OBJECTIVE. The objective of this study was to describe the MR imaging features of osteochondritis dissecans of the femoral sulcus, which have not been described previously.

CONCLUSION. Osteochondritis dissecans of the femoral sulcus has been recognized as a unique clinical and radiographic entity, warranting early diagnosis and appropriate treatment. Although this type of osteochondritis dissecans may be inconspicuous on radiography, fast spin-echo proton density-weighted and T2-weighted MR imaging sequences allow evaluation for articular cartilage integrity and lesion stability. Because of the orientation of the femoral sulcus, osteochondritis dissecans involving the femoral sulcus is best evaluated on axial and sagittal images.

Materials and Methods

We performed a multiinstitutional retrospective review of 19 patients (20 knees) with MR imaging features of femoral sulcus osteochondritis dissecans (18 lateral, two medial). The patients’ ages ranged from 12 to 28 years (mean age, 18 years); the study population comprised 18 males and one female. Correlative radiographs of the knee were available in 13 cases (including 11 cases with axial views); CT scans were available in two cases; and bone scintigrams, in one case. MR imaging sequences varied somewhat among the institutions. Fast spin-echo proton density–weighted and T2-weighted images were obtained in the sagittal, axial, and coronal planes in all cases. Fast spin-echo T2-weighted images with fat saturation were obtained in four cases; proton density–weighted images with fat saturation, in one case; short tau inversion recovery (STIR) images, in four cases; and various gradient-echo sequences, in five cases.

Two experienced musculoskeletal radiologists reviewed all of the cases by consensus. The MR images were evaluated to identify the imaging plane and sequence that best revealed the bone changes of osteochondritis dissecans of the femoral sulcus. Lesions were classified as unstable using T2-weighted images if any of the following established criteria were present: the presence of a line of high signal intensity at the interface
between the osteochondritic fragment and the adjacent bone, an articular fracture indicated by highsignal joint fluid passing through the subchondral bone plate, a focal osteochondral defect filled with joint fluid, or a 5-mm or larger fluid-filled cyst deep relative to the lesion [5–7]. High signal intensity was defined as a region in which the signal intensity was equal to that of fluid. Lesion length and width were measured on sagittal and axial images. The distance of the lesion from the distal femoral anterior physeal margin or physeal scar was measured on sagittal images. The presence of a joint effusion, a displaced osteochondritic fragment (commonly referred to as a loose body), subchondral cysts, or bone marrow edema was recorded. Coexisting patellar, ligamentous, and meniscal abnormalities were noted. Arthroscopic validation was obtained in 10 patients.

**Results**

On MR imaging, the articular cartilage and bone changes of femoral sulcus osteochondritis dissecans were best shown in all cases on images obtained in the axial and sagittal planes (Fig. 1). In all cases except two, the lesion occurred on the anterior aspect of the lateral femoral condyle, usually close to the midline. The other two lesions occurred at the anterior aspect of the medial femoral condyle close to the midline. All of the lesions were distal relative to the distal femoral physis or physeal scar, except for one that extended to the physeal scar. The distance from the lesion to the physis or physeal scar ranged from 0 to 2.5 cm (mean distance, 1.2 cm). Lesions ranged from 1.3 to 2.9 cm in length (mean length, 2.0 cm) and from 0.3 to 3.2 cm in width (mean width, 1.7 cm).

Eight lesions (40%) were classified as stable (Fig. 2), and 12 lesions (60%) were classified as unstable (Figs. 3–6). The patellar cartilage was abnormal in one case, which showed findings of mild medial facet chondromalacia, but was normal in the remaining cases. Joint effusion was present in 12 cases (60%), loose bodies in four cases (Figs. 4 and 6), and subchondral cysts in six cases (Figs. 1, 5, and 6). We found bone marrow edema within the femur deep relative to the osteochondral lesion in 10 (50%) of 20 lesions (Figs. 5 and 6). None of the patients had a ligament tear or...
patellar subluxation. One patient had a radial tear of the medial meniscus.

The osteochondritis dissecans lesion was detected on radiography prospectively in nine of the 13 cases for which radiographs were available, most commonly on the tangential view (eight cases). In one of 13 cases, the lesion was seen prospectively only on the lateral view, but not on the tangential view. After MR imaging, the osteochondritis dissecans lesion could be identified retrospectively in the remaining four cases.

At arthroscopy, all three osteochondritis dissecans lesions classified on MR imaging as stable were confirmed to be stable. All seven osteochondritis dissecans lesions classified as unstable on MR imaging were confirmed to be unstable at arthroscopy. Treatment consisted of débridement, drilling, loose body removal, reimplantation of the osteochondritic fragment, lateral release, or a combination of these procedures.

Discussion

Osteochondritis dissecans is a pathologic process affecting the articular cartilage and subchondral bone. In the knee, osteochondritis dissecans most commonly involves the medial femoral condyle (85% of cases), classically at its inner aspect. The inferocentral lateral femoral condyle (13%) and rarely the anterior lateral femoral condyle (2%) also may be affected [1]. Trauma, ischemia, abnormal ossification, and genetic factors are suggested causes [1, 8].

Although osteochondritis dissecans of the patellofemoral groove is uncommon, it is an important pathologic process with distinct clinical and radiographic presentations [2]. Osteochondritis dissecans of the femoral sulcus should be considered in young patients presenting with patellofemoral pain [9]. Smith [2] described a distinct clinical pattern for osteochondritis dissecans of the femoral trochlea. This lesion typically occurred in adolescent boys who experienced pain with running or jumping and had tenderness at the lateral surface of the trochlea [2]. Femoral sulcus osteochondritis dissecans characteristically occurs where the lateral femoral condyle contacts the lateral facet of the patella, and chronic repetitive microtrauma has been proposed as the most likely cause [3]. Mori et al. [4] suggest that a deranged extensor mechanism is a common cause of cartilage injury in osteochondritis dissecans of the femoral groove and chondromalacia patellae.

Radiography is the initial imaging examination recommended for the evaluation of suspected osteochondritis dissecans [1]. The radiographic projection that most commonly shows osteochondritis dissecans at the femoral sulcus is a tangential view (e.g., Merchant view), which should be acquired routinely for patients with patellofemoral symptoms. Even with tangential views, however, radiographic findings may not be conspicuous or definitive, because the lesion (on the curving femoral trochlea) may not be tangential to the X-ray beam and because developmental variations in ossification may be difficult to differentiate from juvenile osteochondritis dissecans. On lateral radiographs, indistinct radiolucency and fragmentation at the anterior aspect of the distal femur can easily be overlooked [3]. On anteroposterior radiographs, osteochondri-
dritis dissecans at this site commonly is occult [2–4].

Fluoroscopic spot films, tomography, CT, bone scintigraphy, and arthrography all have been suggested for further evaluation of a suspected trochlear lesion [3, 4, 9]. At other sites in the knee, osteochondritis dissecans lesions have been classified as stable or unstable by radiography, three-phase bone scintigraphy, and MR imaging [5]. MR imaging after intraarticular injection of contrast material may be beneficial in evaluating osteochondritis dissecans for lesion stability, delineating the chondral surface, and detecting intraarticular bodies [10].

Although osteochondritis dissecans of the femoral sulcus has been described as a unique clinical and radiographic entity, specific MR imaging features have not been described [2–4, 9]. MR imaging has an increasingly important role in the assessment of chondral and osteochondral lesions as a result of the development of effective imaging techniques and surgical treatments [11]. Compared with conventional spin-echo techniques, fast spin-echo proton density–weighted and T2-weighted MR imaging sequences are more efficient to acquire and have a higher signal-to-noise ratio. The addition of fat saturation to fast spin-echo techniques can aid in the evaluation of articular cartilage by optimizing the dynamic range of the images. The presence or absence of hyaline cartilage defects can be accurately assessed on fast spin-echo proton density–weighted and T2-weighted MR imaging sequences routinely used in clinical practice [12]. We found that images obtained using fast spin-echo proton density–weighted and T2-weighted sequences adequately showed both the osteochondritis dissecans lesion and the articular cartilage at the femoral sulcus.

Axial and coronal imaging planes have been described as the most powerful pair of imaging planes for assessing most of the articular cartilage in the knee, but images obtained in these planes do not optimally reveal the entire femoral trochlea [12]. In a series of 21 knees reviewed by Mesgarzadeh et al. [6], 76% of the osteochondritis dissecans lesions involved the medial femoral condyle and were best shown in the coronal and sagittal imaging planes, but one lesion on the lateral trochlear surface was...
seen most easily in the axial plane. In our experience, osteochondritis dissecans involving the femoral sulcus is best evaluated on axial and sagittal images. Because of the orientation of the femoral sulcus, coronal imaging does not depict these lesions optimally and does not contribute additional diagnostic information.

The presence and size of articular cartilage defects and cartilaginous loose bodies shown on MR imaging are useful in preoperative planning [5]. The most common sign of unstable osteochondritis dissecans on MR imaging is a high-signal-intensity line between the osteochondritis dissecans fragment and the underlying bone. Other MR imaging signs include subchondral cysts, focal deficits in the cartilage and subchondral bone, and fracture through the subchondral bone plate. The high signal interface and cystic lesions may be caused by reactive fibrovascular granulation tissue [5, 7]. Mesgarzadeh et al. [6] showed that MR imaging was 92% sensitive and 90% specific for differentiating unstable lesions from stable lesions. In stable lesions, no discontinuity of the overlying cartilage is seen.

Treatment of osteochondritis dissecans in the knee can be controversial and depends on several factors, including the physician’s experience; the patient’s age and symptoms; the presence or absence of concomitant structural abnormalities; and the size, stability, location, and chondral status of the lesion [11]. Nonsurgical treatment can be appropriate for skeletally immature patients who respond to conservative treatment, adults with minimal symptoms, and individuals with low-grade lesions.

Although several different classification systems are used to grade lesions, the recent system recommended by the International Cartilage Repair Society classifies osteochondritis dissecans at surgery as stage I (stable lesion in continuity with the host bone, covered by intact cartilage), stage II (partial discontinuity of the lesion, stable on probing), stage III (complete discontinuity of the “dead in situ” lesion, but fragment not dislocated), and stage IV (dislocated fragment) [13]. Surgical treatment options include lesion débridement, internal fixation of a lesion, removal of any loose bodies, marrow stimulation techniques (e.g., drilling, microfracture), transplantation techniques (e.g., autologous chondrocyte implantation, autologous osteochondral allografts), and realignment procedures (e.g., lateral retinacular release) [4, 9, 11].

This study has at least three limitations, primarily due to its multinational, retrospective nature. First, radiographs could not be obtained for review in all cases. However, we do not believe this shortcoming hinders our conclusion that MR imaging is a more definitive means of evaluating osteochondritis dissecans lesions of the femoral sulcus than is radiography. Second, MR imaging sequences varied somewhat among the institutions, and no MR arthrography was performed. Third, arthroscopic correlation was not available in all cases. However, our results and the results of other investigators have shown that conventional MR imaging has a high sensitivity and specificity for predicting the stability of osteochondritis dissecans lesions in the knee.

In summary, osteochondritis dissecans of the femoral sulcus is an uncommon entity that may be difficult to diagnose on radiography but can be diagnosed accurately on MR imaging. The abnormality is usually localized to the anterior aspect of the lateral femoral condyle and is always distal to the physis or physeal scar. This lesion is best characterized on routine fast spin-echo proton density-weighted and T2-weighted sequences performed in the sagittal and axial planes because of the orientation of the femoral sulcus. These imaging sequences also adequately show the femoral sulcus articular cartilage and allow evaluation of lesion stability.

References