Correlation of Magnetic Resonance Imaging to Arthroscopic Findings of Stability in Juvenile Osteochondritis Dissecans

Christian S. Heywood, M.D., Michael T. Benke, M.D., Kathleen Brindle, M.D., and Kenneth M. Fine, M.D.

Purpose: To determine the ability of magnetic resonance imaging (MRI) to characterize the stability of osteochondritis dissecans (OCD) fragments in juveniles. **Methods:** Twenty-eight consecutive patients underwent surgery for OCD between 2004 and 2008. Of these, 23 patients had adequate preoperative imaging. There were 14 boys and 9 girls with a mean age of 12.9 years. Of the 23 lesions, 21 were located in the knee and 2 were located in the talus. On the basis of MRI, a single radiologist (1) indicated the presence or absence of 4 established magnetic resonance signs of instability, (2) classified each lesion according to a staging system for OCD stability, and (3) described the lesion as stable or unstable. These findings were compared with the arthroscopic findings. Arthroscopy was considered the gold standard for diagnosing fragment stability. **Results:** Of the OCD lesions, 13 were found to be stable and 10 were found to be unstable. The final MRI impression was unstable in 21 patients and stable in 2 patients. This yielded a sensitivity of 100% and a specificity of 15% for diagnosing fragment instability. When 2 or more criteria were present, the specificity of MRI to classify lesion instability improved to 92%. The sensitivity, however, dropped to 50%. Concordance between arthroscopic stage and MRI stage was 30% (7 of 23). **Conclusions:** MRI predicted 21 of 23 lesions to be unstable, whereas arthroscopy found only 10 of these 23 lesions to be unstable. The most common pattern of false-positive findings involved lesions with an area of high signal intensity at the bone-fragment interface. MRI should not be used in isolation to determine lesion instability in young patients with juvenile OCD. **Level of Evidence:** Level IV, therapeutic case series.

Osteochondritis dissecans (OCD) is a relatively prevalent disorder in juveniles, affecting adolescents at a rate between 15 and 30 per 100,000. There is evidence that the incidence is growing, particularly in young girls. The percentage of children aged below 10 years in whom OCD develops appears to be increasing as well.[1] The treatment of OCD depends on characteristics of the patient as well as the lesion.[1-4] Young patients with small, stable lesions have been treated nonoperatively with good success.[3,5,6] Factors that seem to predict a poorer outcome include older age of the patient, larger lesion size, and instability of the fragment.[3,4,6,7] Whereas patient age and size of the lesion are easily determined, fragment stability can remain variable up until the time of surgery; surgical decision making is thus largely affected by determination of fragment stability. Magnetic resonance imaging (MRI) has emerged as the modality of choice to characterize the fragment stability in OCD.[8-11] Various classification systems for OCD stability have been proposed based on MRI appearance. De Smet et al.[12] described 4 different magnetic resonance (MR) signs

From the Kerlan-Jobe Orthopaedic Clinic (C.S.H.), Los Angeles, California;Departments of Orthopaedic Surgery (M.T.B., K.M.F.) and Musculoskeletal Radiology (K.B.), George Washington University, Washington, DC; and Children's National Medical Center (K.M.F.), Washington, DC, U.S.A.

The authors report no conflict of interest.

Received February 2, 2010; accepted July 8, 2010.

Address correspondence and reprint requests to Michael Benke, M.D., Department of Orthopaedic Surgery, George Washington University, 2150 Pennsylvania Ave NW, 7th Floor, Washington, DC 20037, U.S.A. E-mail: mtbenke@gmail.com

0749-8063/1083/$36.00

doi:10.1016/j.arthro.2010.07.009

Table 1. *De Smet MRI Criteria for Fragment Instability**

	Description
1	A thin line of high signal intensity 5 mm or more in length at the interface between the OCD and the underlying bone
2	A discrete, round area of homogeneous high signal intensity 5 mm or more in diameter beneath the lesion
3	A focal defect with a width of 5 mm or more in the articular surface of the lesion
4	A high–signal intensity line traversing the articular cartilage and subchondral bone plate into the lesion

*Based on data from reference 12.

that indicate instability. In addition, Dipaola et al.[13] proposed a staging system that correlates MRI with arthroscopic findings.

The purpose of our study was to correlate preoperative MRI to arthroscopic findings. Two methods for characterizing OCD by use of MRI were used and subsequently compared with arthroscopic findings. The value of using MRI to accurately predict fragment stability was then assessed. We hypothesized that MRI would not accurately predict fragment stability in a cohort of young patients with juvenile OCD.

METHODS

We identified 28 patients who underwent surgery for the diagnosis of OCD. Two patients did not have preoperative MRI performed and were excluded. One patient who did have a preoperative MRI scan performed was excluded because the MRI scan was performed 2 years before the surgery. One patient was found to have a stellate lesion of the articular cartilage with underlying bony edema. On the basis of the morphology of the lesion, it was not considered to represent OCD by either MRI or arthroscopy and was thus excluded from the study. Finally, a fifth patient was excluded for inadequate quality of imaging. This patient had bilateral Blount disease with accompanying bilateral OCD. A single MRI scan was performed of both lower extremities with a torso coil. This resulted in a field of view too large and image quality too poor to properly characterize the lesion. The remaining 23 subjects represented all arthroscopies performed for the diagnosis of OCD between 2004 and 2008.

Patients had presented with persistent pain, effusion, or locking and catching. All patients had failed an extended period (≥6 months) of conservative management consisting of activity modification and weight-bearing restriction.

The MRI scans were obtained for each patient and subsequently read by a single radiologist who is fellowship trained in musculoskeletal radiology. All MRI evaluations were performed by use of a 1.5-T magnet (GE Medical Systems, Milwaukee, WI) with surface coils for both the knee and ankle. Validated cartilage-sensitive fast spin-echo proton density sequences were obtained in all patients.[14] Proton density–weighted images have a long repetition time (3,000 to 5,000 milliseconds) and an intermediate echo time (30 to 40 milliseconds). Images were acquired with 3- to 4-mm slice thickness, no interslice gap, a field of view of 16 to 18 cm, and a matrix of 256 by 224. T1-weighted, fast spin-echo T2-weighted fat saturated, and short tau inversion recovery sequences were also obtained.

The radiologist was blinded to all patient data and intraoperative findings, as well as the method of treatment. The radiologist indicated the presence or absence of each of the 4 MR signs of instability as described by De Smet et al.[12] (Table 1). The presence of any 1 sign indicates instability. Lesions were also classified according to the system proposed by Dipaola et al.[13] (Table 2). Finally, the radiologist gave each lesion a final diagnosis of stable or unstable.

Table 2. *Dipaola Staging System for Characterizing Osteochondral Lesions*

	Arthroscopic	MRI
Stage I	Irregularity and softening of articular cartilage, no definable fragment	Thickening of articular cartilage and low signal changes
Stage II	Articular cartilage breached, definable fragment, not displaceable	Articular cartilage breached, low signal rim behind fragment indicating fibrous attachment
Stage III	Articular cartilage breached, definable fragment, displaceable, but attached by some overlying articular cartilage	Articular cartilage breached, high signal changes behind fragment indicating synovial fluid between fragment and underlying subchondral bone
Stage IV	Loose body	Loose body

NOTE. Stages I and II are considered stable, whereas stages III and IV are considered unstable.[13]