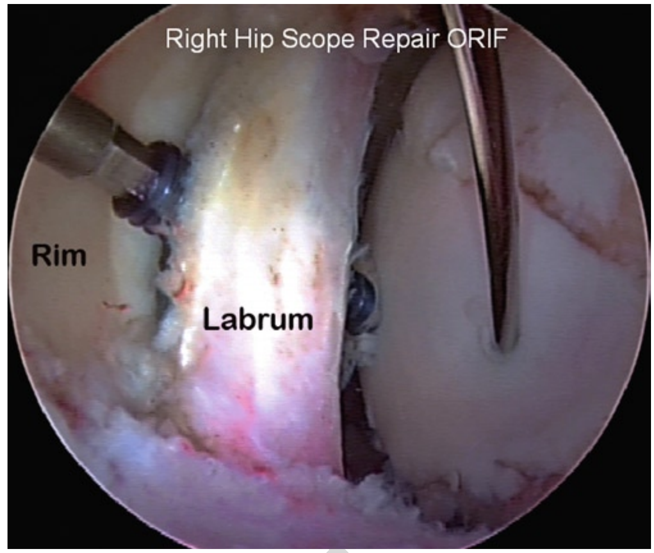

Fig. 12.4 Arthroscopic view of first headless screw being inserted after angle of approach has been improved with arthroscopic rim trimming. Note the cannulated screw being inserted between trimmed acetabular rim and detached labrum (Courtesy of Dean Matsuda, MD, with permission from *Orthopedics Today*)

of a large osteochondral fracture in a critical weight-bearing region favored arthroscopic osteosynthesis over resection; however, concurrent FAI morphology affected the arthroscopic management. During hip arthroscopy, the osteochondral fragment was found folded over itself in a "clamshell" configuration. The "clamshell" was pried open using a microfracture awl (Fig. 12.3). The fragment was reduced and fixated using two headless screws, but only after rim reduction and labral detachment permitted an improved angle of approach for screw fixation (Fig. 12.4). Arthroscopic labral refixation and femoral osteoplasty followed. One year postoperatively radiographs showed healing of the fracture (Fig. 12.5), and the patient was highly satisfied, able to return to snowboarding and tennis.

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Synovial Chondromatosis

Synovial chondromatosis (Figs. 12.6 and 12.7) is one of the most common causes of loose bodies in the hip joint. Milgram [6] has identified three stages of the disease: (1) active intrasynovial disease with no loose bodies, (2) transitional phase, with intrasynovial nodules and free loose bodies, and (3) multiple loose bodies with no active intrasynovial disease. The disease is subtle in nature; by the time it becomes symptomatic and diagnosis is made, the synovial process is usually resolved and the source of the symptoms is the resulting loose bodies. X-ray will not show the loose bodies in most cases; however, MRI may show small loose bodies within the synovial fluid (Fig. 12.6). Boyer and Dorfmann [12] reported the results of 111 cases of primary synovial chondromatosis in the hip that were treated arthroscopically. In their cohort with a follow-up of 1–16 years, more than half of the patients required at least one additional surgery.

Fig. 12.5 One year postoperatively, the fracture is seen healed (Courtesy of Dean Matsuda, MD)

Degenerative Joint Disease and Avascular Necrosis

Loose bodies are known to be related to degenerative joint disease (DJD) and to proliferate as the disease progresses. There are three mechanisms of loose body formation in the presence

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Fig. 12.6 Coronal cut of the left hip, via a proton density magnetic resonance with gadolinium showing loose bodies within the synovial fluid at the same patient with synovial chondromatosis

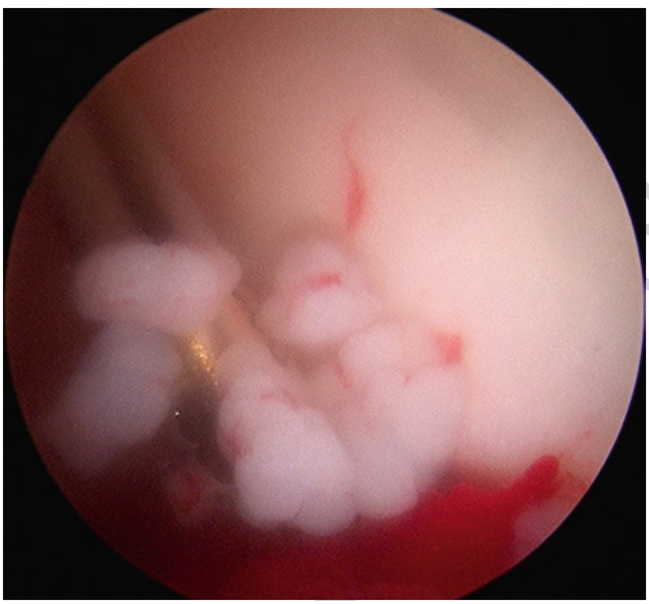

Fig. 12.7 Arthroscopic view of the left hip showing myriad loose bodies in a patient with synovial chondromatosis

of DJD: (1) fragmentation of the joint surface, (2) fractured osteophytes, and (3) osteochondral nodule proliferation in the periarticular soft tissue [6]. Removal of loose bodies and osteophytes may address the mechanical symptoms; this will not, however, stop the progression of the disease. It has been shown in the past that joint space narrowing and high Tonnis grade are predictors of poor prognosis with hip arthroscopy. According to the authors' experience on 231 patients, hips which were graded as Tonnis 2 or 3 had satisfying results 3 months postoperatively, but worse results at following visits [13].

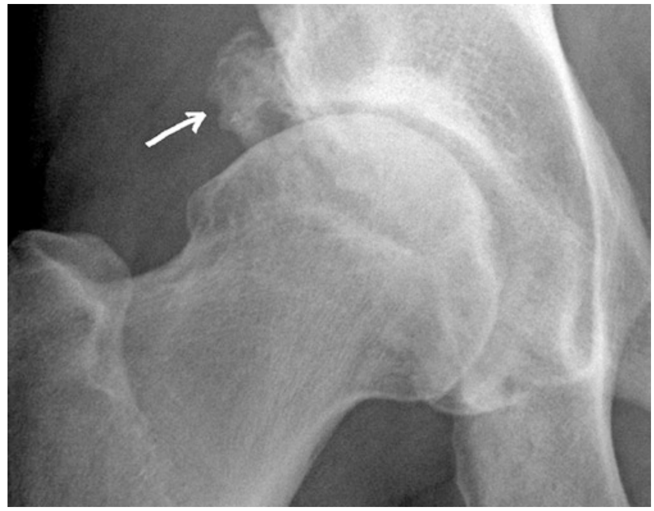

Fig. 12.8 Preoperative view of the right hip of a patient with hypertrophic osteoarthritis; large osteophyte is seen latterly (*arrow*)

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Degenerative Joint Disease: Case Presentation

A 42-year-old man came to our clinic with complaint of right hip pain for 4 months; the pain was insidious in onset. He was an avid soccer player, and the pain was hindering his ability to play. He also complained of pain while walking long distances. On physical exam, he walked without a limp and had extreme pain and range of motion (ROM) limitation in flexion (up to 100°) and internal rotation (up to 5°). A positive anterior impingement test was noted. The X-rays (Fig. 12.8) showed joint space of 2.8 mm minimum on the lateral side, a large cam lesion, and large broken irregular osteophytes. During hip arthroscopy surgery, the broken osteophytes were removed (Fig. 12.9), the FAI morphology was addressed with acetabuloplasty and osteoplasty, and a labral tear was repaired. At 3 and 6 months postoperatively, the patient reported relief of the pain and was able to walk 5–10 miles every day at work. Fifteen months after the hip arthroscopy, the patient reported excruciating pain and soreness while walking and climbing stairs. On X-rays, increased osteoarthritic changes were noted; therefore, THR was advised. This case illustrates that arthroscopy for loose bodies in the setting of DJD may provide short-term relief; however, in the long-term, the DJD is expected to progress.

Osteochondritis Dissecans as a Sequela of Perthes Disease

Osteochondritis dissecans (OCD) in the hip is one of the four known sequelae of LCPD, which include coxa magna, coxa brevis, and coxa irregularis [14]. In most cases, the OCD will not appear solely, and treatment of one or more of the other

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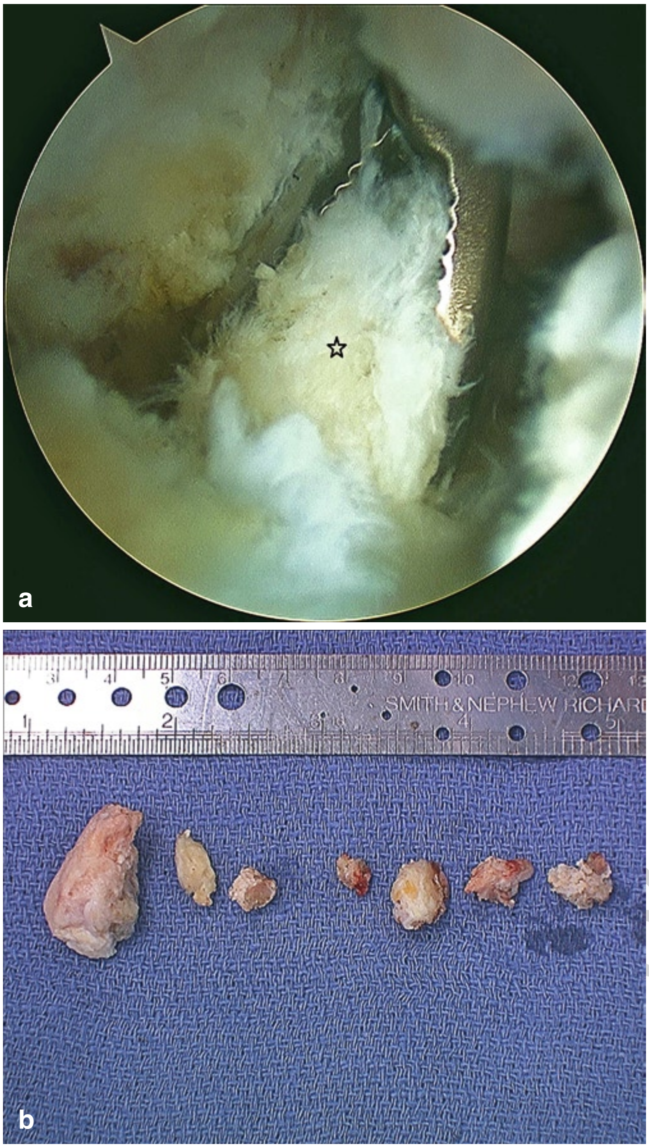

Fig. 12.9 (**a**) Arthroscopic removal of broken osteophyte (*star*) using a standard arthroscopic tool. View through the anterolateral portal, instrument through mid-anterior portal. (**b**) Seven osteophytes which were removed arthroscopically from the same patient

pathologies is warranted. In the case that the OCD is not in a weight-bearing area, arthroscopic removal of the lesion, debridement, and osteoplasty suffice. However, in the case the OCD is in a weight-bearing area, removal of the lesion will create a deformed femoral head; in that case, it is advised to either fix the OCD back to its place (see case presentation) or to use an osteochondral graft to fill the defect [14, 15]. The decision whether to use an open dislocation or an arthroscopic technique is dependent on the lesion size and concomitant pathology. For example, in the case of coxa brevis in which the neck is shortened and the greater trochanter has overgrown, open surgery may be indicated since greater trochanter advancement is beneficial [14].

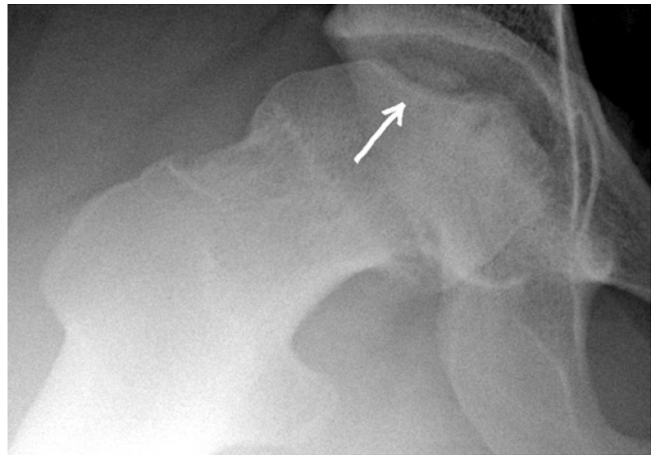

Fig. 12.10 Preoperative Dunn view of the right hip of a 24-year-old patient showing a large osteochondritis dissecans (OCD) lesion as a sequela of Legg-Calve-Perthes disease as a child (*arrow*)

OCD After LCPD: Case Presentation

Twenty-five-year-old female athletic trainer, presented with hip pain with a history of LCPD that was diagnosed at the age of 9. On examination, a marked ROM limitation was noted. The X-rays showed a deformation of the femoral head combined with large OCD (Fig. 12.10); the joint space, however, was intact. Via open surgical dislocation, the OCD was refixated using absorbable pins and osteoplasty of the head was done (Fig. 12.11 and Video 12.1: www.goo.gl/Ien9i). Three months after surgery, the patient was satisfied with an increased range of motion, reduced pain, and a very slight Trendelenburg gait; the X-ray showed healing of the OCD (Fig. 12.12).

Os Acetabuli

Os acetabuli is an ossicle located at the acetabular rim. It was describe by Ponseti in 1978 as a secondary ossification center of the acetabulum and a normal stage in its development [16]. In some patients, the os acetabuli remains unfused even at adulthood, resulting in an os acetabuli. Some authors consider this to be a fatigue fracture due to stress overload [17]. It should be noted that radiographic appearance similar to an os acetabuli may stem from multiple other causes, as listed in Table 12.1.

On a retrospective study, Martinez et al. [17] have found large osseous fragments at the anterolateral acetabular rim in 18 hips (15 patients) out of 495 patients treated for FAI. All hips presented with a "cam"-type impingement, and 16 had additional anterior overcoverage of the acetabulum as reflected by a retroverted acetabulum.

Os acetabuli can be a source of hip pain and should be removed during surgery if suspected to be part of the

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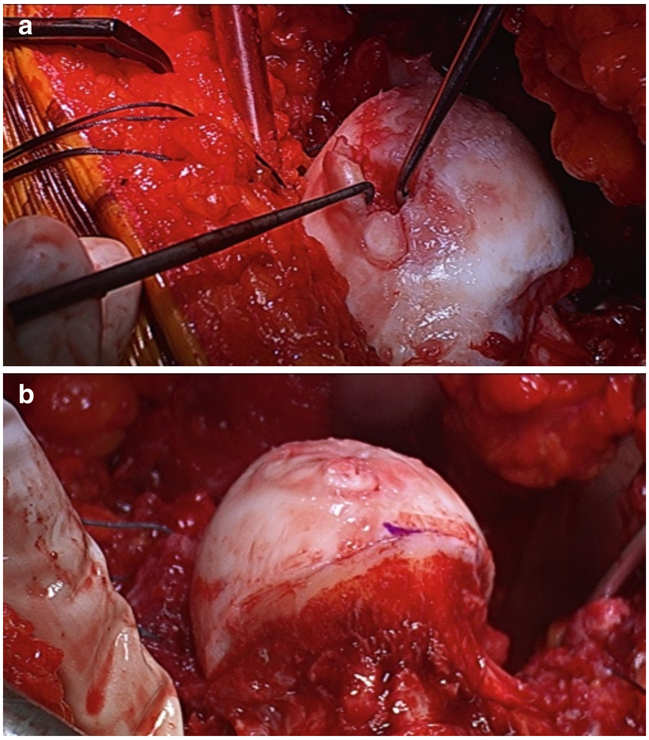

Fig. 12.11 (**a**) Microfracture of the OCD lesion via open surgical dislocation, the deformation of the femoral head is clearly seen. (**b**) Same patient after fixation of the OCD using absorbable pins and femoral neck osteoplasty

Fig. 12.12 Postoperative Dunn view of the right hip 3 months after the fixation of the OCD and femoral neck osteoplasty

Table 12.1 Pathologies with radiographic appearance of os acetabuli

1. Unfused secondary ossification center
2. Fatigue fracture due to stress overload (FAI morphology)
3. Acute acetabular rim fracture (Trauma)
4. Ossification of the labrum
5. Calcium deposit in the labrum
6. Fractured rim osteophyte
7. Adhesed loose body to the acetabular rim

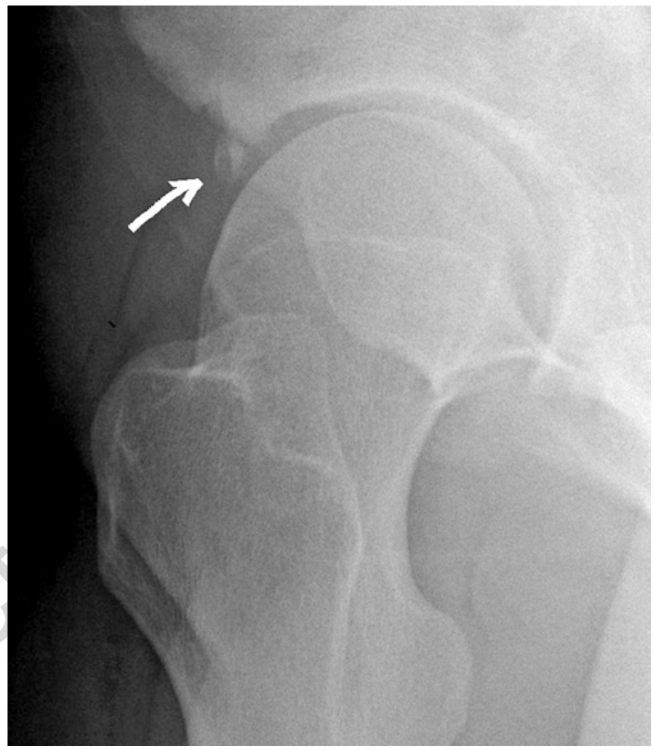

Fig. 12.13 False profile view of a left hip with anterior os acetabuli (*arrow*)

pathology. However, care should be taken in removing unfused secondary ossification centers, as removal of a large os may result in iatrogenic dysplasia. In order to prevent this, the lateral and anterior center-edge (CE) angles should be measured preoperatively with and without inclusion of the os, to determine whether removal of the os will leave acetabular undercoverage.

Os Acetabuli: Case Presentation

Nineteen-year-old male, presented with right hip pain that began gradually a couple of years earlier. On examination, a positive anterior impingement test was noted along with mild ROM limitations. On the false profile X-ray view of the right hip joint (Fig. 12.13), an os acetabuli was seen in the anterior aspect of the joint. Using an arthroscopic approach, the os acetabuli was removed (Video 12.2: www.goo.gl/UMfo9), a labral tear was repaired, and the bony FAI morphology of the

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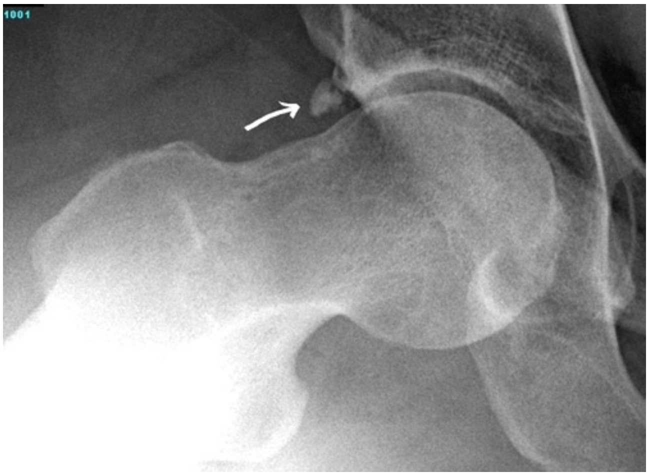

Fig. 12.14 Dunn view of a right hip, 1 year post-hip arthroscopy, demonstrating a calcific deposit in the acetabular labrum (*arrow*)

proximal femur was addressed with osteoplasty. Three months after the surgery, the patient was satisfied, with improved ROM.

Calcium Deposit Inside a Labral Tear

In some cases with labral tears, a calcium deposit inside the labrum can be seen on plain X-ray. Seldes et al. in a milestone study regarding the acetabular labrum anatomy, found formation of peripheral osteophytes inside the labral tear between the articular margin and the detached labrum. The calcium deposit seen under X-ray is characterized by irregular borders and a popcorn appearance. The calcification can either be very small and hardly seen or large as in the next case presentation and video.

Calcium Deposit: Case Presentation

60-year-old female, referred for evaluation 1 year after hip arthroscopy with labral debridement and pain that did not resolve postoperatively. On physical exam, a limited range of motion was noted along with posterior hip pain at flexion and a modified Harris hip score (mHHS) of 67.2 points. On preoperative X-ray (Fig. 12.14), a calcium deposit is seen lateral to the joint. Additionally, lateral joint space narrowing and bone sclerosis was noted. Due to the arthritic stage of the joint, hip replacement was offered as an option. However, the patient selected hip arthroscopy in order to delay arthroplasty. During revision arthroscopy, a large calcium deposit was found in the labrum and removed using a probe (Video 12.3: www.goo.gl/ISe8s). Later, the labrum was debrided, and acetabuloplasty and osteoplasty were done. After the surgery, the patient experienced relief of pain and symptoms, with postoperative mHHS of 95.7 points.

Foreign Bodies

Foreign bodies in the hip joint can be iatrogenic, e.g., breakage of a surgical tool, or penetration from the outside, such as bullets. There have been several reports about removal of bullets from the hip joint using arthroscopic devices [19–21]. There are several indications for bullet removal: (1) intra-articular lodging of the bullet, in order to prevent additional chondral damage; (2) neurovascular proximity; and (3) lead bullets, in order to prevent chronic lead poisoning.

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The Authors' Experience

Over the last 728 hip arthroscopies performed by the senior author (B.G.D.), 87 cases (12%) involved removal of free bodies. The mean age of the patients with free bodies was 42 (range, 16–60), higher than the remaining population ($p=0.03$). Furthermore, the percent of male patients was higher ($p=0.002$), the Tonnis arthritic grade was higher ($p<0.0001$), and the labral tear size was larger ($p<0.0001$) for patients with loose bodies (Table 12.2).

As for the clinical status before the surgery, we found a difference in the preoperative pain, as reflected by the visual analog scale (VAS), which was higher in the presence of free bodies ($p=0.01$). A marginally significant lower score was found according to the non-arthritic hip score (NAHS); however, no difference was found according to the modified Harris score (mHHS). One year after the surgery, there was no significant difference in the improvement of the VAS, NASH, or mHHS results between patients with or without free bodies.

Tips and Pearls for Arthroscopic Free Body Removal

The first step in removal of free bodies from the joint is the diagnosis of their presence. In most cases, the diagnosis is made by preoperative imaging, i.e., an os acetabulum or a fracture. In other cases, smaller free bodies will be visible at the time of introduction to the joint, as in many cases of synovial chondromatosis. However, in some cases, the free bodies may not be immediately obvious upon insertion of the

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Table 12.2 Authors' experience comparing procedures involving loose body removal to all other hip arthroscopies

		Loose body removal		
		+	–	*p* value
Number of patients (total 728)		87	641	
Mean age (years)		41.84	38.38	0.0351
Gender (*n*)	Male	52 (59.77%)	246 (38.38%)	0.0001
	Female	35 (40.23%)	395 (61.62%)	
Tonnis grade	0	31 (41.33%)	338 (67.74%)	<0.0001
	1	34 (45.33%)	116 (23.25%)	
	2	9 (12.00%)	45 (9.02%)	
	3	1 (1.33%)	0 (0%)	
Labral tear size (hours)		3.63	2.9	<0.0001
Preoperative VAS		6.70	6.1	0.0144
Mean 1 year VAS change		−3.21	−2.73	0.4344
Preoperative mHHS		60.41	60.04	0.8601
Mean 1 year mHHS change		+22.04	+21.00	0.8225
Preoperative NAHS		52.27	56.78	0.0675
Mean 1 year NAHS change		+19.03	+20.89	0.6678

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arthroscope; common hiding places are the acetabular fossa, the inferior recess, and the distal to the zona orbicularis.

Accessing the loose body may be a hurdle in the hip joint. A majority of loose bodies, particularly those near the rim such as os acetabuli, can be accessed through the anterolateral and mid-anterior portals. However, some loose bodies such as those in synovial chondromatosis can float or adhere in the acetabular fossa. To access the fossa, additional direct anterior portal and posterolateral portal can be useful.

In general, three device types are used for free body removal: motorized shavers, hollow bore cannulas, and arthroscopic graspers. The size of the free body determines which device is used. Small free bodies or debris in the joint can be removed using a shaver. With the shaver suction on, small free bodies are easily sucked out of the joint. Medium-size free bodies can be extracted using a cannula; the hydrostatic pressure inside the joint creates "vacuum cleaner" effect at the end of the cannula, which allows the loose bodies to flow out of the joint. This is highly applicable in synovial chondromatosis. Large free bodies can usually be removed intact with a grasper. Extremely large loose bodies can be broken inside the joint into smaller fragments, which may then be individually removed with the grasper.

A major obstacle in retrieving loose bodies from the hip joint stems from the depth of the hip within its soft tissue envelope. In order to avoid dislodging the loose bodies in the soft tissues during retrieval, it is often useful to enlarge the portal tract at the capsule, fascia, and skin. Enlarging the portal tract can be accomplished using a long tonsil or hemostat clamp, by inserting the clamp, and then spreading as you pull back.

In summary, loose bodies may appear in many forms. A repertoire of multiple approaches, devices, and techniques will facilitate easy removal of most loose bodies with minimal surgical time or morbidity to the patient.

[AU2]

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