[Primary Care]

Use of Knee Magnetic Resonance Imaging by Primary Care Physicians in Patients Aged 40 Years and Older

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Background: Criteria are needed for primary care providers such that they can evaluate age-related knee pain in a cost-effective manner. This study examined (1) in what percentage of patients are appropriate radiographic views of the knee ordered before magnetic resonance imaging (MRI) for knee pain, (2) specialists' retrospective evaluation for appropriate utilization of MRI in knee pain, and (3) in what manner would the MRIs have altered diagnosis and management of knee disorders.

Hypothesis: Primary care providers underuse appropriate radiographs—especially, flexion weightbearing posteroanterior films—and overuse MRIs when evaluating older patients with knee pain.

Study Design: Case control.

Methods: The authors performed a retrospective analysis of 100 patients older than 40 years with knee MRIs. Patient encounters with primary care physicians were reviewed. Given available information, specialists then formulated a pre- and post-MRI diagnosis and treatment plan and indicated whether the MRI would have altered their treatment.

Results: Only 12 of 100 MRIs would have been ordered by an orthopaedist given the documented data. No MRIs would have been ordered in the 19 patients aged 60 years or older. Among 44 radiographs ordered, only 7 were flexion weightbearing. The most common pre-MRI diagnoses made by primary care providers were joint pain (22%) and meniscus injury (24%); the most common post-MRI diagnoses were osteoarthritis (40%) and degenerative meniscus injury (23%). In contrast, the 2 most common pre- and post-MRI diagnoses by specialists were osteoarthritis (28% and 37%, respectively) and degenerative meniscus injury (23% and 24%, respectively). Also, referrals to specialists increased from 9% pre-MRI to 76% post-MRI.

Conclusion: Primary care providers may be overusing knee MRIs and underusing flexion weightbearing posteroanterior radiographs in patients older than 40 years with knee pain.

Clinical relevance: Primary care providers should strongly consider not ordering knee MRI in patients with radiographic evidence of degenerative changes.

Keywords: knee; flexion weightbearing radiographs; magnetic resonance imaging; degenerative meniscus tear; osteoarthritis

Magnetic resonance imaging (MRI) has had an enormous influence on musculoskeletal treatment. It greatly affects the diagnosis and management of knee disorders. As the availability of MRI has increased, its usage has expanded from the realm of specialists, to become part of the diagnostic armamentarium of the primary care provider. Knee MRI can improve evaluation of knee pain[13]; it is most commonly indicated in patients with clinically important injuries of the menisci, cartilage, and cruciate ligaments.[4,7] However, in older patients, MRI can find age-related degenerative changes without clinical significance.[2,6,16,19] With the high prevalence of osteoarthritis (OA) in older patients (in an estimated 60% to 80% of people older than 55 years),[8] knee MRI findings may confound the diagnosis and treatment plans of primary care providers.

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No potential conflict of interest declared.

DOI: 10.1177/1941738110377420

As a primary care sports medicine specialist and as sports medicine orthopaedic surgeons at the University of Utah Orthopaedic Center, we had noticed an increase in referred patients over the age of 40 years with knee MRIs completed before referral. These patients often came without prior flexion weightbearing posteroanterior (PA) radiographs, which is a mainstay in the evaluation of knee pain in older patients.[1,5,12,15,18] In many of these older patients with knee pain, MRI did not change their diagnosis or management. It is unknown whether primary care providers are using MRI in the diagnosis and management of knee pain in a cost-effective manner.[3,9,17] We hypothesize that primary care providers underuse appropriate radiographs—especially, flexion weightbearing PA films—and overuse knee MRIs when evaluating older patients with knee pain. To test our hypothesis, we performed a retrospective analysis of provider encounters, radiographs, and MRI findings in patients aged 40 years or older who were evaluated for knee pain. The goals of this study were to determine the following: (1) in what percentage of patients had appropriate radiographic views of the knee been ordered before MRI; (2) in what percentage of patients would an orthopaedic specialist order an MRI; and (3) did knee MRIs, as ordered by primary care providers, alter the specialists' diagnosis and management of knee disorders in patients aged 40 years or older? By answering these questions, we may develop criteria for how primary care providers can better evaluate older individuals' knee pain in a more cost-effective manner.

METHODS

After obtaining approval from the University of Utah Institutional Review Board, we collected reports from 100 random knee MRIs ordered by 32 different primary care providers from 5 university clinics over a period of 2 years from January 2006 to December 2007. We obtained a list of patients who had knee MRIs during this period, and we selected the first 100 patients from the list. All patients were at least 40 years old at the time of the knee MRI. We obtained corresponding electronic chart records regarding patients' knee pain visits, including any radiographs and reports, and matched them with knee MRI reports. Plain films were then exported as digital files onto a separate research project CD and saved with assigned nonidentifying numbers.

Patient encounters were reviewed for the following information: demographics (ie, age, sex, and weight), history (ie, onset, duration, severity, location of knee pain; previous injury and/or trauma; aggravating and mitigating factors; attempted therapies; pertinent positives, such as locking, swelling, feelings of instability, and difficulty with stairs), physical exam findings (ie, swelling, effusion, range of motion, crepitus, joint line tenderness, laxity, patellofemoral findings, Lachman test, and McMurray test), and average number of visits preceding knee MRI. In addition, we recorded primary care providers' pre- and post-MRI diagnoses and treatment plans. Patients were given new random study identification numbers, and all identifying characteristics of patient and provider were separated from review data. The extrapolated data were then formatted onto paper worksheets for 3 orthopaedic specialists to review. For sample worksheet, see appendix (available in the online version of this article at http://ajs.sagepub.com/supplemental/). Study physicians were also given digital copies of radiographs corresponding to the patients' worksheets.

Study physicians were asked to review the 100 patients for history, physical examination findings, radiographic findings, and pre-MRI diagnoses by the primary care providers. Given the available information, the specialists then formulated a pre-MRI diagnosis and treatment plan before reviewing the MRI report on the back side of the worksheet. The specialists were also asked if they would have ordered an MRI in each case. After reviewing the MRI results on the back of the worksheet, the reviewers formulated a post-MRI diagnosis and treatment plan. Finally, the specialists were asked if the MRI would have altered their treatment plan.

Results were then processed from paper sheets into a chart review database to be compared with the diagnosis and management by primary care providers.

RESULTS

Table 1 summarizes the extrapolated data from the 100 patient encounters. The median age of the patients was 53 years (range, 40-85 years). There were 41 men and 59 women. Knee MRIs were ordered by 32 primary care providers, including doctors of medicine and osteopathy, nurse practitioners, and physician assistants. On average, each patient saw his or her primary care provider 1.9 times for evaluation of knee pain before an MRI was ordered.

Of the 100 patients with knee MRIs, only 44 had corresponding plain radiographs of the knee. Of those 44 radiographs, only 24 were weightbearing films (Table 2). Of the 24 weightbearing films, only 7 were flexion weightbearing.

The 2 most common pre-MRI diagnosis documented by primary care providers were joint pain (22%) and meniscus injury (24%) (Table 3 and Figure 1). The 2 most common post-MRI diagnosis documented by primary care providers were OA and degenerative changes (40%) and meniscus injury (23%). In contrast, the 2 most common pre- and post-MRI diagnoses documented by orthopaedic specialists were OA and degenerative changes (28% and 37%, respectively) and meniscus injury (23% and 24%).

In comparison of the pre- and post-MRI treatment plans by primary care providers (Table 3), the only major change is the large increase in referral to orthopaedic specialists after knee MRI. Overall, 76 of 100 treatment plans were altered after MRI was obtained (with *altered* defined as starting physical therapy, adding medication, doing injections, or referring to an orthopaedic specialist). For 66 of those 76, the only management change was that of referral to an orthopaedic specialist. The remaining 24 of 100 treatment plans had no change in management after MRI was obtained. Considered as

Table 1. Patient demographics, history, and physical exam findings.[a]

Patient characteristics	Median age	53 years
	Range	40-85
	Men	41
	Women	59
	Median weight	93.4 kg
Patient history	Average no. of knee pain visits before MRI	1.9
	Gradual onset	48
	Sudden onset	42
	Trauma	41
	Swelling	34
	Feelings of instability	31
	Prior injury	21
	Locking	20
	Difficulty with stairs	13
Physical exam findings	Joint line tenderness	50
	Decreased range of motion	27
	Effusion	24
	Crepitus	21
	Patellofemoral findings	17
	Swelling	16
	Joint laxity	7
	Lachman test, positive	3
	McMurray test, positive	21

[a]Numbers indicate number/percentage of patients with each history and physical exam finding (N, 100).

Table 2. Patients who received knee radiographs before magnetic resonance imaging (N, 100).

Radiographs	n
Nonweightbearing	20
Extension weightbearing	17
Flexion weightbearing	7
Total ordered before MRI	44

a whole, 90 treatment plans were either unaffected by MRI or were referred to an orthopaedic specialist.

The orthopaedic specialists were unable to formulate a pre-MRI treatment plan in 56 of the 100 patient cases reviewed. Specialists reported that the information provided was inadequate owing to the paucity of weightbearing radiographs. Analysis revealed that 50 of these 56 patients did not have prior weightbearing radiographs. Conversely, the specialists were unable to formulate a pre-MRI treatment plan in 6 patients who had weightbearing radiographs. Furthermore, only 1 of the 6 patients had flexion weightbearing radiographs.

Overall, the study physicians reported that they would have ordered only 12 of the 100 knee MRIs ordered by the primary care providers (Table 4); interestingly, they would not have ordered an MRI for any patient aged 60 years or older (n, 19). The specialists believed that MRI would have changed their treatment plans in 17% of the patient cases reviewed.

DISCUSSION

Major Findings

Out of 100 patients aged 40 years or older with knee MRIs ordered by primary care providers, only 12 would have been ordered by orthopaedic specialists based on the documented data for each patient. Specifically, no MRIs would have been ordered in the 19 patients aged 60 years or older. The data reveal that primary care providers had underdiagnosed OA and degenerative changes before obtaining knee MRIs (6 pre-MRI diagnoses versus 40 post-MRI diagnoses). Orthopaedic specialists reported that weightbearing PA radiographs—preferably, flexion views—in all patients would have likely provided crucial information in diagnosing OA and degenerative changes pre-MRI and in formulating pre-MRI treatment plans.

Interpretation

Although MRI is a sensitive tool for identifying pathology of the knee, it is not often a specific test for determining clinically significant lesions. This lack of specificity becomes increasingly problematic in older populations with knee pain. As described in several studies, knee MRI can find age-related degenerative changes that are not clinically significant.[2,6,16,19] These changes may include cartilage lesions, bone marrow edema patterns, and ligamentous and meniscal lesions.[11] A recent study by Englund et al[6] randomly evaluated 991 knee MRIs and 963 corresponding knee radiographs in symptomatic and asymptomatic ambulatory patients between the ages of 50 and 90 years. They found that in patients with radiographic evidence of knee OA, the prevalence of meniscus tear was 63% among symptomatic individuals and 60% among asymptomatic individuals. They concluded that incidental findings detected

Table 3. Diagnoses and treatment plans before and after magnetic resonance imaging: Primary care providers and orthopaedic specialists

	Pre-MRI	Post-MRI
Primary care providers		
Diagnosis, n		
Joint pain	22	
Meniscus injury	24	23
Internal derangement	19	
Ligament injury (anterior, medial)	12	18
Osteoarthritis / degenerative changes	6	40
Other	17	22
Treatment plan, n		
Physical therapy	5	7
Anti-inflammatory	64	63
Other pain medication	30	32
Injections	1	1
Refer to orthopaedic specialist	9	76
Orthopaedic specialists		
Diagnosis, n		
Meniscus injury	23	24
Ligament injury (anterior, medial)	8	7
Osteoarthritis / degenerative joint disease	28	37
Knee pain	21	8
Patellofemoral disease	12	11
Other	8	13
Treatment plan, n		
Conservative	32	63
Surgical	11	26
Inadequate information	56	10
Other (eg, "depends on symptoms")	1	1

on MRI are frequently encountered and that the increased use of MRI for assessment of knee symptoms may result in considerable confusion when attempting to discriminate between symptoms associated with a meniscus tear and those associated with another cause. Furthermore, the authors described that discrimination may be particularly complicated by the strong association between meniscus damage and the presence of knee OA. In a similar study by Bhattacharyya et al,[2] MRI of the knee was performed in a group of patients 45 years of age or older—154 patients with symptomatic OA and 49 age-matched asymptomatic controls. A medial or lateral meniscal tear was found in 76% of asymptomatic patients and in 91% of symptomatic patients. These 2 studies illustrate the lack of specificity of knee MRI for clinically significant lesions.

Because OA has a prevalence of 60% to 80% in people over the age of 55 years,[8] clinicians should keep it near the top of their differential diagnosis list in any older individual with knee pain. Furthermore, because weightbearing PA radiographs—particularly, flexion weightbearing films—are considered a mainstay for identifying knee OA,[12,15,19] it would seem logical and cost-effective for primary care providers to order such films in patients over the age of 40 years with knee pain before ordering MRI. The study physicians would have ordered flexion weightbearing PA radiographs on all 100 patients, as opposed to the 24 that were ordered. This would likely have increased the number of patients found to have joint space narrowing and thus decreased the need for MRI. Even in patients presenting with mechanical symptoms, the clinical diagnosis of meniscal tear can often be made without MRI, which is unlikely to provide additional information in this situation. Furthermore, the identification of degenerative changes of the knee with MRI should do little to alter surgical management decisions when corresponding findings of OA are first identified with flexion weightbearing PA radiographs. Moseley et al supported this notion, demonstrating that in patients with knee OA, the outcomes after arthroscopic lavage or arthroscopic debridement are no better than those after a placebo procedure.[14] In a more recent randomized controlled study on the treatment of moderate to severe knee OA, Kirkley et al[10] demonstrated that arthroscopic debridement, along with maximized medical treatment, was no more efficacious than medical treatment alone.

In analysis of the data from this study, one concern was that of how primary care providers used the information from the knee MRI. As mentioned above, most changes in treatment plans after knee MRI came in the form of a referral to an orthopaedic specialist. One might argue that the patient's care might be expedited if the specialist had the MRI results on the patient's first visit. However, we question the cost-effectiveness of such a strategy given that our orthopaedic experts would have ordered only 12 of the 100 MRIs when given the available information. Although this study did not intend to evaluate the cost-effectiveness of knee MRIs in patients older than 40 years, we performed a simplistic analysis of medical cost to facilitate discussion and further research. The cost of a knee MRI at our institution is roughly $800, and the cost of an orthopaedic

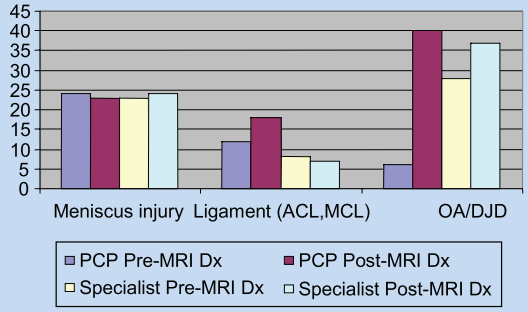

Figure 1. Comparison of pre- and post-knee MRI diagnoses by primary care providers (PCP) and orthopaedic specialists in 100 patients older than 40 years with knee pain

Table 4. Specialists who would have ordered magnetic resonance imaging and altered subsequent treatment.

	n (%)
Ordered MRI	12 (12)
Altered plan based on MRI	16/97[a] (17)

[a]Specialists stated that for 3 patients, the MRI would have altered the treatment plan depending on the presence of symptoms not well documented in the 3 cases.

intake visit with knee radiographs is $200. Based on our patient population data, health care costs for the 100 knee MRIs and 76 subsequent orthopaedic specialist intake visits would cost $95 200: ($800 × 100) + ($200 × 76). In contrast, if all 100 patients had been referred to a specialist who in turn ordered only 12 MRIs (as deemed necessary), the cost would be $29 600: ($800 × 12) + ($200 × 100). This does not take into account additional visits to the primary care provider to review results and arrange referral to the specialist. Although many variables are not included in this financial sketch, it does represent a nearly 70% reduction in health care costs, a point worth further clarifying. To that end, there is currently an ongoing randomized trial of 500 patients in Europe to determine whether general practitioners should refer patients with internal derangement of the knee for MRI or directly to a knee specialist.[16] Results from that and other studies may help determine the cost-effectiveness of knee MRI usage by primary care providers.

Limitations

This study has certain limitations. First is the limited data that can be gathered from a pool of only 100 patients. The results may have also been skewed by the fact that one provider was responsible for ordering about 25% of the 100 MRIs evaluated. Another limitation is the difficulty that specialists might have in formulating a diagnosis and treatment plan based solely on documented history and physical findings. Clinician-patient interactions reveal much more information than what the subsequent documentation specifies; therefore, decisions based solely on documentation are not as accurate as decisions based on actual patient interview. We are thus drawing conclusions from retrospective assessments that may not be completely valid. A prospective study in which the patient is seen by both the primary care provider and the specialist, with the 2 diagnoses and treatment plans then compared, would better validate our findings.

One other limitation or potential bias in the study may be that a significant number of primary care offices do not have the ability to obtain radiographs within their facility. In these cases, it is potentially as easy to order an MRI as it is to order a radiograph, given that patients need to go elsewhere to obtain the study. This is in contrast to orthopaedic specialty practices, where radiographs are routinely available in the office and can be evaluated at the same clinic visit. The inconvenience of sending a patient elsewhere to obtain a radiograph may add to the overuse of MRIs by primary care physicians.

CONCLUSION

Primary care providers may be overusing MRIs in patients aged 40 years or older with knee pain. Furthermore, primary care providers appear to be underusing flexion weightbearing PA radiographs in these patients.

Primary care providers could more cost-effectively evaluate knee pain in patients over the age of 40 years if they were to (1) order flexion weightbearing films and (2) opt to not order a knee MRI in patients with radiographic evidence of degenerative changes. However, further research is necessary to further evaluate these issues.

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