

## The role of preoperative MRI in knee arthroscopy: a retrospective analysis of 2,000 patients

E. Liodakis · S. Hankemeier · M. Jagodzinski ·  
R. Meller · C. Krettek · J. Brand

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**Abstract** The aim of this study was to investigate, to what extent routine preoperative MRI scans could set the indications for knee arthroscopies and reduce the number of diagnostic arthroscopies. For this retrospective cohort study, 1,000 patients who had knee arthroscopies documented in 1994/1995 were compared with 1,000 patients that were treated in 2004/2005. The preoperative diagnoses that gave indications for knee arthroscopy were compared with the intraoperative findings. The congruence of preoperative diagnosis with the intraoperative findings was evaluated comparing both study populations. The number of patients who were referred to orthopaedic trauma surgeons with MRI increased from 24% to 56%. A high congruence of preoperative diagnosis and intraoperative findings was found in 49% in 1994/1995 and 55% in 2004/2005. However, regarding the most important outcome parameter, the number of diagnostic arthroscopies, no improvement was found (3% in both periods). The presented data suggests that MRI scans are not routinely necessary as an indication for knee arthroscopy, as clinical examination and plain radiograph are sufficient. However, MRI scans do allow a more detailed characterization of the expected findings and can therefore be helpful in therapy planning.

**Keywords** Knee joint · Arthroscopy · MRI · Indication · Diagnostic

### Introduction

A total of 3,00,000 knee arthroscopies are performed in Germany every year. The main purpose of diagnostic imaging in surgery is to aid in the planning of procedures and confirming operative indications. After personal communication with the scientific institute of the AOK (the largest statutory health insurance company in Germany), we discovered that in the past 5 years, the rate of pure diagnostic arthroscopies in Germany has remained at the constant rate of 5%, despite an increase in the number of preoperative MRI. The above information was confirmed by the Federal Union of Health Insurance Fund Physicians (KBV).

According to the Federal Office for Radiation Protection, 3.7 million MRI scans are performed annually in Germany. The number of knee MRI scans has been doubled in the last 10 years at an increasing rate. The average cost of this procedure is 150–200 Euro per scan in Germany. Furthermore, the waiting period can be as long as 5–15 days. This delay is a major factor for lengthening the treatment period.

Newer MRI units provide excellent quality knee images which can be considered the gold standard for evaluating the knee. Crawford et al. compared 7,000 MRI scans with the following arthroscopic findings [1]. This study showed a sensitivity for medial meniscal injuries at 91% and a specificity of 81%. The specificity for lateral meniscal lesions was higher at 93%, but the sensitivity of 76% was significantly lower. Anterior cruciate ligament injuries recognition had a sensitivity of 87% and a specificity of

E. Liodakis (✉) · S. Hankemeier · M. Jagodzinski ·  
R. Meller · C. Krettek  
Division of Knee Surgery, Department of Trauma Surgery,  
Medical School Hannover, Carl-Neuberg-Str. 1,  
30627 Hannover, Germany  
e-mail: manoliodakis@yahoo.gr

J. Brand  
Ambulatory Surgery Center 'Dr. Brand/Dyck/Schulz',  
Celler Str. 24, 29525 Uelzen, Germany

95%. These results correlated with the findings of other authors, who reported sensitivities up to 98% and specificities of 96% for medial meniscal lesions with lower sensitivities for lateral meniscus lesions, at 88%, and a specificity of 98% [12, 17, 22]. For bucket-handle tears the sensitivity was clearly lower compared to the specificity [2, 19]. With such impressive results we would expect magnetic resonance imaging to be established as a mandatory procedure prior to knee arthroscopy. However, many experienced knee surgeons doubt the role of MRI in indicating the need for surgery [7–9].

The purpose of this study was to examine the value of MRI as a standard preoperative examination and to give answers to the following questions: Has the improvement of the quality of MRI images and the increasing number of MRI studies lowered the rate of purely diagnostic arthroscopies? Are there significant differences in the clinical outcome of patients who have undergone a preoperative MRI scan?

Our hypothesis is that MRI cannot reduce the number of purely diagnostic arthroscopies and is not mandatory in preoperative assessment. We believe that the diagnosis is often evident from the history and the physical examination and that the indication for a knee arthroscopy can be set in these cases without the use of expensive imaging studies.

## Patients and methods

We reviewed data of 2,000 patients, who underwent knee arthroscopy in our institution between September 1994 and September 1995 and then again between September 2004 and September 2005. We studied unselected the first 1,000 arthroscopies of the year 1994/1995 and 2004/2005. Unselected means, that the first 1,000 patients who underwent an arthroscopy in these two periods were blind inclusions in our study. The age, gender, or diagnosis did not play any role in the selection of the patients. No patients were excluded. Since 1993 every patient's medical record including past and present illnesses, radiological examinations, treatments, and outcomes have been documented electronically in the hospital computer system. This system provides valid information for retrospective analysis.

All arthroscopies were performed by five experienced fellowship trained orthopaedic surgeons. Three of them operated patients operated on patients from both groups (1994/1995 and 2004/2005). Patient's who had MRI scans with no significant findings and therefore did not have arthroscopies were not part of this study.

We have studied the following groups of patients:

**Group A (1994/1995):** Patients with preoperative MRI ( $n = 237$ ). More than 90% of the scans were done in five different radiological institutions.

**Group B (1994/1995):** Patients without preoperative MRI ( $n = 763$ ).

**Group C (1994/1995):** All the patients from the period 1994/1995 ( $n = 1,000$ ). Of them, 623 were male patients with a median age of 39 years (range 18–62 years). The rest 377 female patients had a median age of 44 years (range 17–67 years). 24% of the patients had preoperative MRI.

**Group A1 (2004/2005):** Patients with preoperative MRI ( $n = 565$ ). More than 90% of the scans were conducted in six different radiological institutions.

**Group B1 (2004/2005):** Patients without preoperative MRI ( $n = 435$ ).

**Group C1 (2004/2005):** All the patients for the period 2004/2005 ( $n = 1,000$ ). Of them, 598 were male patients with a mean age of 39 years (range 19–69 years). The rest 402 female patients had a mean age of 43 years (range 16–67 years). Fifty-six percent of the patients had preoperative MRI.

We analyzed the frequency of the following diagnoses:

- Isolated meniscal lesions (grade I and II)
- Chondromalacia (CM), grade I and II
- Isolated chondromalacia (CM), grade III and IV
- Meniscal lesion and chondromalacia (CM) greater than grade II
- Cruciate ligament lesions
- Isolated patellofemoral lesions
- Other diagnoses (osteochondral fracture, osteochondritis dissecans, synovitis)

We examined the state of agreement (congruence) between suspected diagnoses and intraoperative findings and compared the preoperative documented MRI findings with the arthroscopical findings.

We created the following groups according to the quality of the indications:

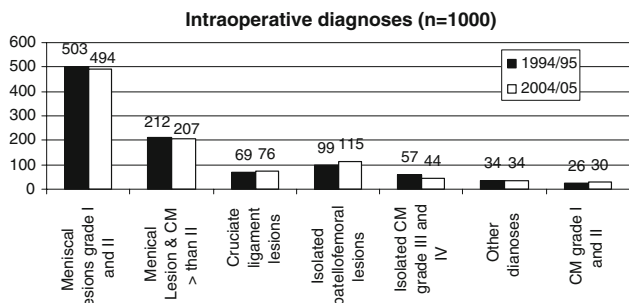
- G1: Complete congruence between the preoperative and the intraoperative diagnosis.
- G2: Partial congruence. At least one relevant preoperative MRI finding is intraoperatively verified. Reasonable indication for the operation. For example in a preoperative MRI scan of a patient showing an ACL tear, a lateral meniscal lesion is detected additionally intraoperatively.
- G3: Incongruence. The preoperative diagnosis is not verified, but the indication for the operation is correct.
- GF: Incorrect indication for the arthroscopy. Normal knee or knee with grade I–II chondromalacia.

The Chi-square test was used to analyze the statistical significance.  $P < 0.05$  was considered to be statistically significant.

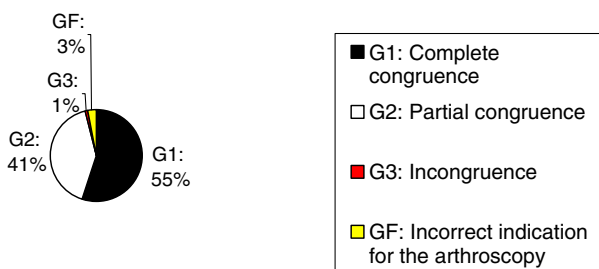
**Results**

Figure 1 shows the distribution of intraoperative diagnoses into the different groups. Meniscal lesions, isolated or in combination with cartilage lesions constitute the majority of the diseases. A preoperative MRI scan in Group C (1994/1995) was present in 237 out of 1,000 patients. The decision to do a MRI scan preoperatively was made in 38% of these patients by our unit. The rest of the MRI scans were available by the time the patients appeared in clinic. In 2004/2005 (Group C1), a higher number of patients had an MRI scan. Fifty-seven percent of these scans were done with our unit's recommendation. Surprisingly, a remarkably high number of patients who came to our clinic with an MRI scan (43%) had obtained no plain radiographs prior to their appointment!

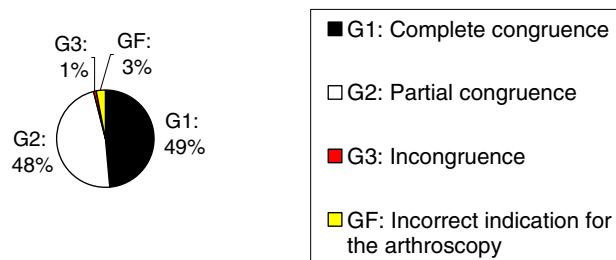
When we compared groups C (1994/1995) and C1 (2004/2005) the most startling conclusion we found was the huge increase in MRI scans today: 56% compared to 24% ( $P < 0.05$ ) done 10 years ago. However, this did not lead to a reduction of false indicated arthroscopies. It contributed to an increase of 6% in the congruence between the preoperatively suspected diagnosis ( $P < 0.05$ ) (Figs. 2, 3). The same conclusion was made after comparing subgroups with (Figs. 4, 5) and without preoperative MRI scans (Figs. 6, 7).



**Fig. 1** Rate of intraoperative diagnoses

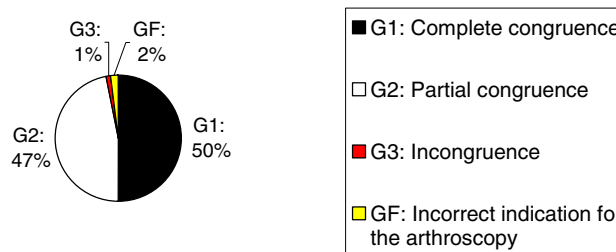


**Fig. 2** Comparison of MRI scans and arthroscopic findings (2004/2005)



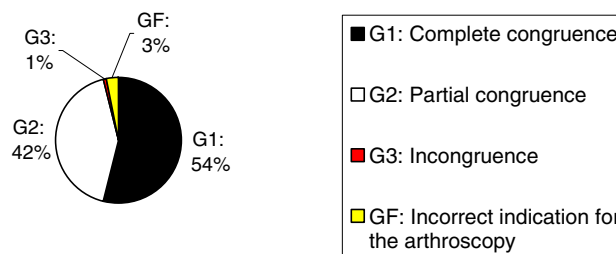
**Fig. 3** Comparison of MRI scans and arthroscopic findings (1994/1995)

**Group A (1994/05, n=237) - with MRI scan**



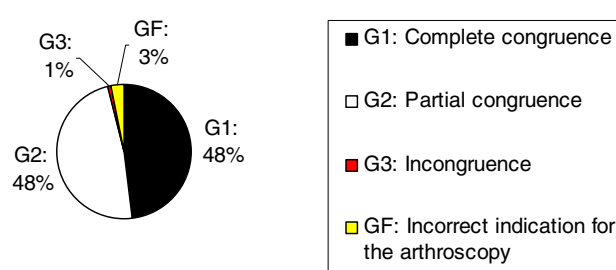
**Fig. 4** Level of congruence in group A

**Group A1 (2004/05, n=565) - with MRI scan**

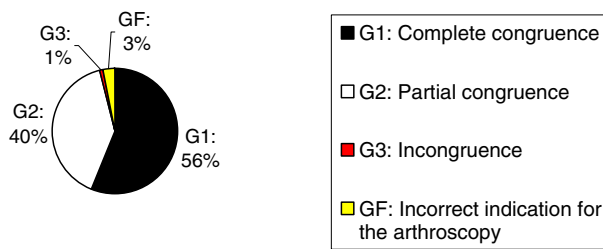


**Fig. 5** Level of congruence in group A1

**Group B (1994/05, n=763) - without MRI scan**



**Fig. 6** Level of congruence in group B

**Group B1 (2004/05, n=234) - without MRI scan****Fig. 7** Level of congruence in group B1

The improvement in complete intraoperative congruence in non MR-scanned patients between 1994/1995 (48%) and 2004/2005 (56%) can be explained through the high rate of MRIs made in the year 2004/2005. Patients operated without MRI had evident diagnoses such as ‘internal meniscus lesions’. We do not hold the improvement of congruence in patients with MRI scans as statistically significant.

Coincidentally confirmed operative indications (G3), despite the wrong preoperative diagnosis, are very seldom compared to the pure diagnostic arthroscopies (GF) made with or without an MRI scan (Figs. 2, 3).

**Discussion**

The principal finding of this study was that routine preoperative MRI scans have no place in modern knee surgery. Despite the high sensitivity and specificity of this examination, especially for meniscal lesions, no further reduction of the purely diagnostic arthroscopies can be achieved with preoperative MRI scans. Only the congruence between pre- and intraoperative diagnosis can be improved.

The proportion of male and female patients and their ages were comparable in both groups and the distribution of intraoperative findings was constant. The number of preoperative MRI scans in our patients has more than doubled in the past 10 years. One explanation for that is that many of them were arranged by inexperienced surgeons, and not by the operating surgeons themselves. Furthermore, the majority of MRI examinations are arranged by general practitioners before the first appointment with a specialist.

The main limitation of our study is the fact that the MRI examinations were conducted in more than 10 different radiological institutions using different MRI machines. In addition, rapid evolution in technology means the quality of the recent scans is significant better.

Makdissi et al. [13] studied professional athletes, who avoid unnecessary operations under any circumstances. Eight athletes with persistent knee complaints underwent knee arthroscopy despite negative MRI scans.

Intraoperatively a bucket-handle tear of the lateral meniscus was diagnosed in each athlete. This study showed that a normal MRI study does not necessarily exclude lesions requiring intervention. As already discussed, the specificity and sensitivity of the MRI scan for lateral meniscal lesions is lower than that compared to other lesions of the knee [1, 17]. Despite this study’s weaknesses it highlighted dilemmas we face everyday. According to van Dyck [20], such mistakes are unavoidable because of the poor representation of the lateral meniscus in MRI scans.

Kocabey et al. [8] showed that MRI scans studies are particularly useful in differentiating suspected diagnoses. However, a MRI scan cannot be used solely as an indication for an operative procedure.

Cartilage defects on MRI scans are frequently overestimated [5]. In some cases, MRI scans detect cartilage defects even when the articular cartilage is intact [4, 7, 16, 18]. On the other hand, Duc et al. believe that cartilage defects are underestimated by MRI. This is more pronounced in grade I and II cartilage lesions [3].

In some injuries, e.g., posterior cruciate ligament tears or bone bruises, MRI scans are the diagnostic study of choice. The probability of diagnosing these injuries through an MRI scan is higher than with arthroscopy [15]. MRI scans are especially useful in differentiating true mechanical blockages from pseudoblockages caused by pain [6, 14]. Winters et al. showed a very high sensitivity of MRI scans for meniscal, cruciate, and collateral ligament injuries. These findings are verified by many other authors [7, 10, 11, 21].

Normally, studies done by radiologists use only one MRI machine and one radiologist, thus making the results more reproducible [2, 12]. Runkel showed in a prospective analysis that the probability of pure diagnostic arthroscopies could be reduced if the MRI was reported by an experienced radiologist [17]. Only the prospectivity of the study affects the quality of the examination in a positive manner. The above result is contradicted by studies of many surgeons. Kocabey found in a prospective analysis no significant differences between the MRI scans and the physical examination from an experienced surgeon before arthroscopy in diagnosing meniscal and cruciate ligament injuries [8]. Lützner also found no statistically significant differences between physical examination and MRI scans, indicating that physical examinations can predict preoperatively, without MRI scans, the diagnoses found at operation with high accuracy [11].

**Conclusions**

We found that the performance of routine MRI before arthroscopy is not necessary. Patients with chronic degenerative knee lesions should not undergo a MRI scan before

arthroscopy, since the indication for arthroscopy of a degenerative knee can be made by history, physical examination, and plain radiographs. This examination can be used to confirm the suspected injury and allows for preoperative planning in complex knee trauma.

Finally, we showed that the increase of the rate of preoperative MRI scans does not decrease the probability of a purely diagnostic arthroscopy.

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