Original Article

Use of MRI by radiologists and orthopaedic surgeons to detect intra-articular injuries of the knee

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A B S T R A C T

Objective: Magnetic resonance imaging (MRI) is paramount in the assessment of knee pathology, particularly when planning for a surgical procedure. This study compared the diagnostic accuracy in MRI reading of pathological knees by radiologists and orthopaedic surgeons.

Materials and methods: Cross-sectional study comprising 80 randomly selected patients previously submitted to arthroscopic surgery after clinical examination and MRI. A diagnosis by MRI interpretation was requested from the two teams, one of radiologists and another of orthopaedic surgeons. The conclusions of each team were later compared. Statistical significance was considered for \( p < 0.05 \).

Results: The radiologists’ findings achieved statistical significance regarding osteochondral injuries, ACL, and medial meniscus \( (p < 0.05) \), and orthopaedic surgeons regarding ACL injuries and menisci \( (p < 0.05) \). ACL injuries demonstrated a statistically significant association between teams \( (p < 0.001) \).

Conclusions: MRI appears to offer reliable readings of ACL injuries, regardless the specialty of the observer. The lateral compartment is scarcely well read.

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Uso de ressonância magnética por radiologistas e cirurgiões ortopédicos para detectar lesões intra-articulares do joelho

R E S U M O

Objetivo: A ressonância magnética (RM) é primordial na avaliação de patologias do joelho, particularmente no planejamento de um procedimento cirúrgico. Este estudo comparou a precisão diagnóstica na leitura dos resultados da RM de joelhos patológicos por radiologistas e cirurgiões ortopédicos.

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Introduction

Magnetic resonance imaging (MRI) of the pathological knee, although a popular examination, has not yet completely proved to be worthy against a properly performed physical examination. Studies vary widely regarding its accuracy. In a trial with 100 patients, MRI interpretation achieved accuracy rates of 76% and 69% for both medial and lateral menisci injuries, when compared with rates of 82% and 76%, respectively, for physical examination alone. The opposite was observed in another study of 26 patients in which the MRI accuracy rate was of 84.1% and the physical examination accuracy rate of 63.3%. It is also known that MRI interpretation accuracy may decrease in the existence of multiple injuries, particularly when the anterior cruciate ligament (ACL) is torn. All this variation may be reasoned by different skills in observation of the MRI, as well as its quality. Our objective was to compare the diagnostic accuracy in MRI reading of the pathological knee for both radiologists and orthopaedic surgeons.

Materials and methods

We performed a cross-sectional study by randomly selecting 80 patients from all of those who for any reason were submitted to knee arthroscopy in our institution for any primary procedure, in a time frame of three years (2013; 2015), after clinical examination and MRI observation. Simple randomization followed sequential selection within a patients’ list using intervals randomly given by dice throwing (ranging from 1 to 6), until a total of 80 individuals was achieved. Data collected from these patients came from both their imaging resources as well as reports performed at the time of surgery. The latter follows, for quite some time, a systematic approach, naming injuries in the three compartments on about osteochondral injuries (specifying its grade according to Outerbridge’s classification and the surface that was affected), meniscal injuries (regarding its type and extension, when applicable), cruciate ligament injuries (regarding its type and extension, either partial or complete) as well as the presence or absence of synovitis. Two teams of 3 elements each, one composed of radiologists and the other composed of orthopaedic surgeons, were gathered to interpret the 1.5T MRIs previously gathered. None of the teams was particularly keen on knee analysis, although radiologists had some experience with musculoskeletal imaging. We therefore considered the elements as equal in regards of advantage in reading images of the knee. The patient’s clinical information was not given at any moment, in order to eliminate diagnosis bias coming from suggestion. Diagnostic conclusions for any of the aforementioned topics were selected by a matter of majority within each team. The surgical reports were for exclusive observation of an independent individual, and were never given to neither the radiologists nor to the orthopaedic surgeons.

Comparison between what was observed by any of the teams and the respective surgical findings was made using Chi-squared tests for all the selected topics. The similarity between teams’ findings was sought running Cochran–Mantel–Haenszel’s tests. Positive and negative predictive values, sensitivity, specificity and accuracy were calculated whenever possible. Statistical significance was considered whenever a p-value under 0.05 was found. Data analysis was performed using IBM SPSS Statistics version 20.0.

Results

The selected patients had a mean age at the time of the surgery of 41.57 [confidence interval at 95%: 38.77; 44.36] years old, with women representing 40% (32) of cases. The time-lapse between MRI and knee arthroscopy was 6.34 [confidence interval at 95%: 5.22; 7.47] months. The left side was affected in 48 (60.0%) of cases.

The radiologists achieved statistically significant readings on chondral surface lesions of the lateral compartment (condyle: p < 0.001; plateau: p = 0.044), ACL (p < 0.001) and medial meniscus (p < 0.001). The diagnosis accuracy followed these trends, particularly for the ACL (74.3%) and the medial meniscus (75.3%).

The orthopaedic surgeons overdiagnosed lesions to any chondral surface, but were quite successful in detecting injuries to the ACL (p = 0.003) and menisci (medial: p < 0.001;
lateral: \( p = 0.004 \). For the aforementioned, diagnosis accuracy varied from 68.0% for the lateral meniscus and 74.2% for the medial meniscus. Success in discriminating menisci injuries was also higher in orthopaedic surgeons (medial: \( p = 0.003 \), lateral: \( p = 0.014 \)).

Discriminated data may be observed in Tables 1 and 2.

Despite similarities in medial meniscus readings, significant findings between specialty teams were only found for ACL injuries, according to Cochran–Mantel–Haenszel’s test \( (p < 0.001) \). A trend towards statistically significant findings was also discovered for both medial and lateral menisci \( (p = 0.089 \) and \( p = 0.084 \), respectively). Discriminated data may be found in Table 3.

### Discussion

Formerly mandatory whenever a suspected intraarticular injury suggested arthroscopic treatment, MRI has been criticized on the basis of its non-constant readings.\(^5\) On the other hand, most of the studies seeking for a correlation between MRIs and arthroscopic reports, do not refer what is the skill or specialty of the MRIs observer.\(^6,7\) It seems logical that while radiologists are better trained in imaging interpretation, they lack proper perception on how knee injuries look like in vivo. This is known to eventually interfere with the surgeon’s decision to change the treatment plan.\(^8,9\)

The several hypotheses being tested in this study, that is, if there was resemblance between radiologists and surgeons in reading pathological knee MRIs, was only confirmed for ACL injuries, although menisci injuries detection also came close to statistical significance. The same did not occur on chondral surface injuries, in which orthopaedic surgeons constantly over-estimated its frequency. As a sum, however, none offered more than modest sensitivity and specificity rates in their readings for all the categories. This does not differ from what has been published so far, with extreme variations particularly regarding sensitivity.\(^10–12\) What was previously thought about the lower value of physical examination against MRI seems not to be confirmed in recent trials in which the former has proved to be equal, and sometimes superior, to the latter.\(^2,11\) The extent of chondral surface injuries also seems to be misdiagnosed by MRI.\(^10,13\)

Poor readings of the lateral femorotibial compartment are not uncommon, with lateral meniscus injury detection presenting a sensitivity range as wide as 44.0–91.0% and a specificity range of 70.0–100.0%, independently of the pattern of injury or meniscal variances.\(^4,6,11,14–19\) Our readings fall within these limits, with better performance from orthopaedic surgeons in sensitivity (79.2%) and from radiologists to the specificity (75.0%). As the sample was composed of patients suffering from a large spectrum of pathologies, it did not exclude meniscal injuries in the presence of an ACL rupture, for example, which is known to decrease the accuracy of diagnosis for the first.\(^1,20\) The chondral surface, even if lateral, was much better accessed by the radiologists when considering sensitivity alone, at the price of an extremely low sensitivity.

This may be related to reasonably poor cartilage visualization on Tesla 1.5 MRIs, in comparison to more sophisticated image capturing devices, although only the lateral compartment seems to take an advantage on diagnosis using Tesla 3.0 MRIs, and not in all trials.\(^4,21–23\) Another option to increase its accuracy would be to perform a magnetic resonance arthrography, although not without increased risks and costs.\(^24\)

Lesions referred to the anterior cruciate ligament are usually correctly diagnosed. Once again orthopaedic surgeons performed better in regards of sensitivity, with 85.7%, and radiologists achieved a better specificity at 72.3%. These results correspond to the lower end of what has been published.\(^14,17,22,25,26\) One should consider that neither one team nor the other had previous access to each patient's clinical information. Several studies have already addressed the importance of physical examination in increasing the likelihood for a diagnosis, or on diagnosis establishment per
Interestingly, knee flexion at 30° or 55° also seems to add diagnostic accuracy for ACL rupture in the MRI.16,18,27–29

This study presents some limitations, chief among which is the chosen sample of patients. As all of them were submitted to arthroscopic surgery, a radiological diagnosis had already to exist. Consequently, both radiologists and orthopaedic surgeons had the urge to point out positive findings that may have compromised their evaluation. It may be a possible explanation for the overestimation of chondral surface injuries in the orthopaedic group, for example.

Secondly, although, by option, no clinical information was given, we admit that it would most likely positively aid in establishing the correct diagnosis. This is particularly true for the orthopaedic surgeons, as their practice relies on a conjoint analysis of both patient and imaging observation. Therefore, our results may underestimate the reality in our setting. A way to overcome this issue would be to perform a prospective randomize trial, in which both teams would have access to clinical information and the chance to perform physical examination before surgery. This would later be performed by an independent group, in a way to eliminate description bias.

Thirdly, neither the radiologists were firmly confined to musculoskeletal observation in their duty, nor the orthopaedic surgeons were fully dedicated to knee’s arthroscopy. Better results would eventually arise in the presence of higher specialization. By choosing these teams’ composition, on the other hand, we increased this study’s generalization and reproducibility.

This study presents some strengths as well, as it clearly distinguishes what to expect when observations are performed by a radiologist or an orthopaedic surgeon, which in the end is its purpose. Data was also randomly selected, not favouring any kind of condition (although undoubtedly meniscal tears are far more common), thus reproducing reality as much as possible. In its essence, and due to our standardized approach in reporting knee arthroscopy, it is hard for any given injury to be missed, although it is still possible.

### Conclusions

Summarizing, in our study the radiologists seem to perform better in detecting osteochondral injuries while the orthopaedic surgeons take advantage in menisci tears. Torn ACLs are similarly read by both specialties.
Conflicts of interest

The authors declare no conflicts of interest.

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