



Editor's key points

- ▶ A considerable number of older patients underwent magnetic resonance imaging (MRI) for chronic knee pain. Most of them had evidence of pre-existing osteoarthritis (OA) on radiographs that was often moderate to severe. Most radiographs were not done with a standing anteroposterior view.
- ▶ The usefulness of MRI in patients with known OA is limited. Most of the patients with moderate to severe OA who were subsequently seen by an orthopedic surgeon had a diagnosis of OA, and only 3.7% of them underwent arthroscopy compared with 14.9% of the group with mild or no OA. Likewise, 17 of the 134 (12.7%) patients with no OA or mild underlying OA underwent meniscectomies, compared with only 3 of the 81 (3.7%) patients with moderate to severe OA.
- ▶ Knee pain in older patients should be investigated with a comprehensive medical questionnaire, thorough physical examination, and standing anteroposterior-view radiographs. Conservative nonpharmacologic and pharmacologic therapies should be attempted and given sufficient time to take effect before considering an orthopedic surgeon referral or MRI.

Indications for and clinical procedures resulting from magnetic resonance imaging of the knee in older patients

Are we choosing wisely?

Marc-Etienne Parent MD FRCPC François Vézina MD FRCSC
Nathalie Carrier MSc Ariel Masetto MD

Abstract

Objective To analyze the indications for and clinical procedures resulting from knee magnetic resonance imaging (MRI) in older patients.

Design We retrospectively analyzed 215 medical records of patients 50 years of age and older who had undergone a unilateral knee MRI in 2009.

Setting Centre hospitalier universitaire de Sherbrooke in Quebec.

Participants Patients 50 years of age and older who underwent a knee MRI in 2009.

Main outcome measures The main outcome measure was an invasive procedure in the same knee that underwent an MRI. Medical charts were reviewed up to 2014 for patient characteristics, MRI indication, ordering physician specialty, radiography before MRI, MRI findings, and clinical procedures resulting from the MRI.

Results The patients' mean (SD) age was 60.6 (7.5) years. The main MRI indications were meniscopathy (148 [68.8%]) and chronic pain (92 [42.8%]). The main MRI findings were osteoarthritis (OA) (185 [86.0%]) and meniscal lesions (170 [79.1%]). Only 82 (38.1%) patients had a plain radiograph in the 24 months preceding the MRI, usually without a standing anteroposterior view. Findings on pre-MRI radiography (n=201) demonstrated OA in 144 (71.6%) patients. Overall, 87 (40.5%) patients were seen by an orthopedic surgeon and 27 (31.0%) of these patients underwent an invasive intervention. Among the 81 patients with moderate to severe OA on MRI, 36 (44.4%) had radiographic evidence of moderate to severe OA and only 3 (3.7%) underwent arthroscopic meniscectomy.

Conclusion Our study reproduces the known association between OA and degenerative meniscal changes in older patients. We have found a surprising underuse of the standing anteroposterior view on radiography. Most patients in our cohort could have been appropriately diagnosed and treated based on such radiographic information, as demonstrated by pre-MRI findings, thus avoiding the MRI and subsequent evaluation by an orthopedic surgeon. Meniscectomy was rarely performed, particularly in patients with advanced OA. Educational and pragmatic measures must be emphasized to encourage the use of radiography and to limit the inappropriate use of MRI, a costly technique.



Les indications de l'imagerie par résonance magnétique du genou d'une personne âgée et les interventions cliniques qui en résultent

Faisons-nous un choix éclairé?

Marc-Etienne Parent MD FRCPC François Vézina MD FRCSC
Nathalie Carrier MSc Ariel Masetto MD

Résumé

Objectif Analyser les indications d'une imagerie par résonance magnétique (IRM) du genou chez une personne âgée et déterminer les interventions cliniques en résultant.

Type d'étude Analyse rétrospective de 125 dossiers médicaux de patients de 50 ans et plus qui avaient eu une IRM pour un genou en 2009.

Contexte Le Centre hospitalier universitaire de Sherbrooke, au Québec.

Participants Des patients de 50 ans et plus qui avaient eu une IRM du genou en 2009.

Principaux paramètres à l'étude Le principal paramètre utilisé pour évaluer les conséquences de l'IRM était une intervention invasive du genou qui avait fait l'objet de l'IRM. On a révisé les dossiers médicaux jusqu'en 2014 pour déterminer les caractéristiques des patients, les indications de l'IRM, la spécialité du médecin qui l'avait demandée, les radiographies antérieures à l'IRM, les résultats de l'IRM et les interventions cliniques engendrées par cet examen.

Résultats L'âge moyen (DS) des patients était de 60 ans (7,5). Les principales indications des IRM étaient une pathologie méniscale (148 [68,8%]) et une douleur chronique (92 [42,8%]). Les principales constatations de l'IRM étaient une ostéoarthrite (OA) (185 [86,0%]) et une lésion méniscale (170 [79,1%]). Seulement 82 patients (38,1%) avaient eu une radiographie simple du genou au cours des 24 mois précédant l'IRM, généralement sans que le patient soit debout et en incidence autre qu'antéro-postérieure. Les résultats de 201 radiographies prises avant l'IRM montraient la présence d'OA chez 144 patients (71,6%). Dans l'ensemble, 87 patients (40,5%) ont été vus par un chirurgien orthopédiste et 27 (31,0%) d'entre eux ont subi une intervention invasive. Des 81 patients qui avaient une OA de modérée à sévère à l'IRM, 36 (44,4%) avaient eu des preuves radiographiques d'une OA de modérée à sévère, et seulement 3 (3,7%) ont eu une ménisectomie par arthroscopie.

Conclusion Notre étude confirme l'association bien connue entre l'OA et certains changements dégénératifs des ménisques chez des patients âgés. Nous avons observé une sous-utilisation étonnante de l'incidence antéro-postérieure pour la radiographie et de la station debout pour le patient. La plupart des patients de notre cohorte auraient pu avoir un diagnostic et un traitement appropriés si on avait tenu compte des résultats des radiographies antérieures à l'IRM, évitant ainsi l'IRM et l'évaluation subséquente par un chirurgien orthopédiste. Peu de ménisectomies ont été effectuées, en particulier chez ceux qui avaient une OA bien établie. Il y a lieu d'envisager des mesures concrètes et des séances de formation pour encourager l'utilisation de la radiographie et pour réduire l'utilisation inappropriée de l'IRM, dont le coût est élevé.

Points de repère du rédacteur

- ▶ Un nombre important de patients âgés ont eu une imagerie par résonance magnétique (IRM) pour une douleur chronique du genou. La plupart d'entre eux avaient déjà des preuves radiographiques d'une ostéoarthrite (OA) de modérée à sévère. La plupart de ces radiographies n'avaient pas été prises en antéro-postérieure chez un patient debout.
- ▶ L'utilité de l'IRM chez des patients qui ont déjà une OA est limitée. La plupart de ceux qui avaient une OA de modérée à sévère et qui ont été subséquemment vus par un chirurgien orthopédiste avaient un diagnostic d'OA, et seulement 3,7% d'entre eux ont eu une arthroscopie en comparaison de 14,9% de ceux qui n'avaient aucune OA ou seulement une OA légère. De même, 17 des 134 patients (12,7%) qui n'avaient pas d'OA ou seulement une OA sous-jacente légère ont eu une ménisectomie, en comparaison de seulement 3 des 81 patients (3,7%) qui avaient une OA de modérée à sévère.
- ▶ L'investigation d'un genou douloureux chez une personne âgée devrait comprendre un questionnaire médical détaillé, un examen physique complet et des radiographies en position debout en incidence antéro-postérieure. Avant d'envisager une IRM ou une consultation auprès d'un chirurgien orthopédiste, il faudrait tenter un traitement conservateur d'une durée suffisante, avec ou sans médication.

The use of magnetic resonance imaging (MRI) is steadily increasing.¹ In 2011, 1.7 million MRIs took place in Canada—an increase of 8.7% compared with the previous year.² This is most likely a reflection of the increased access to MRI, as the number of MRI scanners grew by 57% between 2006 and 2012.^{2,3} In parallel, the substantial cost of this imaging technique represents an important financial burden on many countries.⁴

Knee pain is prevalent and its investigation often requires some form of imaging. Plain radiographs of the knee, especially those that involve weight-bearing positioning, are very sensitive for bony lesions and osteoarthritis (OA), but not for meniscal or ligamentous injuries.⁵ Magnetic resonance imaging is the technique of choice to investigate such lesions and has a sensitivity of 88% and specificity of 82% for identifying chondral lesions of the tibiofemoral joint.⁶ Magnetic resonance imaging also has its limitations and is greatly dependent on appropriate patient selection. Factors such as age, acute traumatic context, hemarthrosis, radiographic findings, and chronicity of pain considerably influence patient selection as well as the performance of MRI.⁷

The prevalence of asymptomatic meniscal tears increases from 13% to 25% in patients younger than 45 years of age to 36% in older patients.^{8,9} In patients older than 45 years with radiographic evidence of degenerative OA, meniscal lesions are found in 76% and 91% of asymptomatic and symptomatic cases, respectively.¹⁰

A randomized controlled trial demonstrated that surgical lavage and arthroscopic intervention (synovectomy, debridement, or excision of degenerative chondral or meniscal lesions) provided no additional functional or symptomatic benefits at 24 months over optimized medical and physical therapy alone in 188 patients with moderate to severe OA.¹¹ This study excluded patients with large (“bucket-handle”) meniscal tears. Additionally, a randomized controlled trial of 351 symptomatic patients older than 45 years (mean age of 58) with mild to moderate OA and MRI-confirmed meniscal tear found no additional functional or symptomatic benefit from a combination of arthroscopic partial meniscectomy and physiotherapy when compared with physiotherapy alone.¹² Of note, there was a 30% cross-over rate between the 2 groups, which was not accounted for by the intention-to-treat analysis. As these findings demonstrate, MRI in older patients with chronic knee pain is rarely helpful in identifying incriminating meniscal tears.

The American Academy of Orthopaedic Surgeons is unable to recommend for or against arthroscopic partial meniscectomy in patients with OA and meniscal tear.¹³ Recently, the Choosing Wisely campaign published recommendations regarding the use of MRI.¹⁴ However, their recommendations did not specifically address the use of MRI in older patients with degenerative OA. In 2015, the American College of Radiology stated that MRI of the knee should only be performed after careful consideration of alternative imaging methods.¹⁵

The objective of this study was to analyze the indications and clinical procedures resulting from knee MRI in older patients.

— Methods —

We conducted a retrospective, longitudinal descriptive study for the period of January 2009 to October 2014 in a single Canadian centre (Centre hospitalier universitaire de Sherbrooke in Quebec). The Centre hospitalier universitaire de Sherbrooke ethics board approved the study protocol. Medical records were retrieved on a consecutive chronologic basis from an electronic health care database. The records were individually reviewed by a single researcher (M.E.P.).

Study population

Patients 50 years of age and older who underwent unilateral knee MRI in 2009 were included. Only unilateral knee MRI examinations were included because patients undergoing bilateral knee MRI would be more likely to have an underlying degenerative disease, which would disproportionately increase the prevalence of degenerative diseases in our study population. Patients were not included if the MRI was done during hospitalization or an emergency department visit. Variables included patient characteristics (age, sex, height, and weight), symptoms and signs (trauma, knee locking, effusion), MRI indication (as stated on the MRI requisition forms), ordering physician (GP, orthopedic surgeon [OS], rheumatologist, or other), knee radiograph in the 24 months before the MRI (indications, use of the anteroposterior [AP] standing view, findings) and immediately before the MRI (as per our centre's protocol), MRI findings, subsequent consultation with an OS, and clinical diagnosis by the OS. The main outcome was whether the patient had an invasive procedure to the same knee after the MRI (arthroscopy, meniscectomy, or arthroplasty).

Statistical analysis

Statistical analysis was done using χ^2 tests (or Fisher exact tests if the frequency was below 5). The *P* values were considered significant at .05. Data analysis was performed with SPSS, version 24.0, and SAS, version 9.4.

— Results —

A total of 215 knee MRIs from 215 different patients were analyzed. Patient characteristics are described in **Table 1**. Patient age ranged from 50 to 85 years, with a median of 60 years. Both sexes and both knees were represented equally in the sample.

A total of 148 MRIs were ordered by GPs (68.8%), 55 by OSs (25.6%), 10 by rheumatologists (4.7%), and 2 by others (0.9%). Indications for MRI were meniscopathy (148 [68.8%]), chronic pain (92 [42.8%]), ligament injury

(36 [16.7%]), acute pain (14 [6.5%]), OA (9 [4.2%]), arthritis or synovitis (6 [2.8%]), osteochondral lesions (6 [2.8%]), osteonecrosis (4 [1.9%]), tendinopathy (3 [1.4%]), neoplasia (1 [0.5%]), fracture (1 [0.5%]), and others (3 [1.4%]). Chronic pain and meniscopathy were simultaneous indications in 48 (22.3%) cases. Main indications specific to the 2 principal ordering physician specialties (GP and OS) are presented in **Table 2** and **Figure 1**. A significantly higher proportion of MRIs requested by GPs were for chronic pain compared with those requested by OSs ($P=.008$). A combination of many indications was often present. Some physicians included associated symptoms and signs on the MRI requisition form; these included a history of trauma (47 [21.9%]), knee locking (42 [19.5%]), and knee effusion (22 [10.2%]).

A plain radiograph of the same knee was obtained within the 24 months before the MRI in 82 (38.1%) cases, and only 31 (37.8%) of these had a standing AP view. Main findings were mild OA (41 [50.0%]) and moderate to severe OA (8 [9.8%]). Findings for only 30 (36.6%) radiographs were normal. Most radiographs were ordered by GPs and OSs (50 [61.0%] and 28 [34.1%], respectively). The proportion of patients who had a knee radiograph before the MRI was 33.8% for the GP referrals and 50.9% for the OS referrals.

A plain radiograph of the same knee was obtained immediately before the MRI in 201 (93.5%) patients. These radiographs were part of our centre's MRI protocol. None were obtained with a standing AP view. Main findings were mild OA (104 [51.7%]) and moderate

to severe OA (40 [19.9%]). Findings of only 53 (26.4%) radiographs were normal.

Other notable findings included intra-articular loose bodies and osteochondral lesions in 12 (6.0%) and 10 (5.0%) cases, respectively.

The MRI findings showed that a total of 185 (86.0%) patients had OA, of which 104 (56.2%) cases were mild and 81 (43.8%) cases were moderate to severe. A total of 170 (79.1%) patients had either degenerative (myxoid) or nondegenerative meniscal tears: 113 (52.6%) had isolated myxoid meniscal changes (without nondegenerative tearing), 35 (16.3%) had isolated nondegenerative tears, and 22 (10.2%) had both concomitantly. The main MRI findings according to the 2 principal ordering physician specialties (GP and OS) are reported in **Table 3** and **Figure 2**. Osteoarthritis of any severity and meniscal damage could be seen concomitantly in 155 (72.1%) patients.

Overall, 87 (40.5%) patients were seen by an OS after their MRIs. The clinical diagnoses made by the OSs, who had access to the MRI results, were OA (50 [57.5%]), symptomatic meniscal tear (24 [27.6%]), asymptomatic meniscal tear (5 [5.7%]), chondropathy (4 [4.6%]), patellofemoral pain syndrome (2 [2.3%]), cruciate ligament tear (2 [2.3%]), collateral ligament tear (2 [2.3%]), acute fracture (1 [1.1%]), and others (8 [9.2%]).

Twenty-seven (31.0%) of the 87 patients seen by an OS underwent an invasive procedure, either arthroscopy (23 [85.2%]) or open arthroplasty (4 [14.8%]). Twenty (87.0%) of the patients who had an arthroscopy had an arthroscopic meniscectomy performed.

Among the 81 patients with evidence of moderate to severe OA on MRI, 36 (44.4%) and 36 (44.4%) had radiographic evidence of mild OA and moderate to severe OA in the past 2 years, respectively. Sixty-nine (85.2%) of these patients had myxoid meniscal changes and 4 (4.9%) had isolated nondegenerative meniscal tears.

Table 1. Patient characteristics: N 215; mean (SD) age of patients was 60.6 (7.5) y.

CHARACTERISTIC	N (%)
Women	110 (51.2)
Right knee affected	115 (53.5)
Physician ordering MRI	
• GP	148 (68.8)
• Rheumatologist	10 (4.7)
• OS	55 (25.6)
• Other	2 (0.9)
Pre-MRI radiography findings (n = 201)	
• Mild OA	104 (51.7)
• Moderate to severe OA	40 (19.9)
• With standing AP view	0 (0.0)
Radiography in the past 24 mo (n = 82)	
• Findings of mild OA	41 (50.0)
• Findings of moderate to severe OA	8 (9.8)
• With standing AP view	31 (37.8)

AP—anteroposterior, MRI—magnetic resonance imaging, OA—osteoarthritis, OS—orthopedic surgeon.

Table 2. Most frequent magnetic resonance imaging indications by main ordering physician specialties

INDICATION	SPECIALTY		TOTAL, N	P VALUE
	GP (N 148), %	OS (N 55), %		
Meniscopathy	70.3	72.7	144	.732
Chronic pain	48.0	27.3	86	.008
Ligamentopathy	19.6	9.1	34	.075
Acute pain	6.1	7.3	13	.752
Osteoarthritis	5.4	1.8	9	.449
Osteochondral lesion	2.0	5.5	6	.347
Arthritis or synovitis	0.0	7.3	4	.005
Osteonecrosis	0.0	5.5	3	.019

OS—orthopedic surgeon.

Figure 1. Most frequent magnetic resonance imaging indications by main ordering physician specialties

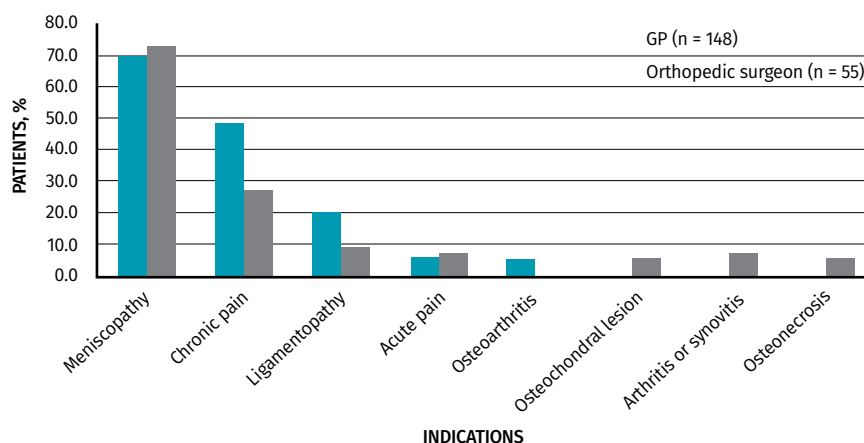


Table 3. Magnetic resonance imaging findings by main ordering physician specialties

FINDING	SPECIALTY		TOTAL, N	P VALUE
	GP (N 148), %	OS (N 55), %		
Normal	2.7	3.6	6	.663
Mild OA	43.9	60.0	98	.042
Moderate to severe OA	42.6	45.5	77	.026
Degenerative meniscal tear (myxoid)	68.2	49.1	128	.012
Nondegenerative meniscal tear	30.4	16.4	54	.044
Osteochondral lesion	22.3	36.4	53	.043
Intra-articular effusion	14.9	9.1	27	.282
Baker cyst	9.5	10.9	20	.758
Cruciate ligament tear	6.8	12.7	17	.172
Arthritis or synovitis	2.0	3.6	5	.614

OA—osteoarthritis, OS—orthopedic surgeon.

Among the 28 (34.6%) patients who went on to see an OS, 24 (85.7%) were given a final diagnosis of OA, 3 (10.7%) underwent an arthroscopic meniscectomy, and 2 (7.1%) underwent a total knee arthroplasty.

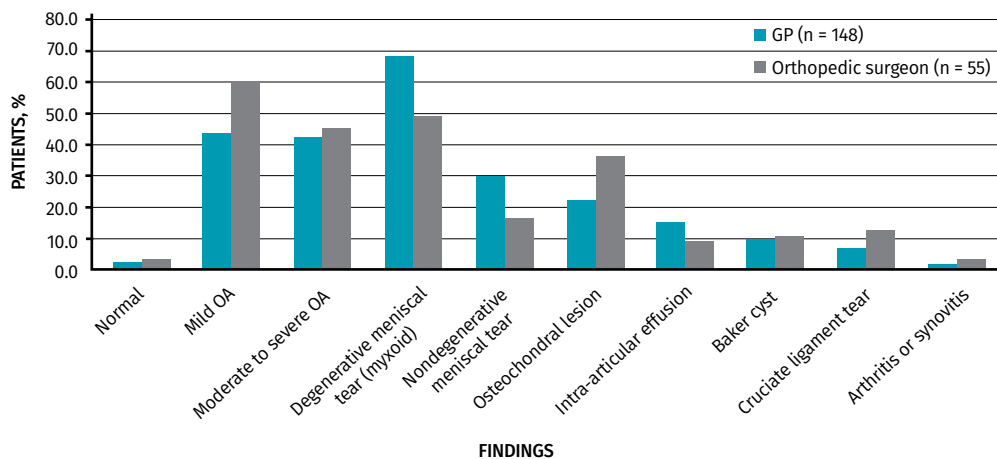
— Discussion —

We conducted a retrospective study on the use and effect of knee MRIs in an older population. We reproduced

the known association between OA and degenerative meniscal lesions in older patients. Our study demonstrates a striking underuse of plain radiographs in the investigation of knee pain. Particularly, the infrequent use of the standing AP view (the criterion standard for diagnosing OA) is quite surprising in this older population. This is consistent with data published in a 2010 study on the use of MRI of the knee by primary care providers, where patients had weight-bearing and non-weight-bearing radiographs in only 24% and 20% of cases, respectively.¹⁶ Furthermore, the presence of symptoms (knee pain, aching, or stiffness) does not increase the likelihood of finding a meniscal tear in patients with existing radiographic evidence of OA (prevalence ratio of 1.14, 95% CI 0.90 to 1.45), but it increases the likelihood of finding a meniscal tear in patients with no radiographic evidence of OA (prevalence ratio of 1.43, 95% CI 1.08 to 1.90).¹⁷ Therefore, it is important to identify these patients by means of a simple standing AP-view radiograph to properly evaluate the pretest probability of finding a meniscal lesion indicative of OA on MRI.

Of interest, there is a striking difference in the number of patients with moderate to severe OA on plain radiographs and the number of patients with moderate to severe OA on MRI. This could be owing to under-reporting of the moderate to severe cases seen on radiographs or an over-reporting of cases seen on MRI. We believe the former to be more likely, as most radiographs in our study were not done with a standing AP view. This difference was also reported in an earlier study of patients with and without knee pain and was most likely related to the higher MRI sensitivity.¹⁸

Our study also illustrates the limited usefulness of MRI in patients with known OA. Most of the patients with moderate to severe OA who were subsequently seen by an OS had a diagnosis of OA, and only 3.7%

Figure 2. Magnetic resonance imaging findings by main ordering physician specialties

OA—osteoarthritis.

of them underwent arthroscopy compared with 14.9% of the patients with mild or no OA. Likewise, 17 of the 134 (12.7%) patients with no OA or mild underlying OA underwent meniscectomies, compared with only 3 of the 81 (3.7%) patients with moderate to severe OA. There is sufficient evidence showing that adopting an invasive approach to treating meniscal lesions in these patients is of no additional clinical benefit.^{11,12} The origin of the pain is most likely the underlying degenerative process, with the accompanying meniscal changes as a consequence of this very same process. Depending on the delay, primary care physicians might deem it reasonable to accelerate the OS referral by requesting an MRI. This practice should be discouraged, and the decision to request an MRI should be made independently of the decision to refer to an OS.

Of interest, a recent meta-analysis of 7 studies has shown no functional or symptomatic benefit when comparing arthroscopic meniscal debridement with a conservative approach in older patients (50 years of age or older) with symptomatic meniscal lesions with only mild or no concurrent OA.¹⁹ Thus, regardless of an underlying degenerative process, the role of invasive procedures for meniscopathies in older patients is becoming less and less clear.

Limitations


The limitations of our study are owing to the retrospective nature of the data collection. Our centre serves as a referring centre for a vast area. As such, there is likely a slight underestimation of certain variables such as the presence of plain radiographs in the previous 24 months, past OS consultations, and past invasive interventions. These could all have been carried out in another referring centre. A regional radiology database, which covers most of the area served, was consulted by

using patient information to find the maximum number of available radiographs. Other limitations include the under-reporting of clinical findings at the time of examination, the poor descriptive quality of the information (context, chronicity of pain, signs, symptoms, attempted treatments, etc) given by physicians on MRI requisition forms, and the lack of data on functional or symptomatic outcomes following the invasive interventions.

Patients who underwent MRI as part of a hospitalization or emergency department visit were not included in order to limit the number of very acute indications such as trauma, infections, metastases, fractures, osteonecrosis, and others. In doing so, we hoped to have increased the generalizability of our study results toward primary care physicians, the principal MRI-ordering physicians.

Conclusion

In younger patients suffering from acute knee pain in a traumatic context, MRI still plays an important role in identifying meniscal lesions. Arthroscopic meniscectomy in these cases has been associated with substantially better outcomes.^{20,21} In recent years it has been shown that invasive approaches are of no benefit in older patients or in patients with substantial concurrent OA.^{11,12} In this study, we have demonstrated that a considerable number of older patients undergo MRI for chronic knee pain. Most of them have radiographic evidence of pre-existing OA that is often moderate to severe. This study dealt with patients from 2009 and, since then, many new studies addressing the issue have been published. With the accumulating evidence, it is essential that the role of MRI be reconsidered in older patients and in those with OA. We recommend investigating knee pain in older patients with a comprehensive medical questionnaire, thorough physical examination, and radiographs using

the standing AP view. Conservative nonpharmacologic and pharmacologic therapies should be attempted and given sufficient time to take effect before considering an OS referral or MRI. Pragmatic measures need to be taken to increase awareness and educate physicians to limit the inappropriate use of this costly imaging technique. Thereafter, a study such as this one could be repeated for comparison purposes. 

Dr Parent is a resident in the Department of Rheumatology at the Centre hospitalier universitaire de Sherbrooke in Quebec. **Dr Vézina** is Adjunct Professor in the Department of Orthopaedic Surgery at the Centre hospitalier universitaire de Sherbrooke. **Ms Carrier** is a statistician and **Dr Masetto** is Adjunct Professor, both in the Department of Rheumatology at the Centre hospitalier universitaire de Sherbrooke.

Contributors

Dr Parent is responsible for the study design, data collection and analysis, and writing and submitting the manuscript. **Drs Vézina** and **Masetto** are responsible for the study design, data analysis, and manuscript revision. **Ms Carrier** is responsible for the statistical analysis. All authors have contributed substantially to the study design, data interpretation, and to the editing of the manuscript. All authors read and approved the final manuscript.

Competing interests

None declared

Correspondence

Dr Marc-Etienne Parent; e-mail marc-etienne.parent@usherbrooke.ca

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