The Clinical Utility and Diagnostic Performance of MRI for Identification and Classification of Knee Osteochondritis Dissecans

Carmen E. Quatman, MD, PhD, Catherine C. Quatman-Yates, PT, DPT, PhD, Laura C. Schmitt, PT, MPT, PhD, and Mark V. Paterno, PT, PhD, SCS, MBA, ATC

Investigation performed at the Ohio State University Medical Center, Columbus, and Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

Background: Magnetic resonance imaging (MRI) is a common clinical tool used to diagnose and monitor the progression and/or healing of osteochondritis dissecans of the knee. The purpose of this study was to systematically review the literature relative to the following questions: (1) Is MRI a valid, sensitive, specific, accurate, and reliable imaging modality to identify knee osteochondritis dissecans compared with arthroscopy? (2) Is MRI a sensitive tool that can be utilized to characterize lesion severity and stability of osteochondritis dissecans fragments in the knee?

Methods: A systematic search was performed in December 2010 with use of PubMed MEDLINE (from 1966), CINAHL (from 1982), SPORTDiscus (from 1985), Scopus (from 1996), and EMBASE (from 1974) databases.

Results: Seven studies, four Level-II and three Level-III investigations, met the specified inclusion criteria. No randomized controlled studies were identified. Because of inconsistencies between imaging techniques and methodological shortcomings of many of the studies, a meta-analysis was not performed.

Conclusions: The limited available evidence, methodological inconsistencies in imaging techniques, and lack of standardized grading criteria used in current studies prevent clear conclusions regarding the diagnostic and specific staging equivalency of MRI with arthroscopy. However, available evidence supports the use of MRI to detect the stability or instability of the lesion. Given the benefits of the use of MRI as a noninvasive tool to diagnose, predict lesion progression, and assess clinical outcomes of treatment, there is a pressing need for high-level, systematic, sound, and thorough studies related to the clinical utility of MRI for assessing osteochondritis dissecans of the knee.

Level of Evidence: Diagnostic Level III. See Instructions for Authors for a complete description of levels of evidence.

Osteochondritis dissecans of the knee, a lesion of the subchondral bone that may involve partial or total separation of a fragment of the articular cartilage and the subchondral bone from the articular surface, is an increasingly recognized cause of knee pain and joint dysfunction. Individuals with unresolved osteochondritis dissecans lesions often progress to osteoarthritis and often have poor long-term outcomes[1-4]. Osteochondritis dissecans presents in skeletally immature children and adolescents (juvenile form) or in skeletally mature adults (adult form)[5,6]. Management and potential healing of osteochondritis dissecans lesions of the knee are highly variable, depending on the skeletal maturity of the individual and the size, location, and stability of the defect[7-9]. Juvenile cases that involve small and stable lesions have the greatest potential for healing with nonoperative management[9]. In contrast, unstable osteochondritis dissecans lesions and lesions in skeletally mature individuals often fail to respond to nonoperative measures and require operative intervention to alleviate symptoms[7,9]. Early identification and accurate staging of the severity of the osteochondritis dissecans lesion are likely critical to treatment

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success since they may lead to early intervention and prevention of further articular cartilage degradation.

There is a great need for noninvasive clinical tools that can diagnose and grade the severity of osteochondritis dissecans lesions of the knee, monitor disease progression, and assess clinical outcomes of treatments for osteochondritis dissecans. Although both radiography and magnetic resonance imaging (MRI) are routinely used to identify and evaluate osteochondritis dissecans lesions of the knee, MRI is often the imaging modality of choice and has been recommended as a technique to follow the healing response and degree of revascularization of the lesion[6,7]. Despite the widespread use of MRI as a clinical tool to diagnose and monitor the progression or resolution of osteochondritis dissecans lesions of the knee, to our knowledge, no systematic reviews on MRI diagnosis and grading of osteochondritis dissecans lesions of the knee that identify the sensitivity, specificity, accuracy, and reliability of MRI compared with arthroscopy are available in the literature. Without a comprehensive understanding of the diagnostic utility of MRI to characterize the severity of structural articular cartilage and subchondral changes associated with osteochondritis dissecans, insight into its use as a noninvasive and evidence-based tool to guide diagnostic and treatment practices remains limited.

The purpose of this study was to systematically review the literature relative to the following questions: (1) Is MRI a valid, sensitive, specific, accurate, and reliable imaging modality to identify osteochondritis dissecans of the knee compared with arthroscopy? (2) Is MRI a sensitive tool that can be used to characterize disease severity and stability of osteochondritis dissecans lesions of the knee? The aims of this systematic review are to summarize relevant data and identify strengths and weaknesses in the literature. The results of the systematic review are discussed relative to the implications for the clinical utility of MRI as a tool to identify and classify the severity and stability of osteochondritis dissecans of the knee.

Materials and Methods

Search Strategy

Systematic searches were performed in December 2010, with use of PubMed MEDLINE (from 1966), CINAHL (from 1982), SPORTDiscus (from 1985), Scopus (from 1996), and EMBASE (from 1974) databases. The keyword selection was designed to capture all studies that compared the diagnostic capabilities of MRI relative to arthroscopy for chondromalacia of the tibiofemoral and patellofemoral joints. Database searches included the following keywords: knee, arthroscopy, magnetic resonance imaging, osteochondritis dissecans, chondromalacia, osteoarthritis, chondral defect, and articular cartilage. The search was supplemented by a review of the bibliographies of retrieved articles, review of identified osteochondritis dissecans review articles, and manual review of pertinent journals to identify additional studies. (Additional details about search methodology and study inclusion criteria are described in the Appendix.)

Assessment of Methodological Quality

Two independent reviewers evaluated each article on the basis of the methodological criteria listed in a table in the Appendix and determined a level of evidence (Levels I through V). If there was a disagreement between the reviewers, a third reviewer was used to reconcile these differences. Levels of evidence for the diagnostic studies were determined with use of the methods described by Wright et al.[10]. Level-I studies included consecutive patients, prospective data collection, and use of established diagnostic criteria with a gold standard comparison (arthroscopy). Level-II studies included patients who had MRI and arthroscopy (nonconsecutive osteochondritis dissecans identification with consecutive enrollment of patients with osteochondritis dissecans who underwent arthroscopy), retrospective data collection, and use of established diagnostic criteria with a gold standard comparison. If a study did not explicitly state that it was prospective or that it included consecutive patients, but used established diagnostic criteria with a gold standard comparison, it was considered a Level-II study. Studies were classified as Level III if they included nonconsecutive patients or did not use established diagnostic criteria. Level-IV studies included case-control studies, subjects selected or data derived from larger clinical trials or cohorts, and studies without gold standard comparisons. Level-V studies consisted of articles that represented expert opinion. The final comprehensive summary was limited to Level-I, II, and III studies.

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Results

The initial database and bibliography searches identified 3076 potential articles. The abstracts of all 3076 studies were reviewed, and seven articles met the predetermined inclusion and exclusion criteria (Fig. 1). Four Level-II[11-14] and three Level-III studies[15-17] were included in the final analyses. The results are outlined in Table I. No randomized, controlled studies were identified. It is not possible to calculate the diagnostic performance of specificity and sensitivity of all osteochondritis dissecans lesions in the knee since none of the identified studies had consecutive enrollment of all patients with osteochondritis dissecans (only a subset underwent arthroscopy). However, the specificities and sensitivities of the included studies are reported as a "subset" of patients with osteochondritis dissecans who had both MRI and arthroscopy. Several different staging criteria were used to identify the severity of the lesions and are described in the literature[11,18-23]. Studies by Kocher et al., Luhmann et al., and Hung and Huang did not have descriptions of severity grading systems or utilize established criteria to assess the stability of the osteochondritis dissecans lesions[15-17]. Most (four) of the seven studies examined the medial femoral condyle; however, some studies also evaluated the lateral femoral condyle, tibia, patella, and trochlea (Table I). Three of the seven studies did not note which articular surface and/or compartment of the knee had osteochondral lesions[14,16,17]. The MRI magnet strengths used in the studies were between 0.35 and 3.0 T. As a result of inconsistencies between imaging techniques and methodological shortcomings of many of the studies, a meta-analysis was not performed.

The diagnostic validity for identifying an osteochondritis dissecans lesion was reported by Kocher et al.[16] and Luhmann et al.[17], with sensitivities between 77.8% and 90.9%, specificities between 94.9% and 97.9%, positive predictive values between 69.5% and 77.8%, and negative predictive values between 94.9% and 99.5%. Luhmann et al. reported a kappa value of 0.70 for measuring the extent of agreement between the MRI findings and intraoperative findings[17]. Hughes et al. reported a

TABLE I Diagnostic Performance of MRI Relative to Arthroscopy for Osteochondritis Dissecans (OCD) Lesions in the Knee

Study	Grading System	Magnet Strength *(T)*	MRI and Arthroscopy Blinding
Hughes et al.[12](Level II)	Modifications of Pritsch et al.[18], Dipaola et al.[11], Kramer et al.[19], and Bohndorf[23]	1.0	Radiologist blinded to clinical information, radiographs, and arthroscopy; surgeon aware of MRI initial results.
Hung and Huang[15](Level III)	Not established	1.5	Not reported
Kijowski et al.[13](Level II)	De Smet et al.[20]	1.5-3.0	Radiologists blinded to arthroscopy report.
Kocher et al.[16](Level III)	Not reported	1.5	Radiologist not blinded to diagnosis. MRI and reports were available to surgeons.
Luhmann et al.[17](Level III)	Not reported	1.5	Radiologist not blinded to diagnosis. Surgeon not blinded to radiology report.
O'Connor et al.[14](Level II)	Dipaola et al.[11] for MRI and Guhl[21] for arthroscopy	0.5	Radiologist blinded to arthroscopy results. Not stated if surgeon blinded.
Dipaola et al.[11](Level II)	Modification of Berndt and Harty[22]	0.35	Prospective blinded radiographic classification performed by radiologist.

*Temporal refers to the time between MRI and arthroscopy.

100% correlation for identifying stability of the lesion; however, six of eleven lesions were incorrectly graded with use of MRI compared with arthroscopy[12]. The accuracy of their grading improved to 72% if the MRI was performed within four months after arthroscopy[12]. Hung and Huang did not report diagnostic validity; however, there was 100% accuracy for identifying an unstable lesion (calculated from data provided in the paper)[15]. O'Connor et al. reported a 45% to 85% accuracy of the grading

TABLE I (*continued*)

Temporal*	Compartments Analyzed	Diagnostic Performance	Comments
2 mo to 2 yr; majority within 6 mo	Medial femoral condyle (12 knees), lateral femoral condyle (7 knees), lateral tibial plateau (1 knee), and patella (1 knee)	100% correlation for stability of the lesion; 55% (6/11) were not correctly graded by MRI; 72% were correctly graded, with MRI performed within 4 mo of arthroscopy.	Retrospective cohort of 19 patients (5-15 years old) with 21 knees evaluated by both MRI and arthroscopy; not stated if patients were consecutive.
Not reported	Medial and lateral femoral condyles	Sensitivity and specificity not reported; 100% accuracy could be calculated for identifying unstable lesion.	Retrospective (not stated if consecutive) study of 11 patients with OCD (7 in knee), only 5 had comparison with arthroscopy; established diagnostic criteria of OCD lesions were not described and, thus, study downgraded to Level III.
Within 58 d; mean, 21.7 d	Medial femoral condyle (49), lateral femoral condyle (16), and lateral femoral trochlea (5)	100% sensitivity if all criteria used to determine stability, specificity of 11% for juvenile OCD and 100% for adult for determining stability; further information about secondary MRI findings	Retrospective, consecutive study of 65 patients who had both MRI and arthroscopy performed on symptomatic knee with suspected OCD lesion; 34 adult OCD lesions and 36 juvenile OCD lesions.
Not reported	Not reported	Sensitivity of 90.9%, specificity of 97.9%, positive predictive value of 69.5%, and negative predictive value of 99.5% for identifying OCD lesion	Retrospective, consecutive study identified 22 knee OCD lesions in patients with intra-articular knee disorders; established diagnostic criteria of OCD lesions were not described and, thus, study downgraded to Level III.
Not reported	Not reported	Sensitivity of 77.8%, specificity of 94.9%, positive predictive value of 77.8%, and negative predictive value of 94.9% for identifying OCD lesion	Prospective, consecutive study of adolescent knees, 19 OCD lesions; established diagnostic criteria of OCD lesions were not described; and, thus, study downgraded to Level III.
1-58 wk; mean, 18 wk	Not reported	45% of original MRI reports accurately predicted arthroscopy grade; re-report of MRI with Dipaola system resulted in 85% accurate prediction of arthroscopy grade.	Retrospective study of patients who had MRI and arthroscopy of suspected OCD lesions; 33 knees in 31 patients were identified (age range, 6-15 yr; mean, 11.8 yr).
Within 7 wk	Medial femoral condyle	All but 1 of 6 lesions correctly staged.	Prospective, not stated if consecutive (therefore downgraded to Level-II evidence), double-blind study of 14 patients (6 knees examined)

of severity depending on the grading system used for classification[14]. Dipaola et al. correctly classified five of six lesions using MRI compared with arthroscopy[11].

Kijowski et al. examined the diagnostic validity of MRI for indicating instability of osteochondritis dissecans fragments in patients with juvenile or adult osteochondritis dissecans of the knee and compared it with the arthroscopic findings[13]. The use of criteria such as a high-signal-intensity rim on T2-weighted images, cysts, a high-signal-intensity cartilage fracture line on T2-weighted images, or fluid-filled osteochondral defects collectively provided a sensitivity of 100% and specificity of 11% for identifying instability of juvenile osteochondral lesions. In

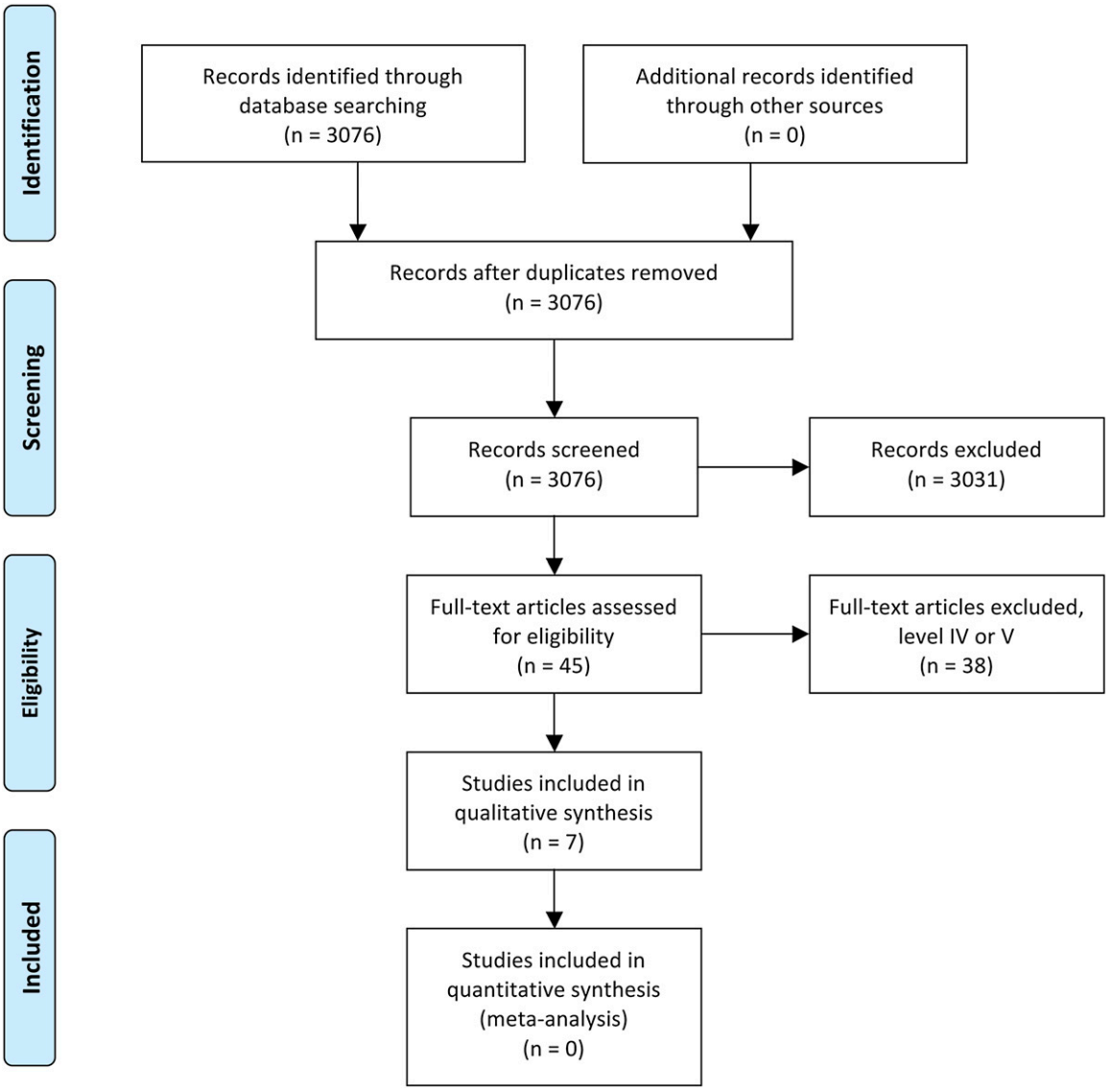

Fig. 1

Keyword search strategy and results from systematic review (PRISMA [Preferred Reporting Items for Systematic Reviews and Meta-Analyses] 2009 flow diagram[35]).

contrast, the same criteria demonstrated a sensitivity of 100% and a specificity of 100% for identifying instability of adult osteochondral lesions.

Discussion

The systematic search process utilized for this review identified 3076 studies that potentially provided information about the diagnostic performance of MRI and arthroscopy of the knee related to osteochondritis dissecans. However, the rigorous search methodology identified only seven studies that met previously established inclusion and exclusion criteria and provided unique and valuable diagnostic performance evidence for identifying and classifying osteochondritis dissecans lesions. The overall sensitivity of MRI for identifying lesions compared with arthroscopy was reported to be between 78% and 91%, and the specificity ranged between 95% and 97.9%. The accuracy of characterizing the severity of lesions was reported to be between 45% and 100%, and the accuracy of identifying instability of an osteochondritis dissecans lesion was reported to be as high as 100% (however, only one study noted the accuracy of this variable).

Is MRI a Valid, Sensitive, Specific, Accurate, and Reliable Imaging Modality to Identify Knee Osteochondritis Dissecans Compared with Arthroscopy?

Although seven studies compared MRI and arthroscopy for examining osteochondritis dissecans lesions, only two studies[16,17] discussed the sensitivity and specificity of MRI for identifying osteochondritis dissecans. In a retrospective MRI review study of a consecutive series of patients treated for intra-articular knee

disorders, Kocher et al. (a Level-III study) identified twenty-two knees with osteochondritis dissecans lesions[16]. Although the sensitivity and specificity for identifying these lesions were relatively high (90.9% and 97.9%, respectively), no reliability or agreement between the MRI and arthroscopy results were provided, the compartments of the knee involved were not described, and the temporal relationship between MRI and arthroscopy was not reported. Similarly, Luhmann et al.[17] (a Level-III study) used a prospective, consecutive study to identify nineteen knees with osteochondritis dissecans lesions. The sensitivity (77.8%) was lower than that in the study by Kocher et al.[16], and the specificity (94.9%) was comparable with that in Kocher et al. Although the accuracy of grading was not reported, Luhmann et al. reported a fair kappa value (0.70) for measuring the extent of agreement between the MRI findings and the intraoperative findings. Luhmann et al. did not describe the compartments involved in the knee or the temporal relationship between MRI and arthroscopy[17]. The limited methods and small sample sizes for the studies by Kocher et al. and Luhmann et al. limit the conclusions that can be drawn regarding the equivalency of MRI and intraoperative findings for specifying the severity of osteochondritis dissecans lesions in the knee.

Is MRI a Sensitive Tool That Can Be Utilized to Characterize Disease Severity and Stability of Osteochondritis Dissecans Fragments in the Knee?

Dipaola et al. (a Level-II study) used a prospective, double-blind study design of six knees to assess the staging ability of MRI[11]. Over 80% of the lesions were correctly staged according to the modified grading criteria described by Berndt and Harty that were established for grading osteochondritis dissecans on conventional radiographs[22]. However, the limited magnet strength (0.35 T) for acquiring the MRI scans and the small sample size limit the conclusions that can be drawn from this study.

Kijowski et al. (a Level-II study) conducted a retrospective study of sixty-five patients (thirty-three adults [thirty-four knees] and thirty-two children [thirty-six knees]) who had both MRI and arthroscopy performed on a symptomatic knee with a suspected osteochondritis dissecans lesion[13]. The sensitivity and specificity of the use of combined imaging criteria for characterizing the stability of osteochondritis dissecans lesions were different, depending on the type of osteochondritis dissecans lesion (juvenile or adult), with 100% sensitivity and 100% specificity reported for the detection of adult lesions and 100% sensitivity and only 11% specificity for the juvenile form. A study by Heywood et al., which assessed juvenile osteochondritis dissecans lesions in both the knee and talus, yielded a sensitivity of 100% but a specificity of only 15% for diagnosing fragment stability; the concordance between arthroscopic stage and MRI stage was 30%[24]. The study by Heywood et al. was not included in the results of the current investigation because the talus and knee sensitivity and specificity were grouped for the study analyses, and information pertaining only to the knee was not provided. In Kijowski et al., the temporal relationship between MRI and arthroscopy was within fifty-eight days (mean, 21.7 days), and either a 1.5-T or 3.0-T magnet was used for imaging[13]. That study highlights the importance of discerning between juvenile and adult osteochondritis dissecans lesions when determining the diagnostic performance of MRI to characterize disease severity and stability of osteochondritis dissecans fragments of the knee.

Hughes et al. (a Level-II study) utilized a retrospective cohort of twenty-one knees to examine the correlation between MRI and arthroscopic grading of osteochondritis dissecans lesions[12]. Although a 100% correlation for identifying the stability of a lesion was reported, more than half of the lesions were graded differently on the basis of the MRI. However, it is likely that the temporal relationship between MRI and arthroscopy substantially affected the accuracy of grading, given the large range reported between the MRI and arthroscopy (two months to two years, with the majority within six months)[12]. While the time interval for healing of osteochondritis dissecans lesions is not well established, it is likely that some healing may have taken place, given that initial MRI-based grades were lower (indicating less severe) than the arthroscopy-based grades six months later. Further, >70% of the lesions were graded equivalently between MRI and arthroscopy when the two measures were performed within four months of each other[12]. The retrospective nature, small sample size, and large time frame between MRI and arthroscopy limit the conclusions that can be drawn from that single study.

Hung and Huang performed a retrospective review of the cases of five patients with knee osteochondritis dissecans who had MRI and subsequent arthroscopy (a Level-III study)[15]. Although no established grading criteria were used, 100% of the unstable lesions in the five patients were identified by MRI. However, the false-positive rate was not reported, and sensitivity could not be calculated given the data provided in the article. Moreover, the small sample size, lack of reporting with regard to blinding of the radiologist and surgeon evaluators, and no report of the temporal relationship between MRI and arthroscopy limit the conclusions that can be drawn from the study.

O'Connor et al. (a Level-II study) utilized a retrospective study of patients who had MRI (0.5-T magnet strength) and arthroscopy of suspected osteochondritis dissecans lesions (thirty-three lesions were identified)[14]. An orthopaedic surgeon was asked to "grade the lesion" through interpretation of the wording of each operative report according to the MRI-based osteochondritis dissecans grading system described by Dipaola et al.[11] and the arthroscopic grading system reported by Guhl[21]. MRI scans were also "re-reported" by a blinded radiologist according to the grading system of Dipaola et al.[11]. The original radiographic classification accurately predicted only 45% of the grading compared with MRI; the re-reported classification improved to 85%. Given the large reported temporal relationship between MRI and arthroscopy (range, one to fifty-eight weeks; mean, eighteen weeks) and the limited retrospective study design that included a "re-report" of the

MRI lesion grading and arthroscopy grading performed by interpretation of an operative note, no conclusive evidence about the utility of MRI for characterizing osteochondral fragment severity and stability can be determined from that study[14].

Methodological Quality of the Studies

Osteochondritis dissecans of the knee is an increasingly recognized condition that presents an epidemiologic challenge for studying the incidence, prevalence, and diagnostic performance of clinical tools used to plan treatment guidelines for patients[6]. Likely because of the relatively low reported prevalence of osteochondritis dissecans[25], the current evidence in the literature is based on small sample sizes, often with locations of lesions such as elbow, ankle, and knee combined, for determining the diagnostic performance of MRI relative to arthroscopy in identifying osteochondritis dissecans lesions[24,26,27]. The limitation of most diagnostic studies that examine the validity of screening tools such as MRI and that use arthroscopy as a gold standard comparison is that not all patients identified as having a potential osteochondritis dissecans lesion have an arthroscopic evaluation. However, currently there is no alternative methodology to overcome this limitation because of the ethical concerns of subjecting all patients with a potential osteochondritis dissecans lesion to arthroscopic evaluation. Thus, the evidence provided by this systematic review is of the highest level currently available to clinicians.

Important considerations for the methodological quality of the studies included in this systematic review included the population studied, the blinding of arthroscopy and MRI evaluators, the temporal relationship between MRI and arthroscopy, the strength of the magnet used for MRI, the compartments of the knee involved in the lesion, and the grading system used to evaluate lesion severity and/or stability. Of the seven studies identified in this systematic review, only four of the studies[11-14] had radiologist evaluators blinded to arthroscopy results. Surgeon blinding was often not reported or the surgeon had access to the radiographic grading for most of the studies. The temporal relationship between MRI and arthroscopy varied considerably among the studies (range, zero days to two years, with no note on the temporal relationship in three of the seven studies) and likely affected the diagnostic accuracy reported by these studies since disease progression or resolution may have taken place in the interim between the evaluations. Ideally, only MRI scans with use of 1.5-T magnet or higher would have been included in the analyses of this systematic review to provide the most relevant and current clinical information. However, because of the small number of studies identified in the literature related to this topic, all studies that utilized MRI were included in the analyses regardless of magnet strength. Four studies used a 1.5-T magnet or higher[13,15-17]; one study, a 1.0-T magnet[12]; one study, a 0.5-T magnet[14]; and one study, a 0.35-T magnet[11]. Although they were not explicitly studied for osteochondritis dissecans, higher magnet strength and enhanced sequence techniques appear to improve MRI sensitivity for articular cartilage lesions[28-32].

In this systematic review, few studies used established criteria (both for arthroscopy and MRI) to characterize the severity and stability of the osteochondritis dissecans lesions. No study that systematically compared the diagnostic performance of MRI (sensitivity and specificity) relative to arthroscopy for the grading of disease severity was identified. Moreover, a recent systematic review of articular cartilage chondromalacia revealed that the articular surface studied may provide different diagnostic performances for MRI[33]. Three of the seven studies in the current investigation failed to provide information about the knee compartment involved[14,16,17], and none of the remaining studies provided a breakdown of the diagnostic performance of MRI for evaluating osteochondritis dissecans lesions in different compartments of the knee.

Clinical Relevance

There is increased need to develop clinical outcome measures to aid in the implementation of evidence-based treatment plans as well as a socioeconomic drive to develop performance-based criteria for clinical reimbursement practices. It is important that clinical tools that predict disease, monitor disease progression, and assess clinical outcomes of treatments of disease be developed and utilized. Ideally, MRI could be employed as a noninvasive clinical tool to predict, monitor, and assess clinical outcomes of osteochondritis dissecans lesions.

In December 2010, a comprehensive clinical practice guideline was adopted by the American Academy of Orthopaedic Surgeons (AAOS) examining the diagnosis and treatment of osteochondritis dissecans[34]. The recent clinical practice guideline findings are important and highlight similar points addressed in the current study about the use of MRI as an adjunct to other examination techniques for the evaluation of potential osteochondritis dissecans lesions[34]. This systematic review was specifically undertaken to evaluate whether there is evidence to support MRI as a clinical tool for analyzing osteochondritis dissecans relative to arthroscopy and to identify if there were consistent, valid grading systems to classify osteochondritis dissecans lesions. In addition to highlighting the findings of the AAOS clinical practice guideline, this systematic review provides evidence about the lack of a validated MRI classification system (not explored in the clinical practice guideline) and describes the methodological limitations of current studies evaluating MRI diagnostic performance such as the magnet strength used for each study, blinding of the evaluators for both MRI and arthroscopy, temporal relationships between MRI and arthroscopy, and knee compartments analyzed.

However, the systematic search strategies of this study failed to identify any appropriately designed studies that directly examined the validity of the use of MRI compared with arthroscopy to predict or monitor disease progression of the lesions. The results from this systematic review highlight a potential need to evaluate juvenile and adult forms of osteochondritis dissecans separately. In particular, arthroscopy may be insensitive to identifying osteochondritis dissecans lesions that have normal surface cartilage with no instability, which

may occur in patients with juvenile osteochondritis dissecans. In these patients, MRI may be the more appropriate tool for accurately diagnosing and monitoring disease progression relative to arthroscopy. Future studies should focus on characterizing the clinical utility of MRI for these applications.

This systematic review examined the diagnostic capabilities of MRI as a tool to capture osteochondritis dissecans in humans. To target MRI diagnostic utility for identifying osteochondritis dissecans, studies that evaluated other articular pathology (i.e., rheumatoid arthritis, infection, osteonecrosis, and osteoarthritis) were excluded from the final analysis. Although cadaveric and animal model studies were identified in the initial search, these studies were excluded from the current review because it is unclear how artificially created lesions in these simulated pathologic models relate to human disease. This concept should be kept in mind as future studies for evaluating the diagnostic performance of clinical tools for osteochondritis dissecans are developed.

In conclusion, although there is encouraging evidence that MRI may be a relatively sensitive, specific, and accurate clinical tool for identifying osteochondritis dissecans abnormalities, it is not possible to offer conclusive guidelines regarding its general clinical utility for the determination of diagnosis and treatment strategies. Technological improvements to MRI practices, such as the use of higher magnet strengths of 3.0 T, may provide superior diagnostic performance strategies in the future. There is a growing need for diagnostic techniques that identify the earliest structural changes in articular cartilage (chondromalacia or osteochondritis dissecans lesions) that predict future knee disability. Early identification of modifiable structural changes to the articular cartilage and subchondral bone of the knee, such as those that occur in unstable osteochondritis dissecans, is critical for adolescents and young adults who are at high risk of developing long-term sequelae related to unresolved osteochondritis dissecans lesions[6]. There is an important need for a large clinical trial with rigorous methodology to evaluate the diagnostic performance of MRI as an instrument to identify and characterize the severity and stability of osteochondritis dissecans lesions in the knee.

Appendix

(eA) A description of the study selection process and a table showing the methodological questions used to appraise the quality of the studies are available with the online version of this article as a data supplement at jbjs.org. ■

Carmen E. Quatman, MD, PhD
Laura C. Schmitt, PT, MPT, PhD
Department of Orthopaedic Surgery (C.E.Q.),
Sports Health and Performance Institute (C.E.Q. and L.S.),
and Division of Physical Therapy,
School of Health and Rehabilitation Services (L.S.),
Ohio State University, 2050 Kenny Road,
Suite 3100, Columbus, OH 43221.
E-mail address for C.E. Quatman: Carmen.quatman@gmail.com

Catherine C. Quatman-Yates, PT, DPT, PhD
Mark V. Paterno, PT, PhD, SCS, MBA, ATC
Human Performance Laboratory at the Sports Medicine Biodynamics Center (C.C.Q.-Y. and M.P.), Department of Pediatrics (M.P.),
and Division of Occupational Therapy and Physical Therapy (C.C.Q.-Y. and M.P.), Cincinnati Children's Hospital Medical Center,
3333 Burnett Avenue, Cincinnati, OH 45229

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