Sakarya Tıp Dergisi
Sakarya Med J

E-ISSN: 4146-409X
Publisher: Sakarya University

Vol. 14, No. 4, 368-375, 2024
DOI: http://doi.org/10.31832/smj.1570985

Research Article

A Comparison of Clinical Examination and Magnetic Resonance Imaging Results with Arthroscopy Results in Knee Intra-Articular Pathologies

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Received:
21.10.2024
Accepted:
27.11.2024
Available Online Date:
18.12.2024

Objective: We aimed to determine in which of the symptomatic intra-articular pathologies of the knee, clinical examination and magnetic resonance imaging (MRI) can be an alternative to diagnostic arthroscopy.

Materials and Methods: Prospective analysis of 50 patients aged 18 to 50 years who underwent arthroscopy with the diagnosis of meniscus tear, cruciate ligament injury, cartilage damage, or plica between 2013 and 2015 was conducted. The results of the physical examination and MRI were compared with arthroscopy findings.

Results: Patients with a mean age of 35 years. Sensitivity, specificity, and accuracy rates in the Mc-Murray test were 90%, 11%, 76%; 76%, 33%, 68% in the Apley test; and 80%, 33%, 72% in the Ege's test. Sensitivity, specificity, and accuracy rates in the MRI for the medial meniscus were 87%, 68%, 80%; 92%, 92%, 92% for the lateral meniscus; 36%, 95%, 62% for chondral injury; 90%, 95%, 94% for the anterior cruciate ligament; and 21%, 59%, 34% in the plica.

Conclusion: It should be noted that positive results can also be obtained in other knee intra-articular pathologies other than meniscus tear, as the sensitivity of these tests used to diagnose meniscus tear is high, but specificity is low. 1.5-tesla MRI has a high accuracy rate for detecting meniscus and anterior cruciate ligament injuries, while the diagnostic power of chondral surface evaluation remains limited, and high-resolution cartilage-specific images are required. As it is insufficient for evaluating plica on its own, it must be carefully incorporated during arthroscopy.

Keywords: Chondral lesion, Knee, Magnetic resonance imaging, Meniscus, Plica

1. INTRODUCTION

The knee joint is the largest and most complex joint of the human body. The knee joint is covered by a thin layer of muscle from the front. Due to this structure's inherent weakness, it is susceptible to direct and rotational traumas that cause injury to intra-articular anatomical structures.[1]

Symptomatic intra-articular pathologies are mostly caused by meniscus tears, cruciate ligament tears, cartilage damage, and plica. In the past, these pathologies were evaluated with a medical history, physical examination, and direct X-ray. When necessary, they were examined with arthrography, or direct open surgery was performed. In this algorithm, it was found over time that the patients were exposed to unnecessary surgery or that the surgery was delayed. Physical examination alone was found to be insufficient in detecting intra-articular knee pathologies, particularly meniscus tears.[2] Given that meniscus tears are the most common reason for knee arthroscopy in many clinics, the significance of diagnostic techniques can be better understood.

The prevalence of magnetic resonance imaging (MRI) devices and advances in imaging technology have led to an increase in their utilization. Its

Cite this article: Şahin R., Balık M. S. A. Comparison of Clinical Examination and Magnetic Resonance Imaging Results with Arthroscopy Results in Knee Intra-Articular Pathologies. Sakarya Med J 2024; 14(4): 368-375 DOI: 10.31832/smj.1570985

advantages include being non-invasive, not emitting ionizing radiation, providing multiplanar images, and detecting additional injuries.[3,4] However, the accuracy of MRI in detecting these intra-knee pathologies varies widely among studies ranging from 45 to 98%.[4-6]

Accurate and timely diagnosis is essential for minimizing morbidity caused by intra-articular knee pathologies and optimizing potential performance. In our study, we aimed to investigate the avoidability of diagnostic arthroscopy based on the clinical examination and MRI findings of the patients with meniscus or cruciate ligament injuries who underwent arthroscopic diagnosis and treatment, and the MRI findings of patients with chondral damage or pathological plica.

2. MATERIALS AND METHOS

Ethics committee approval was obtained for this study and decision number 2014/148. Verbal and written confirmation documents were acquired from the patients for participation in the research. Fifty knees of fifty patients aged 18–50 who underwent arthroscopic intervention at a tertiary university hospital from 07.2013 to 07.2015 with a preliminary diagnosis of knee intra-articular pathology were evaluated. McMurray, Apley, and Ege tests were performed as physical examination tests in patients presenting with one or more of the following complaints: knee pain, swelling, locking, or a hollow feeling, and an additional anterior drawer test was performed in patients with suspected cruciate ligament injuries. When significant positive results were obtained in at least one of the tests, axial, sagittal, and coronal sections were acquired in T1 and T2 sequences with a thickness of 2 mm in the supine position in full extension of the knee with a Siemens magnetom aera MRI device with 1.5-tesla power in the radiology department of our hospital. The MRIs were evaluated by a radiologist with expertise in the musculoskeletal system. The arthroscopic results of the patients were considered the gold standard, and the findings of the arthroscopy were compared with those of the physical examination and MRI. Preoperative physical examinations of all patients were performed by us. All MRIs were assessed by the same radiologist. Intraoperative arthroscopy results were determined by an orthopedic specialist with expertise in knee arthroscopy.

McMurray, Apley, and Ege tests were performed in patients presenting with at least one of the complaints of pain, swelling, locking, or feeling of hollowness in the knee.[7-9] When at least one of the tests yielded positive results, T1 and T2 sequences of axial, sagittal, and coronal sections were acquired in supine position and with the knee in full extension using a 1.5-tesla Siemens magnetomaera MRI device. The images were assessed by a radiologist with expertise in the musculoskeletal system. The arthroscopy results of patients who underwent knee arthroscopy surgery after imaging were considered the gold standard. Physical examination tests and MRI findings were compared with arthroscopy results.

Meniscus tears were graded according to signal change on MRI. Grade 3 signal changes were accepted as a tear.[10,11] The outerbridge classification was used to grade cartilage damage.[12] Band appearances with high signal intensity on MRI and low signal intensity in joint fluid were accepted as pathologic plica when seen in the medial, lateral, and infrapatellar regions.[13] The loss of continuity in consecutive sections of the cruciate ligaments in any plane in an MRI was considered a tear.

Arthroscopic surgery was performed by an orthopedic surgeon under spinal anesthesia in the supine position with a tourniquet applied to the

thigh. A Wolf brand arthroscopy device and a 30° angle scope was used.

2.1. Statistical analyses

The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy rates of MRI and meniscus diagnostic tests according to the results of arthroscopy were determined using a four-by-four crosstab method in the SPSS 21.0 program. The kappa test was performed to determine the reliability and significance of the tests.

3. RESULTS

Of the 50 patients in the study group, 34 were male (68%) and 16 were female (32%), with a mean age of 35. Of the 50 knees, 31 were left and 19 were right. Thirteen (26%) patients had a history of trauma.

The following intra-articular pathologies were detected during arthroscopy: 41 patients had meniscus tears. Of these, 28 involved the medial meniscus, 10 involved the lateral meniscus, and 3 involved both the medial and lateral meniscus. The anterior cruciate ligament (ACL) was partially ruptured in 7 patients, and 3 patients had a total rupture. No posterior cruciate ligament tear was observed. Chondral damages to varying degrees were detected in the medial femoral condyle in 21 patients, the medial tibial condyle in 10 patients, the lateral femoral condyle in 7 patients, and the lateral tibial condyle in 5 patients. 20 patients had infrapatellar and medial plicae together; 7 patients had only infrapatellar plica; 3 patients had only medial plica; and 3 patients had only lateral plicae.

In the preoperative physical examination of 41 patients with meniscus tears, the Mc-Murray test was positive in 37, the Ege's test was positive in 33, and the Apley test was positive in 31. Of the 9 patients who did not have meniscus tears but had at least one of the other intra-knee pathologies, 8 had positive Mc-Murray tests, 6 had positive Ege's tests, and 6 had positive Apley tests.

In our study, the high sensitivity and low specificity rates of diagnostic tests for meniscus compared to arthroscopy results, which we consider the gold standard, were remarkable (table 1).

Three of the ten patients with varying degrees of anterior cruciate ligament injury had a total rupture, while seven had a partial rupture. During the preoperative physical examination of these patients, only those with a total rupture could be diagnosed.

Table 1.

Results of diagnostic tests for meniscus based on arthroscopy results

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
McMurray	90	11	80	20	76
Apley	76	33	84	23	68
Ege	80	33	85	27	72

PPV: Positive predictive value, NPV: Negative predictive value

When we compared the MRI results of intra-articular pathologies of the knee with arthroscopy results, the accuracy ranged from high to low for the anterior cruciate ligament, lateral meniscus, medial meniscus, chondral damage, and plica (Table 2). In addition, kappa values were 57 for the medial meniscus, 80 for the lateral meniscus, 82 for the ACL, and 29 for the chondral surface.

Table 2.

MRI results based on arthroscopy findings

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Medial meniscus	87	68	87	76	80
Lateral meniscus	92	92	80	97	92
Chondral damage	36	95	91	54	62
Anterior cruciate ligament	90	95	82	97	94
Plica	21	59	50	28	34

PPV: Positive predictive value, NPV: Negative predictive value

4. DISCUSSION

Although the accuracy and sensitivity of McMurray, Apley, and Ege's tests, which are frequently used in the physical examination of meniscus injuries, are high, their specificity is low because they can produce highly positive results not only for meniscus pathologies but also for intra-knee pathologies. Total ruptures of the anterior cruciate ligament can be diagnosed through a physical examination, whereas partial injuries cannot be diagnosed solely through a physical examination. 1.5-tesla MRI has a high accuracy rate in the diagnosis of lateral meniscus and cruciate ligament pathologies. Although the accuracy rate for injuries to the medial meniscus is relatively low, it is adequate. In evaluating the chondral surface, diagnostic power is still limited. It is insufficient for detecting the presence of plica.

The use of MRI has increased significantly because it does not emit ionizing radiation, is noninvasive, and is less expensive than arthroscopy for diagnostic purposes.[14] With the widespread use of MRI, clinical questions that required answers began to attract the interest of researchers. The first of these questions is, if a meniscus tear is suspected based on a patient's medical history and physical examination, should an MRI be performed? The second question is: How much should we rely on MRI if there is no pathology after MRI, but the patient has clinical symptoms? The third question is how accurate is arthroscopic intervention based on anamnesis and physical examination findings without MRI? Although there are numerous studies attempting to answer these questions, there are significant differences in the results.[15-18] Weinstabl et al. randomly divided 823 patients with meniscus tears into two groups following physical examination tests. The first group of patients underwent MRI before arthroscopy. Only 2% of these patients had arthroscopies that revealed no positive results. However, when arthroscopy was

performed on the second group of patients with a prediagnosis of meniscus injury based solely on physical examination tests without MRI, meniscus damage could be detected in only 30% of cases.[18]

Similarly, our study demonstrates that physical examination tests are insufficient to diagnose meniscus injuries. Since the McMurray, Apley, and Ege's tests, which we evaluated among the meniscus diagnostic tests in our study, can yield highly positive results in the presence of other intra-knee pathologies without meniscus tears, we recommend that the preliminary diagnosis be supported by MRI with higher accuracy, sensitivity, and specificity rates prior to deciding on arthroscopy. Although all three diagnostic tests for the meniscus were positive in three of the nine patients who did not have meniscus tears during arthroscopy, two of these patients had only plica damage and one had chondral damage.

In a study examining 82 asymptomatic knees, it was reported that the incidence of positive MRI results in terms of meniscus was high even in asymptomatic patients, especially in patients over the age of 50.[19] This is supported by the MRI specificity rate of 68% for the medial meniscus in our study. However, since our study did not include patients over 50 years of age, MRI yielded more reliable results than in this study. For these reasons, we recommend that a preliminary diagnosis be made with physical examination tests before making a surgical decision for meniscus, especially in patients over 50 years of age, and then this preliminary diagnosis should be supported by MRI.

On physical examination, no additional tears were suspected in seven patients with partial ACL tears. Three patients with total ruptures of the ACL were diagnosed on physical examination. Although physical examination is a reliable diagnostic method for total ACL tears, it is usually insufficient for partial tears. Therefore, we recommend MRI in patients who describe an anterior cruciate ligament injury in their history, even if no injury is suspected on physical exam.

The number of intact osteochondral surfaces on arthroscopy was 22, 21 of which were also found to be intact on MRI. In other words, the specificity was quite high (95%). Of the 18 patients with stage 1 and 2 lesions, 13 (72%) were detected on MRI, whereas only 5 (50%) of the 10 patients with stage 3 and 4 lesions were detected on MRI. While a higher ratio of advanced lesions was expected, a higher ratio of low-stage lesions was diagnosed. This conclusion may have been influenced by the small number of patients in whom we evaluated chondral damage and the effects of concomitant pathologies on signal changes. Many studies have reported that cartilage lesions are frequently localized medially.[18-21] In our study, 20 of 28 patients with chondral damage had only medial side involvement.

The literature indicates that the sensitivity of MRI for detecting partial and full-thickness cartilage lesions is between 8% and 100%, while the specificity is between 80% and 100%.[20-24] Our study had a sensitivity of 36% and a specificity of 95%, which is comparable to other studies. Due to the fact that the accuracy rate remained at 62% and higher accuracy rates were observed in cartilage-specific images with high tesla devices in the literature,[25-29] we recommend cartilage-specific images with higher tesla MRI devices for patients with cartilage damage. In the literature, higher-resolution and more specific imaging protocols are recommended for evaluating chondral lesions with MRI. Rather than standard MRI, 3-tesla and 7-tesla MRI with higher magnetic field strength can provide clearer visualization, especially of small chondral lesions and subchondral changes.[30]

Additionally, imaging techniques such as T2 Mapping and T1 Rho, which are used to assess cartilage water content and collagen matrix structure, may enable the detection of early-stage chondral degeneration.[31,32] However, it should be noted that many factors, such as the movement of the patient at the time of shooting, the position of the knee, the experience of the technician performing the shooting, and the presence of additional pathologies, may affect the result. In a study by Yoon et al., the rate of correct diagnosis was 70% in the presence of one pathology, whereas the accuracy rate decreased to 28% in the presence of three or more pathologies.[33] The higher diagnosis rate of stage 2 lesions compared to stage 3 lesions in this study may be attributable to the aforementioned factors.

Physical examination, ultrasonography, and MRI have previously been used as diagnostic tools in the diagnosis of intra-knee plica.[13,34] However, arthroscopy remains the gold standard diagnostic method for identifying plica.[35] In our study, plicas were detected during arthroscopy in 33 of 50 patients. Only 21% of these plicas were detected on MRI. On MRI, plica was considered in 7 of 17 (41%) patients who did not exhibit plica on arthroscopy. The sensitivity, specificity, and accuracy of MRI in diagnosing plica were 21%, 59%, and 34%, respectively; MRI alone cannot be considered a reliable diagnostic tool. Therefore, we recommend that the presence of plica be carefully examined during all arthroscopic procedures.

The limitations of the study include the small number of patients, especially those with ligament injuries, and the lack of cartilage-specific imaging for patients with chondral injuries.

5. CONCLUSION

Meniscus tears and anterior cruciate ligament ruptures can be diagnosed through clinical examination. However, since the specificity of these tests is limited, it should be kept in mind that positive results may be obtained in the presence of other intra-articular pathologies. Therefore, when these tests yield positive results before planning knee arthroscopy, we recommend utilizing MRI to determine the actual source of the pathology and other intra-knee pathologies that may be associated. However, if a clinical examination yields a negative result, a single test should not be used, and the result should be confirmed by multiple tests. Considering the false positive and false negative rates of MRI, arthroscopic intervention should not be recommended with positive MRI results alone without clinical evidence. In cases where complaints persist due to plica and chondral injuries, we do not recommend further postponement of arthroscopic intervention based on negative MRI findings.

Authors Contributions:

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Rıfat Şahin and Mehmet Sabri Balık. The first draft of the manuscript was written by Rıfat Şahin and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Competing Interest:

The authors declare that they have no conflict of interest. On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical Considerations:

Ethical permission to perform this study was obtained from the Local Ethics Committee (Approval No:2014/148).

Funding:

No funding was received for this study. The authors declare that no funds, grants, or other

support were received during the preparation of this manuscript. The authors have no relevant financial or non-financial interests to disclose.

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