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Accuracy of MRI in Comparison With Arthroscopic Findings in the Diagnosis of Anterior Cruciate Ligament and Meniscus Tears

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Abstract:

Background and Objective: Magnetic resonance imaging (MRI) is of great aid in the diagnosis of knee lesions. Nevertheless, arthroscopy has remained the reference standard for the diagnosis of internal derangements of the knee, to which alternative diagnostic modalities have been compared. This study was designed to assess the value of MRI and clinical examination in the diagnosis of anterior cruciate ligament (ACL) and meniscus tears in comparison with the arthroscopic findings.

Methods: In the present investigation, 55 patients with knee trauma underwent knee MRI, followed by knee arthroscopy. The results of knee arthroscopy were considered as the standard reference and the MRI findings were compared with the arthroscopy results.

Results: According to the results, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were 95%, 80%, 92.6%, and 85.7% for the diagnosis of the ACL tear; 87.8%, 90.9%, 93.5%, and 83.3% for the diagnosis of medial meniscus tear; and 85.7%, 94.1%, 90%, and 91.4% for the diagnosis of lateral meniscus tear, respectively.

Conclusion: The evidence from this study suggests that MRI has a high accuracy in the diagnosis of ACL, medial meniscus, and lateral meniscus injuries in patients with knee trauma.

Keywords: MRI, Anterior cruciate ligament, Medial meniscus, Lateral meniscus

Introduction

Anterior cruciate ligament (ACL) tear is one of the most common injuries after knee trauma. It is the most common body ligament that undergoes surgery (1). Isolated ACL tear occurs in less than 10% of cases. In most cases, it is accompanied by other injuries such as meniscus tear, cartilage injury, lateral and medial collateral ligament tear, and bone bruise (2). Furthermore, ACL tear is frequently associated with meniscus tear. The incidence of meniscal tear is reported to be 16-82% in acute ACL tear and more than 96% in chronic ACL tear. The accurate diagnosis of ACL tear, therefore, is an important factor in determining the therapeutic strategy in patients with knee trauma (3).

Arthroscopy is considered as "the gold standard" for the diagnosis of traumatic articular knee lesions (4). However, it is an invasive procedure with all the potential complications of a surgical procedure. For this reason, the introduction of magnetic resonance imaging (MRI) led to a revolutionary change in medical diagnosis (5). Although the comparison of MRI diagnosis and surgical/clinical findings has always been a challenge for the health professionals, and many publications have addressed the accuracy of MRI in orthopaedic diagnosis, only few studies have associated arthroscopic findings with MRI (6).

In addition, MRI has widely been used in recent years, especially when knee is the most frequently examined joint with MRI. On the other hand, health economics

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plays an important role in patients' management (7). In this regard, few surveys have documented the routine use of MRI before that arthroscopy would reduce the costs and the incidence of unnecessary invasive procedures (8).

Despite the fact that MRI scans are often considered to provide the ultimate diagnostic certainty, indeed, the performance of MRI, as a diagnostic tool of internal derangement of the knee, has not been investigated enough and the judicious use of expensive arthroscopic evaluation versus MRI technology in the diagnosis of internal derangements of the knee has not been clearly defined (9). Therefore, the accuracy of MRI in the diagnosis of ACL, medial meniscus, and lateral meniscus injuries was aimed to be assessed in this study.

Methods & Materials

In the present investigation, 78 patients principally diagnosed with knee trauma were recruited between September 23, 2014 and September 23, 2015. The authors adhered to the STARD statement (Standards for Reporting Diagnostic Accuracy) in the design and presentation of diagnostic studies (10).

Participants were ruled out if they had new injury to the same knee after the MRI examination or before the arthroscopy, or if they delayed undergoing arthroscopy. Additional exclusion criteria were high grade osteoarthritis, fractures around the knee, the history of previous knee surgery, and MRI contraindications. Based on these criteria, out of 78 patients recruited, 23 were excluded: 10 cases for high grade osteoarthritis, 7 cases for fractures around the knee, 5 cases for the history of previous knee surgery, and 1 patient for MRI contraindication because of pacemaker. Therefore, the final study population consisted of 55 patients with knee trauma.

All patients underwent 1.5 Tesla MRI of the knee (Yazd Shahid Sadoughi Hospital). The MR images were obtained while the patients were in supine position at 30 degrees of knee flexion. The MR images were reported by an expert radiologist. Finally, all patients underwent knee arthroscopy as the gold standard for the diagnosis of knee injuries. The mean time interval between knee trauma and performing MRI was 5 months.

The statistical analyses were carried out using SPSS version 18.0 for Windows (SPSS, Chicago, IL, USA).

Results

The mean age of patients was 26 years (ranged from 15 to 57 years). Among the participants, 48 patients (87.3%) were male and 7 (12.6%) were female. Based on the arthroscopic results, 40 patients had ACL tear. Table 1 shows the findings regarding ACL tear diagnosed by MRI and arthroscopy. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of MRI for the diagnosis of ACL tear were 95%, 80%, 92.6%, and 85.7%, respectively.

Table 1. The Findings Regarding ACL Tear Diagnosed by MRI and Arthroscopy

Variables	Positive result in arthroscopy	Negative result in arthroscopy
Positive result in MRI	38 (69%)	3 (5.4%)
Negative result in MRI	2(3.6%)	12 (21.8%)

The arthroscopic results showed meniscal tear in 43 patients (33 medial meniscus tear, 21 lateral meniscus tear, 11 both menisci tears). Tables 2 and 3 display the findings regarding the medial and lateral meniscus tears diagnosed by MRI and arthroscopy. The sensitivity, specificity, PPV, and NPV of MRI were 87.8%, 90.9%, 93.5%, and 83.3% for the diagnosis of medial meniscus tear and 85.7%, 94.1%, 90%, and 91.4% for the diagnosis of lateral meniscus tear, respectively.

Table 2. The Findings Regarding Medial Meniscus Tear Diagnosed by MRI and Arthroscopy

Variables	Positive result in arthroscopy	Negative result in arthroscopy
Positive result in MRI	29 (52.7%)	2 (3.6%)
Negative result in MRI	4 (7.2%)	20 (36.3%)

Table 3. The Findings Regarding Lateral Meniscus Tear Diagnosed by MRI and Arthroscopy

Variables	Positive result in arthroscopy	Negative result in arthroscopy
Positive result in MRI	18 (32.7%)	2 (3.6%)
Negative result in MRI	3 (5.4%)	32 (58.2%)

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Discussion

The purpose of this study was to indicate the diagnostic value of MRI in diagnosing the presence or absence of anterior cruciate ligament (ACL) and meniscus tears. Findings of the current study support the role of MRI in decreasing unnecessary diagnostic arthroscopy (11). Our clinical or MRI diagnostic accuracy in cruciate ligaments and meniscal injuries is similar to that reported elsewhere (12, 13). In line with the present report, Runkle et al emphasized the importance of the expertise of the MRI interpreter in the accuracy of diagnosis (14). In the other words, it is obvious that the MRI reports are highly dependent on the skill and experience of the radiologist and the equipment available (15). In accordance with the findings of this study, several previous research reported High negative predictive value (NPV) of MRI, which suggests MRI as a valuable diagnostic tool for evaluating patients with knee trauma prior to arthroscopy (16, 17).

In contrast, Li et al reported a medium risk of magic angle phenomenon for FSE (fast spin echo). In fact, they mentioned the “magic angle phenomenon” as a cause of missed meniscus tears on MRI (18). This phenomenon also influenced our readings since our MRI centers use FSE. In addition, some lesions could have been missed due to large spacing for imaging (0.5 cm) (19). Therefore, it is unwise to trust negative MRI reports in the case of high clinical suspicion. However, another study reported that the accuracy of MRI for the diagnosis of a torn meniscus is almost equivalent to that of arthroscopy, assuming that MRI study is conducted correctly and assessed by an experienced radiologist (20). Thus, in suspected conditions or low technical quality of an MRI, it is safe to trust a skilled clinical examination and go straight to arthroscopy, rather than ordering an MRI (21).

However, in countries with poor health resources, it is important to consider the economic burden of MRI on patients. Therefore, it is important for an orthopaedic surgeon to choose the best MRI setting and radiologist, in order to save the time and reduce the patient costs (22). In this regard, some studies were carried out to evaluate the economic burden of MRI. For example, Bryan et al and Kocher demonstrated that MRI could decrease the rate of surgery in chronic knee problems, especially in those for whom surgery was already planned. Furthermore, they found that it did not increase the overall cost (23, 24). However, Brooks et al, in a prospective study, reported contradictory results. They assessed the agreement between preoperative clinical/arthroscopic and MRI/arthroscopic findings (79% versus 77% agreement, respectively) and concluded that MRI did not reduce the number of negative arthroscopic procedures (25). Considering these controversial results, further surveys are needed to determine the economic burden of MRI.

Conclusion

To conclude, the results of the present study demonstrated that MRI has a high accuracy in the diagnosis of ACL, medial meniscus, and lateral meniscus injuries in patients with knee trauma.

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