

Arthroscopic verification of objectivity of the orthopaedic examination and magnetic resonance imaging in intra-articular knee injury. Retrospective study

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Abstract

Introduction: Arthroscopy of the knee joint is regarded as the most objective diagnostic method in intra-articular knee joint lesions.

Aim: The purpose of this study was to assess the objectivity and diagnostic value of orthopaedic examination (OE) and magnetic resonance imaging (MRI) in reference to the arthroscopic result.

Material and methods: In a group of 113 patients treated by arthroscopic surgery for post-traumatic knee pathology between 2008 and 2010 in our department, accuracy of clinical and MRI findings that preceded surgery were studied retrospectively using a statistical method. Sensitivity, specificity, accuracy and predictive negative and positive values were the subject of analysis.

Results: In the presented trial, sensitivity values of the orthopaedic examination for injuries of the anterior cruciate ligament (ACL), meniscus medialis (MM), meniscus lateralis (ML) and chondral injuries (ChI) were 86%, 65%, 38% and 51%, respectively. Specificity values were 90%, 65%, 100% and 100%, respectively. The MR sensitivity and specificity values were 80%, 88%, 44% and 32%, and 86%, 64%, 93% and 97%, respectively.

Conclusions: Assessment of intra-articular knee joint lesions is a difficult diagnostic problem. In making a decision about arthroscopy of the knee joint, an appropriate sequence of examinations should be carried out: OE, MRI and arthroscopy. The improvement in the effectiveness of the orthopaedic examination and MRI can limit the too high frequency of diagnostic arthroscopies, which generates the risk of operation treatment and costs.

Key words: arthroscopy, orthopaedic examination, magnetic resonance imaging, knee injury.

Introduction

Magnetic resonance imaging (MRI) of the knee joint is regarded as the gold standard in the diagnostics of knee injuries, and since the 1980s it has become more and more popular [1]. The MRI is regarded as an alternative examination with respect to diagnostic arthroscopy. In clinical practice MRI is also regarded as a more credible examination than orthopaedic examination (OE) and it very often pre-

cedes arthroscopy of the knee joint. A treatment dilemma occurs when clinical examination and MRI contradict each other. But is it justified when the orthopaedic examination confirms a knee lesion requiring arthroscopy? And if the MRI diagnosis turns out to be false, will we withdraw the patient from the operation? The MRI is expensive and still not widely available, which can also delay definitive treatment. Still there is no unanimous opinion concerning the credibility of diagnosis based on

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MRI compared with the ultimate and credible arthroscopy verification.

Aim

The purpose of this study was to assess the objectivity and diagnostic value of OE and MRI in reference to the arthroscopic result.

Material and methods

A retrospective trial was conducted including patients with suspected knee lesions and qualified for arthroscopy based on OE or MRI. Between 2008 and 2010 arthroscopy was carried out in 208 patients, with 158 of them having MRI examination done. From this group, 113 met inclusion criteria as follows: had knee injury, were diagnosed with OE and MRI and were treated with arthroscopy. Patients with articular surface fractures, presence of loose bodies and arthrosis of the knee joint were excluded from the study. Patients who had knee injury after MRI assessment were also excluded. The X-ray examination was to detect bone fractures and it was not assessed in further analysis. All patients before arthroscopy of the knee joint were examined by experienced orthopaedists. The orthopaedic examination entailed the assessment of damaged intra-articulate structures of the knee: crucial ligaments (anterior cruciate ligament – ACL, posterior cruciate ligament – PCL), meniscuses (medialis – MM, lateralis – ML) and chondral defects of the joint surface. Orthopaedic surgeons used the same protocol of the examination including clinical tests of the assessment of individual structures of the knee: anterior and posterior drawer test, Lachman, pivot-shift,

McMurey’s and Apley tests [2]. The MRI of the knee joint was done in various centres not later than 1 month before arthroscopy and reported by radiologists who knew the preliminary diagnosis. All arthroscopies were done as part of the hospitalization by 2 experienced surgeons. Arthroscopy was performed from at least two ports for accurate visualisation of articular structures and the possibility of surgical intervention. Joint cartilage was assessed according to the Outerbridge criteria [3]. Injuries of crucial ligaments were identified when total or partial interruption was found and confirmed with dynamic examination. Meniscal lesions were diagnosed in stress positions using a probe device. All pathological lesions were registered (print, video). The statistical analysis compared orthopaedic examination and MRI findings with the result of arthroscopy. To determine the credibility of the examinations and MRI sensitivity, the specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were assessed. Significance was determined at $p < 0.05$.

Results

In 113 patients knee injuries were diagnosed on orthopaedic examination and MRI followed by arthroscopy. Mean age of the patients was 37.2 years. Demographic data are presented in Table I. In all arthroscopies, 71 ACL lesions, 1 PCL, 43 MM, 16 ML and 41 chondral defects were diagnosed (Table I). The sensitivity of MRI and orthopaedic examination for ACL were 80% and 86% and no statistical differences were observed. The specificity was 86% and 90% and statistically significant differences were not observed (Table II). For MM lesions MRI sensitivity was 88%

Table I. Demographic data

No. of patients	113
Age (SD) [years]	37.2 (12.2)
ACL lesion [%]	71
MM lesion [%]	43
ML lesion [%]	16
Chondral defect [%]	41
PCL lesion [%]	1

ACL – anterior cruciate ligament, MM – meniscus medialis, ML – meniscus lateralis, PCL – posterior cruciate ligament

Table II. Results of the data analysis: sensitivity, specificity, PPV, NPV, accuracy for ACL lesions

Parameter	MRI	OE	Value of <i>p</i>
Sensitivity (95% CI)	80 (69-89)	86 (76-93)	0.370
Specificity (95% CI)	86 (71-95)	90 (77-97)	0.500
PPV (95% CI)	90 (80-96)	94 (85-99)	0.478
NPV (95% CI)	72 (58-84)	79 (65-90)	0.410
Accuracy (95% CI)	82 (74-89)	88 (80-93)	0.264

PPV – positive predictive value, NPV – negative predictive value, MRI – magnetic resonance imaging, OE – orthopaedic examination

Table III. Results of the data analysis: sensitivity, specificity, PPV, NPV, accuracy in MM lesions

Parameter	MRI	OE	Value of <i>p</i>
Sensitivity (95% CI)	88 (75-96)	65 (49-79)	0.011
Specificity (95% CI)	64 (52-75)	87 (77-94)	0.002
PPV (95% CI)	60 (47-72)	76 (59-88)	0.118
NPV (95% CI)	90 (78-97)	80 (70-89)	0.143
Accuracy (95% CI)	73 (64-81)	79 (70-86)	0.349

Abbreviations – see table II

and for orthopaedic examination 65%; this difference is statistically significant to the benefit of MRI. However, the specificity for orthopaedic examination was 87% and for MRI 64%; the difference is statistically significant (Table III). Sensitivity of the resonance in the case of ML lesions was 44% and the OE 38%; differences between examinations are not statistically significant. For ML lesions the OE is more specific and was 100%, for MRI 93%, and this difference is statistically significant (Table IV). Differences of specificity for cartilage lesions in MRI and OE did not demonstrate statistical differences and they were 32% and 51% respectively. The specificity for these lesions did not show statistical differences but they demonstrate much greater values and the score for MRI was 97% and for OE 100% (Table V). Because of the very few cases of PCL lesions, statistical analyses were not carried out. In the studied material 1 PCL was diagnosed in arthroscopy and confirmed in MRI but not in the OE. In 1 MRI, a PCL lesion was diagnosed which was not confirmed in arthroscopy and OE. The credibility of sensitivity and the specificity of diagnostic tests for intra-articular structures were additionally confirmed with PPV, NPV and accuracy results.

Discussion

Assessment of intra-articular lesions is a difficult problem in diagnostics of injuries of the knee joint. In knee injury very often more than one structure is damaged and it may complicate establishing the final and precise diagnosis. The purpose of this study is to assess the value and the diagnostic usefulness of OE and MRI in the diagnostics of intra-articular knee lesions. The MRI is a very often carried out and abused examination in many cases. The MRI is wrongfully regarded as the most precise and referen-

Table IV. Results of the data analysis: sensitivity, specificity, PPV, NPV, accuracy in ML lesions

Parameter	MRI	OE	Value of <i>p</i>
Sensitivity (95% CI)	44 (20-70)	38 (15-65)	0.719
Specificity (95% CI)	93 (86-97)	100 (96-100)	0.007
PPV (95% CI)	50 (23-77)	100 (54-100)	0.032
NPV (95% CI)	91 (83-96)	91 (83-95)	0.950
Accuracy (95% CI)	86 (78-92)	91 (84-96)	0.211

Abbreviations – see table II

tial in establishing the accurate diagnosis. However, MRI did not lower the rank of the orthopaedic examination indications for arthroscopy, which gives the credible diagnosis and the possibility of precise treatment.

The ACL lesions are often reliably confirmed both in MRI and OE (Figures 1-2). The sensitivity and specificity of diagnostic methods in the present study are similar. Therefore MRI in ACL lesions is not a referential examination and is not necessary in making a decision in arthroscopy. In the case of lack of manifestations from other intra-articular damaged structures, the OE and medical interview give enough information to establish further treatment. Rayan *et al.* [4] presented similar results of the MRI and OE sensitivity, respectively 81% and 77%. Many other authors have the same point of view [5]. They also claim that the accurate OE is an effective tool in qualification of the patient for ACL reconstruction.

The MM lesions are a frequent injury and sensitivity of MRI in our material is greater than OE. However, OE shows greater specificity. In the assessment of MM lesions, MRI seems to be more justified taking

Table V. Results of the data analysis: sensitivity, specificity, PPV, NPV, accuracy in chondral defects

Parameter	MRI	OE	Value of <i>p</i>
Sensitivity (95% CI)	32 (18-48)	51 (35-67)	0.073
Specificity (95% CI)	97 (90-100)	100 (95-100)	0.154
PPV (95% CI)	87 (60-98)	100 (84-100)	0.085
NPV (95% CI)	71 (61-80)	78 (84-100)	0.279
Accuracy (95% CI)	73 (64 -81)	82 (74-89)	0.109

Abbreviations – see table II



Figure 1. The ACL lesion in MRI

into consideration the diversity of morphology of the lesions (Figures 3-4). Kuikka *et al.* [6] in acute MM tears reported sensitivity of MRI of 91.7% and specificity of 87.1%; however, they did not compare results with OE. In a multi-centre study, Fisher *et al.* [7] assessed the medium sensitivity of MRI as 93% and specificity as 84%. But research findings between centres differed (sensitivity 80-94%, specificity 58-

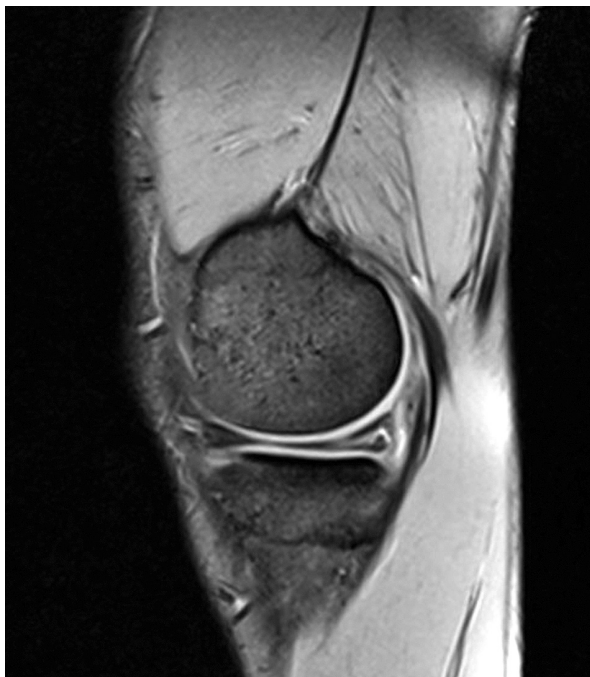


Figure 3. The MM posterior horn lesion in MRI



Figure 2. Arthroscopy verification of ACL lesion

85%), as is also presented in other authors' trials [8, 9]. Rose *et al.* [10] compared MRI with the OE and they stated that they had equivalent value. The variations of sensitivity and specificity of MRI in publications gives evidence of MRI over-interpretation, which arthroscopy verified. In this aspect the value of OE should again be emphasized.

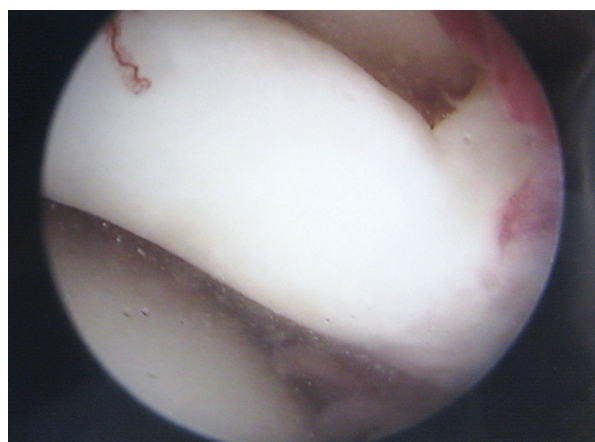


Figure 4. The MM lesion in arthroscopy appeared more extensive

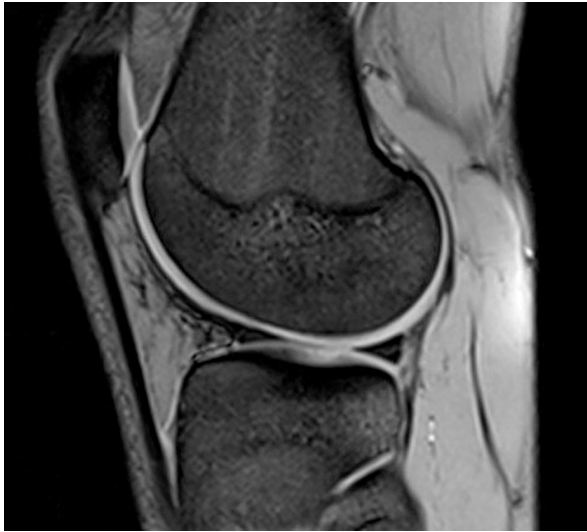


Figure 5. The ML appearance in MRI is normal

The ML lesions are a statistically less frequent problem in knee joint injuries. Sensitivity of both the OE and MRI is low, but specificity is considerably higher. Kuikka *et al.* presented similar results [6], sensitivity of 46.7% and specificity of 98.5%. Research findings in different publications vary markedly [7-9]. Statistical results of MRI for MM and ML clearly differ. Diagnostic sensitivity of MRI for ML is remarkably lower (Figures 5-6). De Smet *et al.* [11] stated that it is connected with more frequent lesions of the posterior horn of the meniscus or only 1/3 of the meniscus torn back, which is more difficult in diagnostics. The ML tears are a difficult problem in diagnostics and qualification for operative treatment. In the case

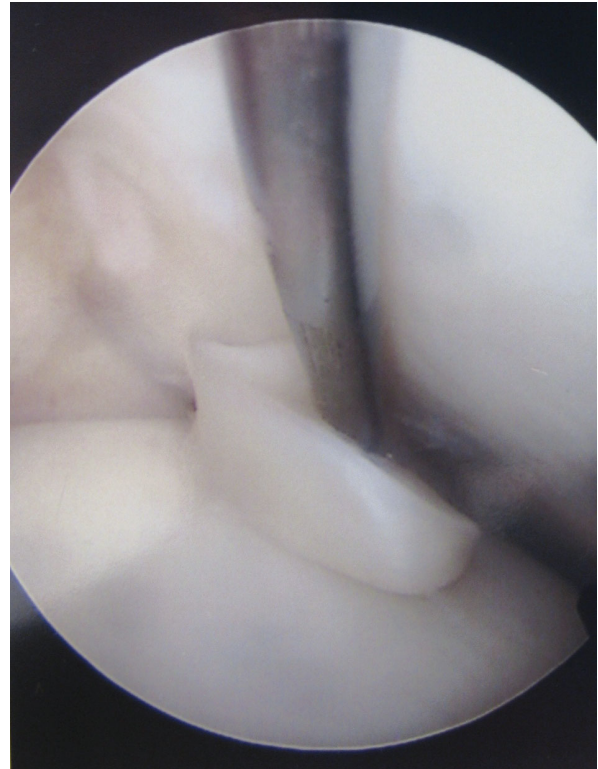


Figure 6. In arthroscopy posterior horn of ML appeared damaged

of lack of a certain MRI diagnosis, OE is crucial. Injuries of the cartilage are a complicated problem in the diagnostics of knee injuries. In the OE an assessment of the type and lesion location is difficult and MRI does not detect this pathology directly. Analysis of the presented material shows that OE is more accurate than MRI. Ochi *et al.* reached similar conclusions [12], underlining MRI's smaller sensitivity. But



Figure 7. Suspected cartilage lesion

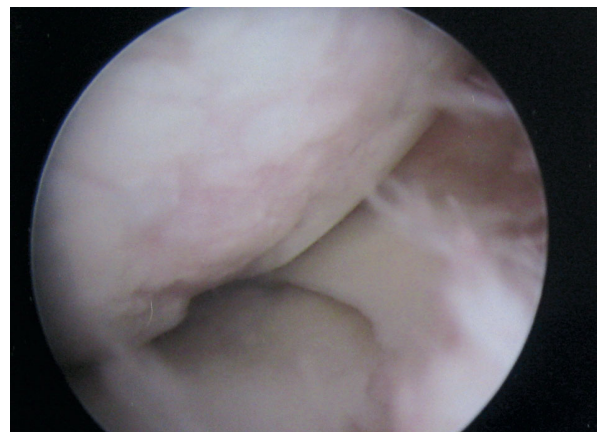


Figure 8. Extensive cartilage defect

second analysis of MRI after arthroscopy verification changes sensitivity from 40% up to 71% [12, 13]. These observations result from the fact that MRI interpretation concentrates more on detecting meniscal and ligament lesions than on cartilage injuries [12, 13]. So injuries of the cartilage can be found accidentally in arthroscopy. The OE is more accurate than MRI and it should be a signal for accurate MRI assessment and increasing its preciseness (Figures 7-8).

On account of the low frequency of PCL lesions (1%), it was not statistically analysed. Based on our own and other authors' experience, both the OE and MRI have great accuracy in detecting this type of lesions [12, 14]. The diagnostics of knee injuries is a complex problem. We should aspire to increase the accuracy and credibility of the OE and MRI in diagnosing intra-articular lesions. It will reduce the number of diagnostic arthroscopies to the benefit of operating arthroscopies. It will significantly reduce the frequency of diagnostic arthroscopies, lower operating risk and its costs.

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