

## Original Article

# Arthroscopic Evaluation of the Accuracy of Clinical Examination versus MRI in Diagnosing Meniscus Tears and Cruciate Ligament Ruptures

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## Abstract

**Background:** Magnetic resonance imaging (MRI) of the knee joint has often been regarded as a noninvasive alternative to diagnostic arthroscopy. In day-to-day clinical practice, the MRI scan is routinely used to support the diagnosis for meniscus or ligamentous injuries prior to recommending arthroscopic examination and surgery. On the other hand, rapidly progressing medical technology sometimes obscures the importance of history and physical examination. This study aims to evaluate the accuracy of physical examination and MRI scanning in the diagnosis of knee injury, including meniscus tears and cruciate ligament ruptures.

**Methods:** In a cross-sectional, descriptive analytical study, 120 patients with knee injury who were candidates for arthroscopy were referred to Tabriz Shohada Hospital during a one-year period. Prior history of arthroscopy or knee surgery was considered as exclusion criteria. Before ordering an MRI and arthroscopy, a thorough physical examination of the affected knee was performed and a preliminary diagnosis made. The results of arthroscopy were considered as the definitive diagnosis, therefore the results of the physical examination and MRI were judged accordingly.

**Results:** Of the 120 evaluated patients with knee injuries, there were 108 males and 12 females with a mean age of  $29.13 \pm 7.37$  (16–54) years. For medial meniscus injuries, clinical examination had an accuracy of 85%, sensitivity of 94.8%, and specificity of 75.8%. Lateral meniscus injuries had the following results: accuracy (85%), sensitivity (70.8%) and specificity (88.5%). Clinical examination of anterior cruciate injuries had an accuracy of 95.8%, sensitivity of 98.6% and specificity of 91.7%. According to MRI results, for medial meniscus injuries there was an accuracy of 77.5%, sensitivity of 84.2%, and specificity of 71.4%. In lateral meniscus injuries, MRI had an accuracy of 85.8%, sensitivity of 56.5% and 92.8% specificity. MRI evaluation of anterior cruciate injuries was 92.5% for accuracy, 98.6% for sensitivity, and 83.3% for specificity. Both clinical examination and MRI were 100% for posterior cruciate injuries. Overall, in isolated injuries, the accuracy of clinical examination was relatively better than with complicated cases. The opposite results were seen for MRI findings in this regard.

**Conclusion:** According to our results, both physical examination and MRI scans are very sensitive and accurate in the diagnosis of knee injuries, with a mild preference for physical examination. MRI should be reserved for doubtful cases or complicated injuries.

**Keywords:** Knee injuries, magnetic resonance imaging, physical examination

**Cite the article as:** Navali AM, Bazavar M, Mohseni MA, Safari B, Tabrizi A. Arthroscopic Evaluation of the Accuracy of Clinical Examination versus MRI in Diagnosing Meniscus Tears and Cruciate Ligament Ruptures. *Arch Iran Med.* 2013; **16(4)**: 229 – 232.

## Introduction

Important components within the knee joint include the medial and lateral menisci, and anterior and posterior cruciate ligaments. Various functions for the knee menisci have been described. Some of these functions can be related to the spread of synovial fluid, nutrition, neutralization of sudden blows to the knee, enhanced knee stability and function of weight-bearing knee.<sup>1</sup> The cruciate ligaments act as knee stabilizers and axial that rotational movements of the knee occur around them. Damage to the components within the knee joint usually occur as a result of injuries during sports activities or from car and motorcycle accidents. Obtaining an accurate patient history and physical examination can reveal the location of acute knee injuries.<sup>2</sup>

The progress of diagnostic tools and technologies, including new methods of imaging such as magnetic resonance imaging

(MRI) have decreased the emphasis that doctors place on physical examination and history-taking. The knee is the most common joint frequently studied by MRI because this technique creates a clear picture of the various components within the knee joint.<sup>3</sup> We perform MRIs at our center to diagnose intra-articular knee injuries. However, until now a study to determine the accuracy of MRI reports of knee injuries has not been performed in this center. Given the importance of physical examination in the diagnosis of intra-articular knee injuries and cost of MRIs to patients we have performed this prospective study to determine the diagnostic accuracy of physical examination and MRI in comparison to arthroscopic findings.

## Materials and Methods

This was a descriptive, analytical study of 120 patients who presented with meniscus tears or cruciate ligament ruptures. The Orthopedic Ward at Tabriz Shohada Hospital was the study location and the study was conducted from October 2008 until October 2009. We approached all patients who presented to the Orthopedic Ward during this period that were diagnosed with either cruciate ligament or meniscus damage and were candidates for arthroscopic

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Accepted for publication: 25 July 2012

py. All injuries were chronic. Any acute injuries were not considered for this study. Patients with previous histories of arthroscopy or history of any other knee surgery were also excluded. The Ethics Committee of Tabriz University of Medical Sciences, Tabriz, Iran approved this study.

Physical examinations were conducted by physicians who lacked prior knowledge of the patient's MRI results, nor did they have access to the MRI scans. All physical examinations were performed by a physician specialized in knee surgery and included examinations of: anterior cruciate ligament, anterior drawer tests, lateral pivot shift, Lachman, posterior cruciate ligament, active quadriceps, and posterior drawer. Arthroscopy surgeries were conducted by an experienced surgeon with the cooperation of his assistants. Meniscus examination consisted of the McMurray meniscus test, joint line tenderness assessment and the squat test. We recorded the physical examination findings for all patients registered, after which each patient's MRI was reviewed, and ligament and meniscus damage reports registered. All MRI results were reported by a radiologist specialized in this field.

Patients subsequently underwent arthroscopic surgery and the findings, as the criterion for diagnosis, were recorded. Using the arthroscopic findings as the final, definitive diagnosis, we compared the physical examination and MRI scans, recording each as true positive, true negative, false positive and false negative for the anterior and posterior cruciate ligaments, and medial and lateral menisci.

We reviewed all cases for sex, age, patient complaint of injury, time of the injury, mechanism of injury, and type of injury. Both the results of the clinical examination and MRI were compared with arthroscopy in a single injury (meniscus or cruciate ligament).

#### Statistical analyses

Statistical analyses were performed with Medcalc. The data obtained from the study was analyzed using descriptive statistical methods (frequency-percent, mean  $\pm$  standard deviation). Sensi-

tivity, specificity, accuracy, positive predictive value, and negative predictive value were calculated.

## Results

Of the 120 evaluated patients with meniscus tears and cruciate ligament ruptures, 108 (90%) were male and 12 (10%) were female. The average age of the studied patients was  $29.13 \pm 7.37$  (16–54) years. The main complaints included: joint pain (n=25, 20.8%); joint effusion (n=10, 8.3%); locked joint (n=8, 6.7%); joint dislocation (n=19, 15.8%); joint click (n=1, 0.8%); pain with joint lock (n=19, 15.8%); pain with dislocation (n=22, 18.3%); pain with joint click (n=3, 2.5%); joint lock with dislocation (n=9, 7.5%); pain, effusion and lock (n=1, 0.8%); pain, effusion, click and lock (n=1, 0.8%); and pain, effusion, lock, dislocation and click (n=2, 1.6%). Injuries occurred at various times prior to the onset of our study. There were 2 (1.7%) cases injured during four weeks prior to the study; 17 (14.2%) were injured within three months before the study, 15 (12.5%) sustained injuries about six months before the study; and 86 (71.7%) were injured over six months before the study. The mechanism of injury in 83 (69.2%) cases was sports-related, 8 (6.7%) resulted from road accidents, 7 (5.8%) were related to workplace accidents, and 22 (18.3%) cases were from other causes. Table 1 summarizes the arthroscopy results. The comparison between clinical examination and MRI results to arthroscopic results is summarized in . The results of physical examination and MRI in single injuries (meniscus or cruciate ligament) is presented in Table 3.

## Discussion

In this study we investigated the diagnostic power of physical examination and MRI in the diagnosis of cruciate ligament injuries and meniscus tears. The results were compared with arthroscopic findings as the final determination. Diagnostic power of both physical examination and MRI in this field was high, with only

**Table 1.** Arthroscopic findings of the knee.

Results	Frequency (%)
No history of injury	17 (14.2)
Internal meniscus injury	21 (17.5)
Lateral meniscus injury	9 (7.5)
Anterior cruciate ligament injury	30 (25)
Medial and lateral meniscus injury	1 (0.8)
Medial meniscus and anterior cruciate ligament injury	29 (24.2)
Lateral meniscus and anterior cruciate ligament injury	7 (5.8)
Medial and lateral meniscus, anterior cruciate ligament injury	5 (4.2)
Medial meniscus, anterior and posterior cruciate ligament injury	1 (0.8)

**Table 2.** Clinical examination and MRI results taking into consideration arthroscopic results as the definitive diagnosis.

Parameter	True positive	True negative	False positive	False negative	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy
Medial meniscus	55 (45.8)	15 (12.5)	47 (39.2)	3 (2.5)	94.8%	75.8%	78.6%	94%	85%
	48 (40)	18 (15)	45 (37.5)	9 (7.5)	84.2%	71.4%	72.7%	83.3%	77.5%
Lateral meniscus	17 (14.2)	11 (9.2)	85 (70.8)	7 (5.8)	70.8%	88.5%	60.7%	92.4%	85%
	13 (10.8)	7 (5.8)	90 (75)	10 (8.3)	56.5%	92.8%	65%	90%	85.8%
Anterior cruciate ligament	71 (59.2)	4 (3.3)	44 (36.7)	1 (0.8)	98.6%	91.7%	94.7%	97.8%	95.8%
	71 (59.2)	8 (6.7)	40 (33.3)	1 (0.8)	98.6%	83.3%	89.9%	97.6%	92.5%
Posterior cruciate ligament	1 (0.8)	0 (0)	119 (99.2)	0 (0)	100%	100%	100%	100%	100%
	1 (0.8)	0 (0)	119 (99.2)	0 (0)	100%	100%	100%	100%	100%

**Table 3.** Diagnostic power of physical examination and MRI in single injuries.

	Parameter	Medial meniscus	Lateral meniscus	Anterior cruciate ligament	Posterior cruciate ligament
MRI	True positive	27 (64.3)	5 (11.9)	41 (97.6)	1 (2.4)
	True negative	6 (14.3)	28 (66.7)	—	48 (97.6)
	False positive	1 (2.4)	2 (4.8)	—	—
	False negative	8 (19)	7 (16.7)	1 (2.4)	—
	Sensitivity	77.1%	41.7%	97.6%	100%
	Specificity	85.7%	93.3%	—	100%
	Positive predictive value	96.4%	71.4%	100%	100%
	Negative predictive value	42.9%	80%	—	100%
	Accuracy	78.6%	78.6%	97.6%	100%
	Clinical examination	True positive	32 (76.2)	8 (19)	42 (100)
True negative		5 (11.9)	29 (69)	—	41 (97.6)
False positive		2 (4.8)	1 (2.4)	—	—
False negative		3 (7.1)	4 (9.5)	—	—
Sensitivity		91.4%	66.7%	100%	100%
Specificity		71.4%	96.7%	—	100%
Positive predictive value		94.1%	88.9%	100%	100%
Negative predictive value		62.5%	87.9%	—	100%
Accuracy		88.1%	90.5%	100%	100%

slight differences observed. Physical examination of the medial meniscus was better compared to MRI results, whereas in the lateral meniscus, the sensitivity, specificity and accuracy of MRI was high. For the anterior cruciate ligament results, the sensitivity of both was the same, however the specificity and accuracy of the examination was higher. The diagnostic power of physical exam and MRI in cases with posterior cruciate ligament injury was about 100%, but there was a low number of samples with this injury, thus the results were inconclusive.

In a study by Esmaili Jah conducted in Tehran on 70 patients with knee injuries, the diagnostic accuracy of both physical examination and MRI were compared with arthroscopic results. In this study, although the difference between the results of the methods was slight, in the majority of cases physical examination was superior. The final conclusion was that in the cases with normal MRI results, clinical suspiciousness and physical examination were acceptable.<sup>4</sup> Madhusudhan et al. in the UK studied arthroscopy on 109 injured knees. In their study the physical examinations, with the exception of meniscus tears, were superior to MRI results.<sup>5</sup> In our study, we noted the same conclusion regarding medial meniscus tears. According to Majid et al. arthroscopy has provided orthopedic surgeons with a highly successful tool for diagnosing and treating meniscal tears.<sup>6</sup> In a study in Mashhad on 92 patients with knee injuries, Mazlomy and colleagues noted similar results and reported a high accuracy for clinical examinations.<sup>7</sup> A British study evaluated 131 patients with knee injuries. In current study, both physical examination and MRI in the diagnosis of knee injuries were valuable diagnostic tools; however, there was a slight difference observed.

In conclusion there was a high accuracy of the physical examination which was similar to MRI. Therefore, MRI only should be used to exclude possible injuries rather than confirm and diagnosis injuries.<sup>8</sup> An Egyptian study of 70 patients noted high diagnostic accuracy of both physical examination and MRI, and in most cases, only slight differences existed between the two methods,<sup>9</sup> which was also confirmed in a study by Thomas et al.<sup>10</sup>

The findings of the current study confirmed the results of several studies. However, in other studies there were contradictory findings. Zairul-Nizam et al. studied patients with knee injuries and concluded that there was a major difference between the results of clinical examination and MRI in diagnosing meniscus and ligamentous injuries.<sup>11</sup> Nikolaou and colleagues studied 46 patients and concluded that the diagnostic power of physical examinations in knee injuries was substantially less than MRI results.<sup>12</sup> Rezaei et al. in a study in Tehran concluded that MRI, rather than physical examination, in the diagnosis of a knee injury was not accurate.<sup>13</sup> Major causes for the differences in the results were related to different skill levels of personnel involved in MRI interpretation, arthroscopy and clinical examination. The difference in technique used for the MRI is of importance.<sup>14</sup> Studies have shown that if the examination is performed by a skilled technician, the results will be accurate.<sup>15,16</sup> Additionally, an exact examination by skilled medical personnel can be as useful as an MRI,<sup>17</sup> as confirmed by our study.

In this study we separately investigated cases of meniscus or single ligament injuries, in addition to those who presented with compound meniscus and ligament injuries. In the majority of single injuries, physical examination was better than MRI, except for the diagnosis of medial meniscus injuries. Meanwhile, in complex cases, MRI was more advantageous in some cases compared to clinical examination, particularly with regards to specificity in the diagnosis of a lateral meniscus injury and sensitivity for diagnosis of an anterior cruciate ligament injury. Of note, the differences in these cases was slight.

In a separate comparison of each method, MRI was slightly better in diagnosing complex injuries compared with single injuries. Limited studies have been conducted in this area. Esmaili and colleagues have shown that the power of diagnostic examination in complex injuries is less than single injuries. One reason, apart from the technical issues related to MRI interpretation, is the presence of multiple injuries in the knee may increase the diagnostic accuracy of the MRI.<sup>4</sup> The results of our study mostly confirm

previous studies. Considering the current results, both the clinical examination and MRI in the diagnosis of knee injuries have high, acceptable diagnostic power although the clinical examination is slightly superior. Therefore, due to cost considerations in comparison of the clinical examination versus MRI, as the first diagnostic step in these patients, the MRI should be considered in cases of high clinical suspicion and complex injuries.

### Acknowledgments

*This study was financially supported by Tabriz University of Medical Sciences, Tabriz, Iran.*

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Shariat House, an old house constructed in the Qajar period, Gonabad, Khorasan-e Razvi province, Iran (Photo by M .H, Azizi MD)