

Magnetic resonance imaging of the knee: An unnecessary cost to the NHS?

Ravi Patel*; Daniel Omonbude; Carl Fenton; Victor Lu; Oliver Watson

***Corresponding Author: Ravi Patel**

Department of Trauma & Orthopaedics, Dianna Princess of Wales Hospital, Grimsby, England.

Tel: 07794890362; Email: hyrp16@hyms.ac.uk

Abstract

Aims and objectives: The aim of this study was to evaluate the indications for patients presenting with knee pain undergoing magnetic resonance imaging (MRI) of the knee prior to referral to the orthopaedic department and to ascertain whether plain radiograph imaging would be more beneficial prior to an MRI scan.

Material and methods: A retrospective review of all referrals received by the hospital over a 6-month period was performed. Patients with knee pain that underwent an MRI scan were classified into two age groups, under 50 years and over 50 years old. Patients having undergone Magnetic resonance imaging (MRI) prior to referral were identified, and findings of the scan were recorded. These patients were reviewed to see if a plain radiograph had been completed prior to or after the MRI. These were reviewed against The National health services (NHS) guidelines for Primary Care Physicians to identify if the imaging performed was appropriate in each case.

Results: A total of 414 patients were referred between 1st January 2021 and 28th July 2021. In the over 50's two hundred and twenty-eight (228) MRI scans were performed. Of these one hundred and three (103/228) patients the predominate finding was meniscal tears and seventy-two (72/228) had a finding of osteoarthritis. A plain radiograph of the knee was completed ninety-nine (99/228) cases, (28/99) before the MRI and (71/83) after the MRI. In the under 50's one hundred and eighty-six (186) scans were performed and of these eighty-five (85/186) the predominate finding was meniscal tears. A plain radiograph of the knee was completed in only eighty-three (83/186) cases, (69/83) before the MRI and (14/83) after the MRI.

Discussion and conclusion: A normal part of the arthritis pathophysiology is degeneration of the meniscus. Meniscal tears are an expected finding in the MRI of a patient with knee osteoarthritis and knee osteoarthritis is best assessed with a weight bearing plain film x-ray. In over 50s, 57% of patients (129 of 228) did not have a knee X-ray before having an MRI. In those with a finding of osteoarthritis (72), this

could almost certainly be avoided. In many of the cases of meniscal tears (103) this likely could have been avoided. For a single hospital's referral over 6 months these unnecessary MRI (magnetic resonance imaging) of knee cost National Health Services (NHS) £7,500. Closer adherence to the guidelines by primary care physicians will result in a financial saving, better patient experience and a more effective use of resources.

Introduction

A patient presenting with knee pain is a common presenting complaint in primary care [1]. The knee joint itself is commonly affected by osteoarthritis especially in those over the age of 50. Patients presenting to clinics have an initial consultation involving, history of presenting complaint, examination and relevant investigations [2]. Often clinician's main findings in consultations include pain localising to the medial or lateral side, joint line tenderness, locking of the knee particularly on squatting and a positive McMurray's test. Currently the first line investigation for the diagnosis of osteoarthritis is plain radiographs, it provides a sensitivity of 88% and a specificity of 84% [3].

Magnetic resonance imaging of the knee is an important diagnostic tool in the detection of meniscal tears. It is considered to have a sensitivity and specificity of 88-92%. Horizontal / cleavage tears occur parallel to the tibial plateau involving one of the articular surfaces or free edge [4]. They are associated with degenerative changes in the knee. Vertical tears are perpendicular to the tibial plateau and parallel to the long axis of the meniscus. These are associated with twisting traumatic knee injuries, commonly seen in young adults and highly associated with the anterior cruciate ligament [5]. Vertical tears primarily are treated with arthroscopic surgery whereas horizontal tears are becoming increasingly managed non-operatively [6].

Along with the detection of meniscal tears, MRI imaging has been used to detect early osteoarthritis in those over the age of 50 years old. Magnetic resonance imaging (MRI) has advantage in the evaluation of structural changes during the progression of knee OA. An MRI allows us to visualize all the tissues involved in OA pathology, such as cartilage, subchondral bone, meniscus, and soft tissue [2]. Although MRI is not recommended for now to diagnose early knee OA in daily clinical practice, because of lack of validated consensus criteria and the frequent prevalence of structural knee joint changes with MRI, the literature suggests that such MRI-detected lesions may represent early knee OA. The significance of MRI finding in the management of these patients with early changes has been under recent review, as it has become hard to warrant if it is as part of the normal aging process or label the initial stages of osteoarthritis [7].

The literature has reported the primary care doctors, overutilize MRI scans for knee pain, resulting in a high rate of inappropriate imaging, poor use of resource allocation and minimal change in patient management pathway [2]. Therefore, MRI scans should be requested only with clinical correlation in patients over 50 years old, after a plain radiograph has been conducted. When considering the literature above, we evaluated whether MRI scans of the knee joint should be requested in those over the age of 50 years old prior to referral to orthopaedic consultant. An MRI is not recommended for the diagnosis of osteoarthritis as it will not change the treatment planning. There is more chance of incidental finding of

degenerative meniscal tear.

Materials and methods

We retrospectively reviewed all referrals received by the hospital over a 6-month period. Patients with knee pain that underwent an MRI scan prior to referral were classified into two age groups, under 50 years and over 50 years old. Findings of the MRI scan were recorded and documented. Patients that had an MRI were further reviewed, to identify whether a plain radiography had been taken prior to or after the MRI scan. These were reviewed against the National health services (NHS) guidelines for Primary Care Physicians to identify if the imaging performed was appropriate in each case (Table 1).

The project was registered as a retrospective review and 414 patients were evaluated that were referred to the orthopaedic consultants in Dianna Princess of Wales Hospital, Grimsby. The study period was from 1st January 2021 and 28th July 2021. Delay between the MRI request and referral to the consultant was noted along with time required for reporting the study. Plain radiograph or MRI of the knee as first-line investigation modality was taken into account. Additionally, we document whether the MRI result had changed the management pathway of the patient, in order to assess the impact on patient care.

Patients met inclusion if they were over the age of 18 and underwent an MRI scan for a painful knee (traumatic and atraumatic), prior to referral to an orthopaedic surgeon. This included patients with the following documentation in clinical notes; knee pain, knee pain and instability, locked knee, locked painful knee, suspicion of osteoarthritis, painful meniscal injury, meniscal injury, traumatic anterior cruciate ligament injury, patella dislocation. Patients that were excluded include patients under the age of 18, patient with suspicion or evidence of bone tumours e.g., osteosarcoma and patients with previous peri-prosthetic fractures of the knee. All clinical records and radiographs were reviewed by two authors (RP and DO) independently, who were not involved in patient treatment process, thus avoiding assessment bias.

Results

A total of 414 patients were referred during the study period. A brief summary description of MRI report is shown (Table 2). In the over 50's two hundred and twenty-eight (228) MRI scans were performed prior to referral. Of these one hundred and three (103/228) patients the main finding was meniscal tears and seventy-two (72/228) had a finding of osteoarthritis. A plain radiograph of the knee was only completed in 43% of patients (99/228) prior to an MRI scan. (28/99) before the MRI and (71/99) after completion of MRI scan (Figure 1).

In the under 50's one hundred and eighty-six (186) scans were performed prior to referral and of these eighty-five (85/186) the predominate finding was meniscal tears. A plain radiograph of the knee was completed in only eighty-three (83/186) cases, (69/83) before the MRI and (14/83) after the MRI (Figure 2).

Overall, 23% of patients (97/414) underwent plain radiography of the knee before their MRI. Additionally, an MRI in the over 50's did not lead to change in management of patients and treatment

options in terms of physiotherapy, intraarticular injections or knee arthroplasty were considered (Figure 3).

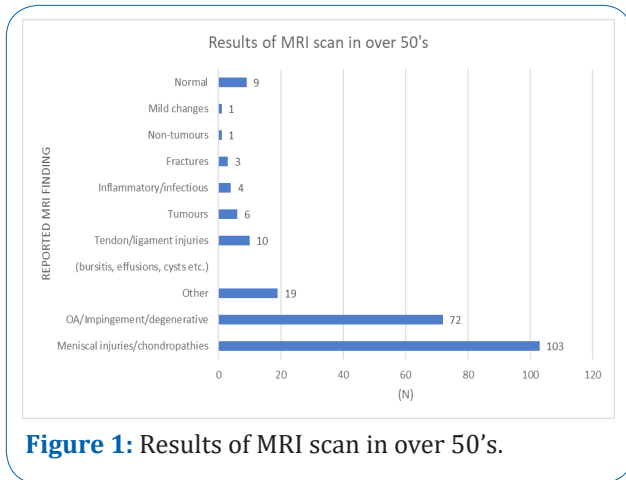


Figure 1: Results of MRI scan in over 50's.

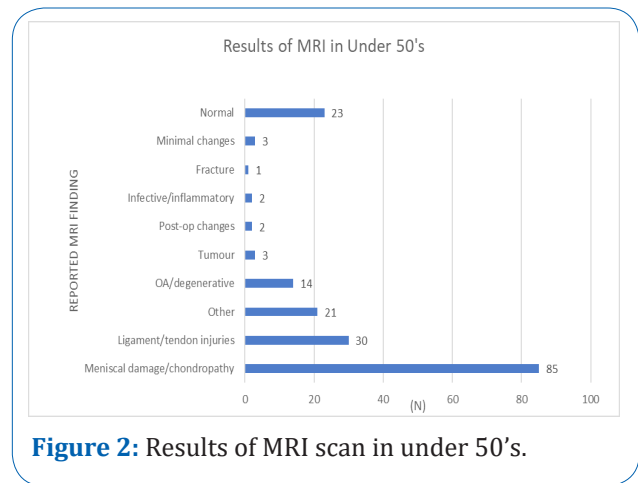


Figure 2: Results of MRI scan in under 50's.

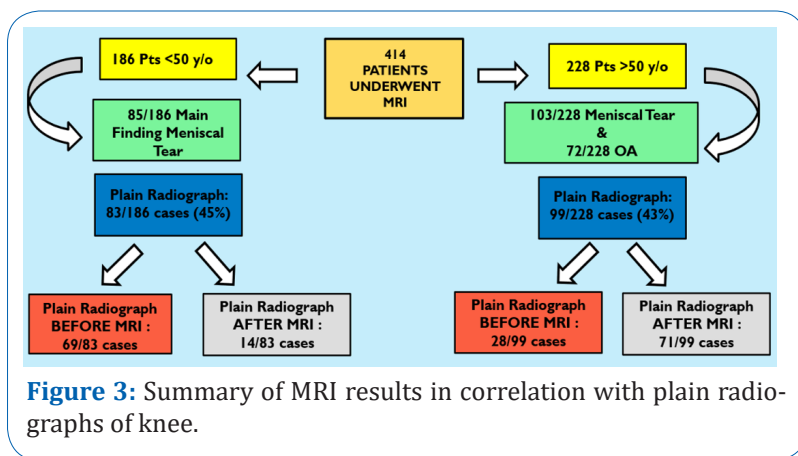


Table 1: MRI contraindications as per NHS guidelines.

Contraindication statement	Yes / No
Active knee inflammatory arthritis	
Previous meniscal surgery	
High BMI patient with radiological/clinical evidence of OA	
Anterior knee pain due to OA, chondromalacia patella, tendon problem	
Any osteoarthritis of knee	
Pseudo locking —momentary period of stiffness following immobility	
Locked knee 15 ° extension unable to flex to 90	
Age <15 years or over 45 years	

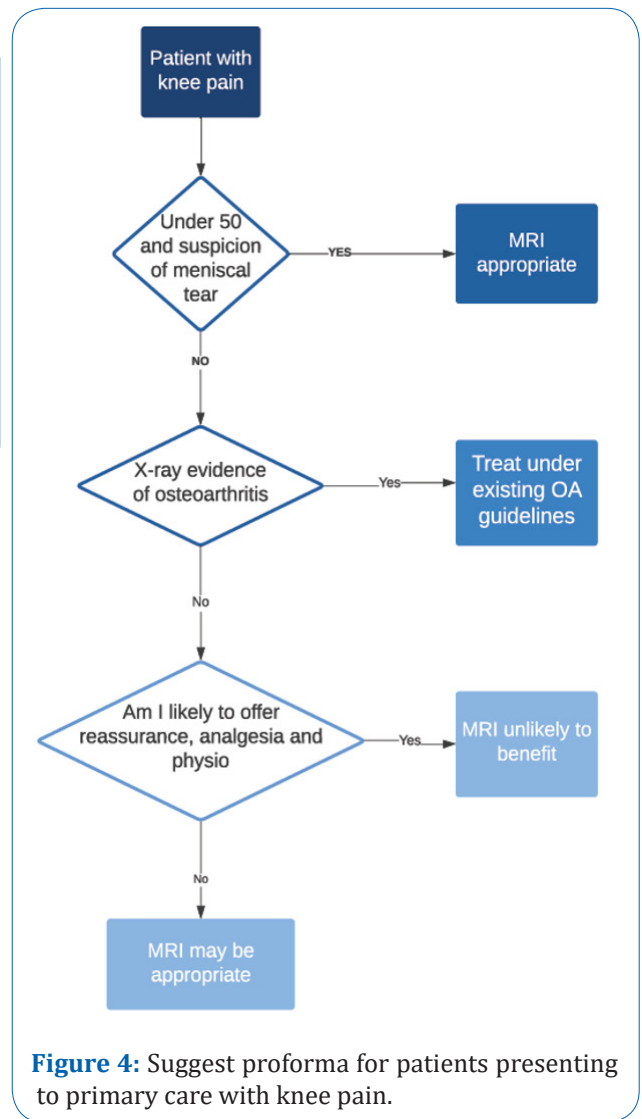


Figure 4: Suggest proforma for patients presenting to primary care with knee pain.

Table 2: Number of MRI scans performed (n) and the reported findings (%).

	Over 50s	Under 50s
Number ofMRI Scans performed (n)	228	186
Osteoarthritis	31.6%	7.6%
Meniscal tears	45.2%	46.2%
Tendon/ ligament injury	4.4%	16.3%
Secondary finding	8.3%	11.4%
Normal	3.9%	12.5%

Discussion

As per our study as well as evidence in the literature, MRI is not recommended for the diagnosis of osteoarthritis in over 50-year-olds, as it will not change the treatment plan. There is a greater chance of an incidental finding of a degenerative meniscal tear. A normal part of the osteoarthritis pathophysiology is degeneration of the meniscus. These degenerative changes start to occur in the knee in subjects over the age of 40 years, especially when there is an absent history of trauma [8]. Meniscal tears are an expected finding in the MRI of a patient with knee osteoarthritis and knee osteoarthritis is best assessed with a weight bearing plain film x-ray. With an abnormal knee plain radiograph, an MRI will not change management of ongoing pain [7].

One study in the literature reported that 13% of patients had an MRI scan despite established diagnosis of osteoarthritis with the help of plain radiograph of knee [9]. The use of MRI as a principal modality of choice for osteoarthritis is not supported in the literature and plain radiographs are still considered as first line of investigation especially in those over 50 years old and elderly individuals.

Figure 1. demonstrates that there is a strong association with degenerative meniscal tears being associated with osteoarthritis in patients of increasing age. This resonates with MRI findings in our study which clarifies depicted evidence of degenerative tear with osteoarthritis as 103/228 patients the main reported finding was meniscal tears and seventy-two 72/228 had a finding of osteoarthritis in the over 50’s subject population. These meniscal tears are likely to be horizontal tear of medial meniscus that run parallel to the tibial surface, as these are associated with degenerative nature [4].

Our study additionally highlighted that in those under the age of 50-years old, presenting with symptoms of knee pain, instability and recent knee trauma the diagnosis of a meniscal injury should be highly suspicious. This is illustrated as 46% (85/186) subjects the predominate MRI finding was meniscal tears. MRI in the under 50’s study group can aid diagnosis and pre-operative planning. This is supported by the literature as it reports 40% of the patients had one or more positive MRI findings potentially requiring further evaluation by an orthopaedic surgeon [10]. These meniscal tears are typically vertical tears and are perpendicular to the tibial plateau and parallel to the long axis of the meniscus [5].

The use of MRI in non-traumatic knee pain has been reported to be less yielding when considering the change in management as end point of investigation for those under 50 years-old. When an MRI was requested

by an orthopaedic doctor 27.6% of the reported scans showed normal or mild osteoarthritis compared to forty-five percent 45% of MRI scans requested by non-orthopaedic doctors [3]. This is in contrast to the usefulness of MRI in the traumatic knee patient in the under 50's I.e. 81% verses degenerative knees 21%.

The financial burden of MRI imaging in the diagnosis and evaluation of pathologic orthopaedic conditions is well recognised. Non-physician and non-academic providers were more likely to order MRI scans when compared with physicians or academic providers. It therefore should be highlighted the importance of education of physicians requesting the scan [3]. This goes hand in hand with addressing the patient's perception about the investigation. Despite various studies in the current literature, few have been able to establish an algorithm for requesting a scan.

Limitations

There are limitations to this study. The results of the MRI scan in overweight patients with a high BMI, leads to variation in reported results. The altered results of the scan be accounted for by the increased strain on the tibiofemoral cartilage leading to alteration in thickness [8]. Subjects with high BMI are considered poor candidates for knee arthroplasty. There is increased mid to long-term revision rate following primary total knee arthroplasty in morbidly obese patients and increased risk of perioperative complications, such as superficial wound infection. The use of MRI in patients with a high BMI with have minimal change on the management of the patient. An incidental finding of a degenerative meniscal tear will not make them a candidate for elective arthroscopy [6].

Another limitation is our single centre, retrospective study was limited to the patients referred to only five knee consultant orthopaedic surgeons and it is possible the findings may have been different if patients referred to other arthroplasty surgeons within the North Lincolnshire and Goole trust (NLAG). However, considering the magnitude of the problem, with believe there is an urgent need to raise awareness in primary care physicians regarding the appropriate request of MRI scans, and consider the possibility of requesting a plain-radiograph prior to the request on an MRI [10].

Conclusions

1. In over 50's, 57% of patients (129 of 228) did not have a knee radiograph before having an MRI scan. In those with a finding of osteoarthritis (72), this could almost certainly be avoided and in many of the cases of meniscal tears (103) this likely could have been avoided. The majority of patients referred to orthopaedics has inappropriate Magnetic resonance imaging arranged by their primary care physician. For a single district general hospital's referral over 6 months these unnecessary MRI (magnetic resonance imaging) of knee cost National Health Services (NHS) £7,500. Greater education and closer adherence to the guidelines by primary care physicians would result in a financial saving, faster referral times and a greater resource allocation.

2. A plain knee radiograph should be performed in all over 50's prior to an MRI scan. With patients under the age of 50 years old use clinical judgement prior to requesting an MRI must be used. With an abnormal

knee radiograph result, an MRI will not change management of the patient. Where knee radiograph is normal, there should be strong suspicion of a traumatic origin for meniscal tear before request for MRI, along with a clear plan of what you would do with a positive result (Figure 4).

3. This study stresses the need of time where primary care and orthopaedic surgeons should work in a more interactive and dynamic way to streamline patient care thus contributing to better understanding of routine/urgent referral and investigation protocol system.

Declarations

Ethical approval: The project was registered after discussion with the local research team. The approval was taken from all the consultants in the local hospital and findings were discussed with the local Clinical commissioning group as well as in the regional trust meeting.

Sources of funding : There is no source of funding used for this project.

Author contribution: Ravi Patel: Manuscript writing, data collection, evaluation, review of literature. Daniel Omonbude: main idea, lead consultant. Carl Fenton: data collection, evaluation, review of literature. Victor Lu: data collection, evaluation, review of literature. Oliver Watson: data collection, evaluation

Declaration of competing interest: There is no conflict of interest associated with this study.

References

1. Roberts TT, Singer N, Hushmendy S, Dempsey IJ, Roberts JT, Uhl RL, Johnson PE. MRI for the evaluation of knee pain: comparison of ordering practices of primary care physicians and orthopaedic surgeons. *J Bone Joint Surg Am.* 2015; 97: 709-14.
2. Swart NM, van Oudenaarde K, Algra PR. et al. Efficacy of MRI in primary care for patients with knee complaints due to trauma: protocol of a randomised controlled non-inferiority trial TACKLE trial). *BMC Musculoskelet Disord.* 2014; 15: 63.
3. Sherman SL, Gulbrandsen TR, Lewis HA, et al. Overuse of Magnetic Resonance Imaging in the Diagnosis and Treatment of Moderate to Severe Osteoarthritis. *Iowa Orthop J.* 2018; 38: 33-37.
4. Mordecai SC, Al-Hadithy N, Ware HE, Gupte CM. Treatment of meniscal tears: An evidence-based approach. *World J Orthop.* 2014; 5: 233-241.
5. Ahmed I, Bowes M, Hutchinson CE, et al. Meniscal tear outcome Study (METRO Study): a study protocol for a multicentre prospective cohort study exploring the factors which affect outcomes in patients with a meniscal tear *BMJ Open.* 2020; 10: e038681.
6. Boyce L, Prasad A, Barrett M, et al. The outcomes of total knee arthroplasty in morbidly obese patients: a systematic review of the literature. *Arch Orthop Trauma Surg.* 2019; 139: 553-560.
7. Englund M, Guermazi A, Gale D, Hunter DJ, Aliabadi P, Clancy M, Felson DT. Incidental meniscal findings on knee MRI in middle-aged and elderly persons. *N Engl J Med.* 2008; 359: 1108-15.
8. Collins AT, Kulvaranon ML, Cutcliffe HC. et al. Obesity alters the in vivo mechanical response and biochemical properties of cartilage as measured by MRI. *Arthritis Res Ther.* 2018; 20: 232.
9. Graham, Patrick Meniscus Tear, *Orthopaedic Nursing.* 2018; 37: 255-257.

10. Sajid IM, Parkunan A, Frost K Unintended consequences: quantifying the benefits, iatrogenic harms and downstream cascade costs of musculoskeletal MRI in UK primary care *BMJ Open Quality* 2021; 10: e001287.

Manuscript Information: Received: June 18, 2022; Accepted: August 01, 2022; Published: August 10, 2022

Authors Information: Ravi Patel^{1*}; Daniel Omonbude²; Carl Fenton³; Victor Lu⁴; Oliver Watson⁵

¹Department of Trauma & Orthopaedics, Dianna Princess of Wales Hospital, Grimsby, England.

²Consultant Trauma & Orthopaedic Surgeon, Dianna Princess of Wales Hospital, Grimsby, England.

³Consultant Trauma & Orthopaedic Surgeon, Department of Trauma & Orthopaedics, Hull Royal Infirmary, Anlaby Road, Hull, HU3 2JZ, UK.

⁴Department of Trauma and Orthopaedics, Addenbrooke's Hospital, CB2 0QQ, United Kingdom.

⁵Foundation Year 2 Doctor, Department of Trauma & Orthopaedics, Dianna Princess of Wales Hospital, Grimsby, England.

Citation: Patel R, Omonbude D, Fenton C, Lu V, Watson O. Magnetic resonance imaging of the knee: An unnecessary cost to the NHS?. *Open J Clin Med Case Rep.* 2022; 1882.

Copy right statement: Content published in the journal follows Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>). © **Patel R (2022)**

About the Journal: Open Journal of Clinical and Medical Case Reports is an international, open access, peer reviewed Journal focusing exclusively on case reports covering all areas of clinical & medical sciences.

Visit the journal website at www.jclinmedcasereports.com

For reprints and other information, contact info@jclinmedcasereports.com