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Research Article

Discrepancies in Radiologists and Knee Surgeons Reporting of MRI Scans in Common Soft Tissue Knee Conditions

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Abstract

Rationale: MRI scan reports should accurately describe relevant pathologic and anatomic abnormalities which may be a source of symptoms, given this is the gold standard for non-invasive diagnosis of soft tissue knee conditions.

Objective: The aim of this study was to review MRI (magnetic resonance imaging) scan reports of patients with common soft tissue knee joint problems by two clinician groups; senior radiologists and specialist knee surgeons to determine, define and analyse similarities and discrepancies.

Methods: A retrospective cohort study was conducted using data collected from a consecutive series of patients seen by a single practitioner using a standardised, detailed proforma, in an outpatient Orthopaedic Department Knee Clinic in an English District Hospital. Patients were aged 18 to 45, with the first presentation of knee problems only with no history past history of knee problems, injuries or other polyarthropathy. From the selected cohort of 74 patients, there were 87 knee MRI scans (13 patients had bilateral scans), undertaken after the detailed clinical history and examination, which was documented in a standardised fashion. The MRI reports from both the consultant knee surgeon and the radiologist were entered into a database, along with demographic and clinical information. The reports were collated and analysed to determine whether they agreed, levels of agreement and key areas of discrepancy.

The null hypothesis and clinical expectation was that there was no discrepancy between MRI reports of radiologists and knee surgeons.

Results: Of 87 knee MRI reports, 14% (n = 12) completely agreed. 45% of the reports (n = 39) partially agreed and 41% (n = 36) completely disagreed. Of reports which partially agreed, 79% (n = 31) had a percentage agreement of ≤ 50%. There was strong agreement for meniscal and ACL tears.

Conclusion: This study reveals that discrepancies between MRI reports of two clinician groups are common, in this patient cohort. This has implications for both patients and practitioners.

Keywords: *MRI; Knee; Soft Tissue Knee; Radiology*

Introduction

The knee is a complex anatomical structure which undergoes high levels of day to day stresses and strains. These are offset by physiologic and anatomic features within the joint [1]. Certain areas of the knee joint are exposed to high ground reaction forces that frequently exceed peoples' body weight, from 4 - 9 times, during varying type and intensity of activity or exercise [2]. The pressure exerted through the knees is increased in those who take part in regular high impact sports. It is therefore unsurprising that the knee is the second most commonly injured body site and the most common cause of sport-related surgeries [3]. The most prevalent sports related knee injury is said to involve the medial meniscus but other structures such as the anterior cruciate ligament, lateral meniscus, articular cartilage, other ligaments, tendons and the synovium can occur either in isolation or combination.

Magnetic resonance imaging (MRI) has become the gold standard non-invasive diagnostic tool for diagnosing knee injuries and problems in general thanks to its excellent soft-tissue contrast and multiplanar abilities [4].

It is preferable to diagnostic arthroscopy as it avoids the surgical risks of arthroscopy and anaesthesia [5] and is superior to clinical assessment alone or assessment in combination with other radiology investigations. Diagnoses reported on an MRI have a significant bearing on treatment, longer term management and prognosis. MRI scans are often interpreted by two different clinician groups, most commonly a radiologist and potentially by the referring clinician, when the scan images are available. There are situations where the referring clinician may not be able to easily view the imaging, particularly in primary care settings. The aim of this study was to determine levels of agreement in a specific, well defined, clinical cohort where the MRI scans were routinely reported by 2 clinician groups. The key research question was whether there were differences between reports from two different clinician groups, consultant radiologists and consultant orthopaedic knee surgeons in reporting of patients with common soft tissue knee conditions. The secondary aims were to further quantify and qualify these discrepancies and potentially identify any patterns by analysis.

Methods

A retrospective controlled cohort study was conducted using data collected from an outpatient Orthopaedic Knee Clinic in a UK District Hospital. Patients were initially seen by a single senior specialist knee physiotherapist, who were referred for an MRI scan, based on an agreed departmental protocol. Patients' clinical data was entered onto a standard departmental knee assessment proforma, shown in appendix 1. The scans were reported both by a senior radiologist and a specialist knee surgeon. The latter worked closely with the physiotherapist, and further post-scan management was determined by the knee surgeon's review of case-notes and imaging in combination. This was a key element of the department's virtual soft-tissue knee follow-up service. In a proportion of patients, based on clinical and scan findings, an arthroscopic evaluation and debridement was suggested, such that a proportion of the cohort also went on to have an arthroscopic procedure. Other outcomes following the MRI review were exercise and activity advice only, further physiotherapy, invitation for face to face follow up or injection in clinic.

In order to provide as homogenous a group of patients as possible, patients were selected into this retrospective study with the following inclusion criteria, summarised in table 1, which also shows exclusion criteria. Included patients were: adults aged 18 - 45, with no previous knee problems affecting the knee being investigated, no previous surgery on the knee being investigated, the first presentation to a secondary care knee clinic and no underlying polyarthritic process such as an inflammatory arthropathy.

From a review of the ESP's total knee clinic workload over a 3 year period of 649 patients, the sample for this analysis comprised 85 patients. Key data was entered into a database including clinical signs and symptoms, MRI and arthroscopy status, MRI reports from both the consultant radiologist and the consultant knee surgeon. Of 85 patients details were entered into the database, of these 7 were referred straight to arthroscopy and 4 had incomplete MRI reports, hence these patients were excluded. This left 74 patients with 87 MRI scans available for analysis. For each patient, the MRI reports were collated and compared as a cohort and at an individual level. This provided a comparison between two types of clinician reviewing the scan.

Inclusion criteria	Age 18-45 years	Exclusion criteria	Age <18 or >45 years
	No prior knee problem on side in question including injury and surgery		Known prior knee pathology
	First visit to secondary care for this problem		Prior appointment for this problem
	No known polyarthropathy		Known to have arthropathy
	Seen by specialist physiotherapist		Declines to see specialist physiotherapist
	Able to have a MRI		Unable to have MRI
	MRI reported by consultant radiologist		MRI not reported by consultant radiologist
	MRI reviewed by consultant knee surgeon		MRI not reviewed by consultant knee surgeon
	Knee proforma complete		Incomplete or absent proforma

Table 1: *Inclusion and exclusion criteria.*

The number of individual diagnoses reported by each clinician group were then collated and a percentage incidence of each diagnosis, made by each reporting clinician group, was calculated. In addition, the number of diagnoses made per scan by each clinician group were also collated and compared.

The two reports were compared and were deemed to either completely agree, completely disagree or partially agree, based on the number of diagnoses documented. The percentage of agreement was then calculated in the "partially agree" group. Statistical analysis for the 2 clinician groups, based on radiographic diagnoses as outcomes was undertaken using Chi-square, with a significance level of $P < 0.05$. The null hypothesis was that there was no difference between the 2 clinician groups.

The project was part of a service evaluation of the efficacy of the specialist knee physiotherapy role and was submitted to the Institution's audit department.

Results

The cohort comprised 87 scans in 74 patients over a 15 month time period in which the total number of patients seen by the senior physiotherapist was 298 patients. The mean age was 33 years old (median 37, range 18 - 45). The male: female ratio was 1.6:1, with 62% (n = 46) of patients being male, 38% female (n = 28). Thirty-two of the MRI scans were of the left knee, 29 of the right and 13 patients had bilateral scans.

Of the 87 interpreted scans, there was a total of 152 different MRI diagnoses made, with a mean number of diagnoses made per knee of 1.7. There were 28 different pathologic abnormalities reported on the scans, excluding equivalence for medial, lateral and patella-femoral compartments. The single most common abnormality was a medial meniscal tear noted in 12%. The complete list of pathologies is shown in table 2.

Comparing the reporting of the scans by clinician group, only 14% of the reports (n = 12) completely agreed. There were 41% of cases (n = 36) with no diagnoses in common and hence completely disagreed. The remaining 39 reports (45%) had 1 or more concordant finding and therefore partially agreed (See figure 1).

Anterior cruciate ligament injury
Anterior cruciate ligament tear
Anterior synovitis
Bursitis
Baker's Cyst
Chondropathy (General)
Effusion
Fibula delayed union
Ganglion cyst
Hoffa fat pad impingement
Lateral or medial compartment chondropathy
Lateral or medial compartment osteochondral defect
Lateral or medial compartment osteoarthritis
Lateral or medial meniscus changes
Lateral or medial meniscus tear
Lateral or medial meniscal wear
Lateral or medial meniscus cyst
Lateral or medial femoral condyle tear
Medial compartment osteoarthritis
Medial synovitis
Osteoarthritis (general, not localised specifically)
Posterior cruciate ligament injury
Posterior cruciate ligament tear
Patello-femoral chondropathy
Patello-femoral maltracking
Patello femoral osteoarthritis
Patello-femoral osteochondral defect
Proximal tibio-fibular joint abnormality
Patella tendinopathy
Synovitis
Subchondral cyst
Vascular anomaly proximal tibio-fibular-joint

Table 2: *Pathologies described in the cohort (by one or both clinical groups).*

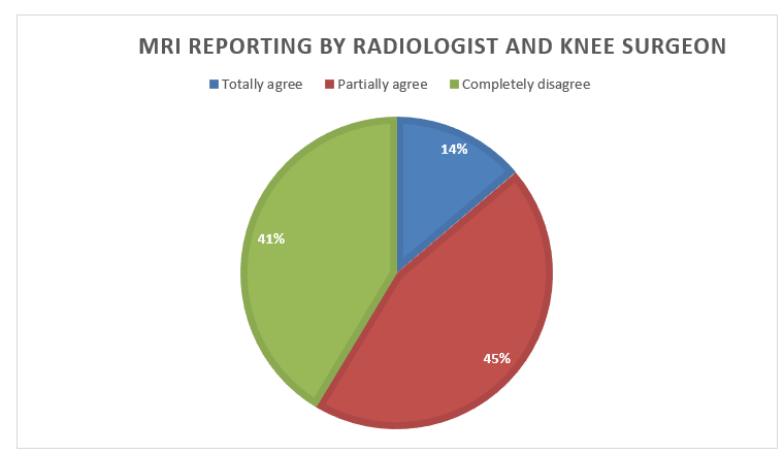

Figure 1: *MRI diagnostic agreement between clinical groups.*

Of the reports which partially agreed the majority, 79%, (n = 31) had a percentage agreement of less than 50% (See figure 2).

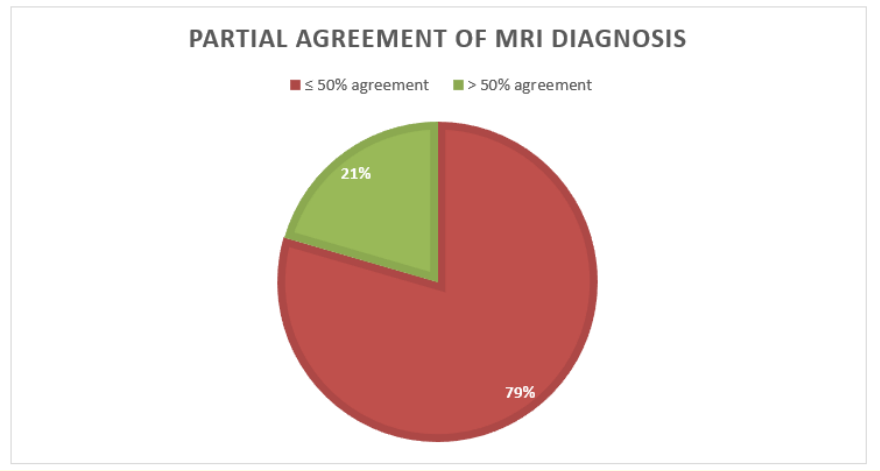

Figure 2: *Levels of agreement in MRI diagnosis.*

In addition to the discrepancies in agreement of reports we also noted a difference in the number of diagnoses each clinician group made per scan, as shown in table 3. The radiologists were much more likely to diagnose no pathologies i.e. a normal scan, which occurred in 20% (n = 17). In contrast the knee surgeons only reported 3 normal scans (3%) which is statistically significant ($p < 0.05$). In 88% (n = 15) of cases in which the radiologist reported no pathology, the knee surgeon reported synovitis, usually anterior within the knee. The knee surgeon was more likely to diagnose 1 or 2 pathologies per scan, 47% (n = 41) and 32% (n = 28) respectively, compared to the radi-

ologists 39% (n = 34) and 17% (n = 15) respectively, which was not statistically significant. The radiologists reported 3 or more diagnoses more often than the knee surgeon 24% (n = 21) compared to 17% (n = 15), which again was not statistically significance. The differences in diagnoses are shown in table 4. Overall, almost half of scans reported 2 or more abnormalities as reported by either clinician group, 49% (n = 43) by knee surgeons and 41% (n = 36) by radiologists.

Number of Diagnoses made per scan	By Radiologist	By Orthopaedic surgeon
0	17	3
1	34	41
2	15	28
3	13	12
>3	8	3
	87	87

Table 3: *Number of diagnoses per scan by each clinical group.*

Report findings	No. of diagnoses by Radiologist	No. of diagnoses by knee surgeon
Normal	17	3
Effusion	20	2
Anterior synovitis	0	39
Patellofemoral chondropathy	16	22
Medial meniscal tear	17	18
Medial chondropathy	8	17
Lateral meniscal tear	7	8
ACL rupture	6	5
Patella femoral maltracking	7	4
Lateral chondropathy	8	7
Medial Meniscal wear	5	5
Hoffman fat pad impingement	8	0
Patella femoral osteoarthritis	5	1
Proximal tibiofibular joint	3	1
Baker's cyst	7	1
Patella tendinopathy	4	6
Synovitis	1	5
MCL injury	2	2
Lateral osteoarthritis	1	0
Medial osteoarthritis	4	1
Chondropathy (general)	1	0
Bursitis	2	0
PCL injury	1	1
Subchondral cysts	3	0
Lateral meniscal cyst	1	1
ACL injury	0	1
	154	150

Table 4: *Different diagnoses and number of different diagnoses by the clinical groups.*

The most common findings reported by the two clinician groups are also different, as seen in table 4. For the consultant knee surgeon, the most common diagnosis was anterior synovitis, reported in 45% (n = 39), whilst the percentage reporting of anterior synovitis for the radiologist was 0%, which was statistically significant ($p < 0.05$). The main finding reported by the radiologist was effusion 23% (n = 20), the percentage incidence of effusion reported by the knee surgeon was 2% (n = 2), which was is statistically significant ($p < 0.05$). The radiologist reported a greater number of Hoffa fat pad impingement's 9% compared to 0% and Baker's cysts 8% compared to 1% whereas the knee surgeon had a much higher incidence of reporting medial chondropathy 20% compared to 9%.

There was stronger agreement in the reporting of medial and lateral meniscal tears lateral chondropathy and ACL ruptures was seen between the two clinician groups. The diagnosis showing greatest agreement were medial meniscal tears and patella-femoral chondropathy, as shown in figure 3.

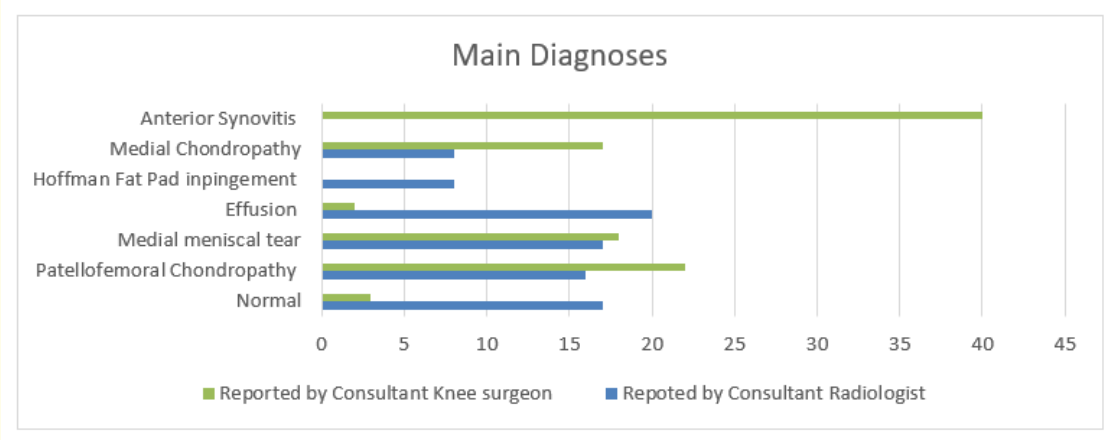

Figure 3: *Main diagnosis by each clinical group.*

Discussion

There are several studies that have shown that MRI scans have a high degree of sensitivity, specificity and accuracy when detecting intra-articular pathologies of the knee [6-9]. The majority of these studies compare MRIs and arthroscopic reports to determine their hypotheses yet there is little research looking into the discrepancies between inter-observer findings of such reports, particularly when the observers come from different clinician groups. A study carried out in 2017 analysed the diagnostic accuracy of MRI reporting of pathological knees by radiologists and surgeons [9]. Their hypothesis, that there is a resemblance between radiologists and surgeons in reading pathological knee MRIs was only confirmed for ACL injuries, although menisci pathology detection came close [10] similar findings to our results.

The strong emphasis of most studies on the MRI radiologic findings within the knee joint centre on meniscal, cruciate ligament and chondral damage in that order. Within the orthopaedic and sports literature, there is a similar emphasis on these types of pathology, with the focus being more centred on treatment or management of meniscal or cruciate problems. There are far fewer papers on other pathologic processes within the knee joint such as synovitic lesions or abnormalities, Hoffa's fat pad impingement or pathologies affecting tendons. A brief review of the number of papers in PROQUEST Premium with key terms "radiology, MRI or surgery, then (MRI OR Radiology)

AND the differing pathologies of anterior cruciate or meniscus or chondral or synovitis or Hoffa's fat pad or Plica syndrome" over the past decade is shown in table 5. (The search was limited to humans and peer reviewed). We hypothesise that the differences in reporting may in part stem from the availability heuristic in conjunction with confirmation bias [10], whereby recall of relatively well known entities is actively looked for and other entities relatively downplayed or ignored [11]. For surgeons, the presence and significance of the anterior synovitis often extending into the intercondylar notch area and commonly seen antero-medial plicae are likely to be more actively sought for on scans as this is one of the first things visualised at arthroscopy. The precise role for some of these patho-anatomic areas in causing knee pain remains controversial, but their presence should be documented if seen and ideally quantified in some way, in order to follow

Search Term	No. of citations 'MRI'	No. of citations 'Radiology'	No. of citations 'surgery'	No. of citations 'MRI' OR 'Radiology AND 'surgery'
Cruciate ligament	730	318	1931	22338
Meniscus	519	248	1003	22164
Chondral	365	182	593	22057
Synovitis	519	293	583	22139
Hoffa's fat pad	15	9	18	21860
Plica syndrome	21	15	33	21863

Table 5: *The literature since November 2011 about knee pathology and imaging.*

the rationale of undertaking and reporting the MRI scan, namely to document both abnormal and normal structures.

The frequency of other non-meniscal and non-cruciate pathology, either in the presence or absence of meniscal pathology demonstrated by the study should also lead the wider healthcare community dealing with sports injuries to consider that we may not fully understand mechanisms of symptomatology in these types of knee conditions. There are some confounding institution-specific factors that need to be considered, such as acute cruciate injuries and more severe soft tissue injuries and acute locked knees having their own treatment pathways from the Emergency Department. We also note the use of terms such as chondropathy and osteoarthritis may be interchangeable, and would suggest better clarity in the use of such terms. The additional overall finding is the lack of definition as to the size and extent of the various lesions described, which should be noted by all practitioners reviewing and reporting on imaging.

Limitations of the Study

The orthopaedic surgeon had greater detail of the patients' clinical information at the time of interpreting the scan which could additionally assist in establishing radiologic diagnoses and could act as an advantage for them. However this makes the study more clinically relevant as the practice of an orthopaedic surgeon relies on a combined analysis of both patient history and examination with further imaging results.

The patient numbers are relatively low, making more detailed analysis more difficult, but are in keeping with other similar studies in the current literature. There would certainly be scope for a larger scale set of studies, particularly focussing on correlation between severity of patient symptoms with patho-anatomic abnormalities.

There is no follow-up data available for these patients, therefore the effects of non-diagnosis or differing diagnoses cannot be determined and would be the subject of further research.

Conclusion

This study has found discrepancies in the reports of the same MRI interpreted by two clinician groups, beyond what should be expected. This has potentially significant clinical impact as non-reporting clinicians are reliant on reports to describe diagnoses to patients and then planning treatment and management. This study provides information for further dialogue between reporting radiologists and surgeons, including using common terminologies and flagging reporting discrepancies. It demonstrates that more research and on-going audits should be done to determine the extent of and reasons for these discrepancies, as well as impacts on patients.

Appendix 1

Knee Assessment Tool Page 1 of 2

ASSESSMENT DATE:

AGE:

SEX: MALE / FEMALE

OCCUPATION:

MAJOR HEALTH PROBLEMS:

HISTORY OF KNEE PAIN: LEFT / RIGHT / BOTH (Which is worst)

DATE OF ONSET:

ONSET: PROGRESSIVE / SUDDEN / NO TRAUMA / TRAUMA

If TRAUMA please specify:

MAIN SYMPTOM(S) specify and/or order:

PAIN / VAS / MECHANICAL

PAIN LOCATION: front / inner side / outer side / back / all over

AGGRAVATING: any activity / sports / stairs up/down / start up

RELIEVING: NONE / rest / massage / elevation

NIGHT: CONSTANT / occasional / none

MECHANICAL: LOCKING YES / NO if YES, specify:

GIVING WAY YES / NO if YES, specify:

ACTUAL FEELING

FEELS STABLE YES / NO if NO, specify:

OTHER: SWELLING CLICKING GRATING

EFFECTS ON FUNCTION:

WORK: normal / modified / time off

SPORTS: normal / reduced / stopped

Specify sport(s) & level:

HOBBIES: normal / reduced / stopped

Specify activity:

SUBJECTIVE % LEVEL OF FUNCTION: _____%

QUALITY OF LIFE ↓: normal / mild / moderate / severe

PREVIOUS TREATMENTS, INVESTIGATIONS: NO / YES

If YES, specify with dates:

MEDICATION:

Knee Assessment Tool March 2005. Updated Oct 2011

Knee Assessment Tool Page 2 of 2

OTHER KNEE PROBLEMS: NO / YES

OTHER JOINT PROBLEMS: NO / YES

OTHER MEDICAL PROBLEMS: NO / YES

OTHER ASSOCIATED SYMPTOMS: NO / YES

EXAMINATION FINDINGS:

GAIT: antalgic / short leg / trendelenburg HIP

LEG ALIGNMENT: NORMAL / ABNORMAL, specify ANKLE

LEG LENGTH DISCREPANCY: NO / YES, specify LSP

SWELLING: NO / YES, specify NEURO

EFFUSION: NO / YES, specify

FIXED FLEXION: NO / YES, specify

EXTENSOR LAG: NO / YES, specify

RANGE OF MOTION: NORMAL (same as other side) / ↓

Specify range:

TENDERNESS: NO / YES, specify

Patellar (Clarke's sign)

Medial Joint Line - specify where

Lateral Joint Line - specify where

Patellar Tendon

Femur epicondyles

Tibial condyles

Other, specify

McMURRAYS SIGN: NEGATIVE / POSITIVE

If POSITIVE, which side:

COLLATERALS: STABLE / UNSTABLE

If UNSTABLE, specify:

CRUCIATE: Lachmann NORMAL / LAX I / II / III

APD NORMAL / LAX I / II / III

Pivot apprehension NEGATIVE / POSITIVE

If POSITIVE, how much:

PATELLO-FEMORAL: J-sign

Squinting patellae

Apprehension

Subluxable / dislocatable

Diagnosis (Δ) or differential diagnosis (ΔΔ):

Management Plan:

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