

The Comparison of Diagnostic Accuracy of MRI In Patients Suspected with Meniscus Tear Contrasted to Findings of Arthroscopy

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ABSTRACT

Background and objectives: Despite widespread use of Magnetic Resonance imaging (MRI) in clinical practice, a systematic evaluation of the diagnostic accuracy with which it does, so far has not been carried out. In this context we sought to compare the outcomes of MRI and arthroscopic examination for better understanding something important about this new technique.

Methods: Current study enrolled 65 Iraqi patients with clinical features of meniscal tears. The findings of arthroscopy in those patients were compared to that of MRI and the degree of accuracy of MRI was calculated using sensitivity and specificity statistical formulas.

Results: Comparison of results of MRI to that of arthroscopy revealed the following: the agreement about positive cases (true positive) was identified in 50 cases and the agreement about negative cases (true negative) was identified in 7 cases MRI failed in detecting 3 cases (false negative) and falsely diagnosed 5 cases (false positive). Comparison of accuracy levels and agreement between MRI and arthroscopy is shown in table 4. Kappa level of agreement value was 0.56 indicating moderate agreement between MRI and arthroscopy findings. The sensitivity level was 94.3%, the specificity level was 58.3%, the positive predictive value (PPV) was 90.9% and the negative predictive value was 70.0% and total accuracy level was 87.7%.

Conclusion: The concordance rate between MRI and arthroscopy is great with respect to diagnosis of meniscal tear; however, detailed evaluation of extent and severity of lesions requires arthroscopic examination.

Keywords: Meniscus injury, Magnetic resonance imaging, Arthroscopy.

INTRODUCTION

The incidence of traumatic knee injuries is on the rise and they are mostly associated with active people of all ages who engage in athletic activities (1-3). Thus a precise diagnosis is necessary to ensure the implementation of surgical or alternative treatments in time to prevent damage to joint parts and onset of secondary degenerative conditions (4). Arthroscopy and Magnetic Resonance Imaging (MRI) are the most commonly used diagnostic techniques for injuries to knee ligaments (5-7). Knee ligament injuries are more accurately diagnosed by arthroscopy, which possesses a diagnostic accuracy rate of as high as 94% (8). Arthroscopy can also serve therapeutic purposes (9). The disadvantages of arthroscopy remind us it is a surgical procedure involving both great cost and hospitalization. There is risk of complications such as an infection. That is why surgeons are now in a tendency to make use of MRI as a non-invasive way for the diagnosis of ligament injuries (8,10,11).

By now MRI has proved to be the number one non-invasive examination method for people with suspected knee injuries. It has improved soft tissue contrast, it is possible to take slices in different directions and planes, there is an increased signal-to-noise ratio (SNR), better resolution as well as being free from ionizing radiation (8,12). MRI is now the main way for exploring anything suspected to be a knee injury that is influential on some other parts of the body. Its ability to show soft-tissue contrast well, with views points in which there is a lesser all background noise will undoubtedly be enjoyed (8).

Research has been limited in this field to date, but in several recent studies that compared magnetic resonance imaging (MRI) of the knee with clinical diagnoses or arthroscopic examination, inconsistent conclusions have been drawn (11-14). There is a noticeable lack of extensive studies designed to assess the sensitivity, specificity, positive predictive value and negative predictive value of knee MRI in detecting meniscal injuries seen under arthroscopy (8). This research was designed to evaluate the accuracy of knee MRI compared with arthroscopy, particularly with regard to meniscal injuries; it also aimed to study what benefits (and limitations) MRI offers over arthroscopy in diagnosing these injuries.

PATIENTS AND METHODS

Patient's selection: In this research, sixty-five individuals showing possible knee meniscus tears and anterior cruciate ligament damages constitute the cohort. These subjects were admitted to Al Diwanayah Teaching Hospital's orthopedic department (Iraq), from September 2023 until September 2024. This group comprised 36 males and 29 females, with ages ranging from 35 to 62 years and a mean age of (48.42±8.09) years. The criteria for inclusion were as follows: (1) patients who exhibited joint swelling, pain, laxity, and locking as determined by clinical examination; (2) subjects with ante-posterior abduction tests, supination-extension float tests, axial shift tests, and bounce tests which all showed positive findings; (3) able to give voluntary consent for participation in the study with a signed informed consent form. The exclusion criteria included: (1) people declining to

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participate in the study; (2) individuals with a diagnosis of rheumatoid arthritis.

MRI examination: To ensure that the femoral arc emerges such that its lateral and medial pedicles were equidistant from the coronal plane, the patients were placed supine and the outer end of the bone was lined within an elliptical orientation parallel to the skewed direction of the canal. The two magnetic resonance imaging (MRI) scanners utilized in clinical practice are as follows: Siemens superconducting model, 1.5T; United Imaging temperature model, 3.0T. In addition, at both 1.5T and 3.0T magnetic field strengths, the knee phased array surface coil was used together with echo time (TE) and repetition time (TR) parameters established to have T2-weighted coronal spin echo imaging (SE T2WI) run for 90 ms and 2100 ms. For Philips systems the TE/TR setting is 18 ms/540 ms. The United Imaging devices had additional parameters as well, including aspheric SE. Two expert imaging specialists analyzed and interpreted the images cooperatively, and then assessed the meniscus tear within the knee joint.

Arthroscopy: After the administration of lumbar anesthesia, the patient was placed on his back. An incision was made in the anteroinferior portion and posterior portion of the knee joint that utilized traditional techniques, followed by application of arthroscopy. The main aim of this operation was to examine closely and to evaluate the texture and morphology of the meniscus and articular cartilage. Arthroscopic diagnostic parameters: Meniscus tear: the posterior horn of the medial meniscus is not directly visible with arthroscopy as it is usually obstructed by the internal femoral capsule; for this reason, one cannot see in that portion of the posterior horn using arthroscopy and therefore it becomes essential to use a probe equipped with a blunt hook to probe this area--a probe which has already been devised by ourselves (4).

Statistical analysis: Microsoft office Excel version 2010 was used to make statistical work. The variable that are qualitative were described using counts and percentage (%); whereas, numeric data were presented using the following: minimum value, maximum value, standard deviation and mean. The kappa level of agreement was calculated according to formula described by McHugh (15). The sensitivity, the specificity, the positive predictive value, the negative predictive value and accuracy level were calculated using formulas described by Trevethan (2017) (16).

RESULTS

Demographic characteristics of patients with suspected meniscal lesions are shown in table 1. The study included 65 patients of whom there were 36 (55.4%) males and 29 (44.6%) females. The range of age was between 35 and 62 years and the mean age of all patients was 48.42±8.09 years. Detection of meniscal lesions by MRI and arthroscopy is shown in table 2. The MRI detected 55 patients with meniscal lesions and arthroscopy confirmed 53 cases of them. According to MRI, there were 32 cases of medial meniscus lesions and 23 cases of lateral meniscus lesions. Based on arthroscopy, there were 23 cases of medial meniscus lesions and 22 cases of lateral meniscus lesions.

Comparison of results of MRI to that of arthroscopy is shown in table 3. The agreement about positive cases (true positive) was identified in 50 cases and the agreement about negative cases (true negative) was identified in 7 cases MRI failed in detecting 3 cases (false negative) and falsely diagnosed 5 cases (false positive). This means that the result of the MRI examination of the meniscus tear depends on the experience of radiologists and the sensitivity of MRI, which is in the best condition does not give us 100% accurate diagnosis. Comparison of accuracy

levels and agreement between MRI and arthroscopy is shown in table 4. Kappa level of agreement value was 0.56 indicating moderate agreement between MRI and arthroscopy findings. The sensitivity level was 94.3%, the specificity level was 58.3%, the positive predictive value (PPV) was 90.9% and the negative predictive value was 70.0% and total accuracy level was 87.7%.

Table 1. Demographic characteristics of patients with suspected meniscal lesions

Characteristic	Result
Age, years	Mean±SD & Range 48.42±8.09 (35-62)
Sex	Male, n (%) 36 (55.4%) Female, n (%) 29 (44.6%)

SD: standard deviation; n: number of cases

Table 2. Detection of meniscal lesions by MRI and arthroscopy

Technique of diagnosis	Total	Medial meniscus	Lateral meniscus
	n(%)	n(%)	n(%)
MRI	55 (84.5)	32(49.2)	23(35.4)
Arthroscopy	53(81.5)	31(47.7)	22(33.8)

MRI: magnetic resonance imaging

Table 3. Comparing the results of MRI to that of arthroscopy.

	Arthroscopy		
	Positive	Negative	Total
MRI	50 (TP)	5 (FP)	55
	3 (FN)	7 (TN)	10
	53	12	65

MRI: magnetic resonance imaging; TP: true positive; FP: false positive; FN: false negative; TN: true negative

Table 4. Comparison of accuracy levels and agreement between MRI and arthroscopy.

Characteristic	Result
Kappa value	0.56
Sensitivity	94.3
Specificity	58.3
PPV	90.9
NPV	70.0
Accuracy	87.7

PPV: positive predictive value;
NPV: negative predictive value

DISCUSSION

Magnetic resonance imaging (MRI) has ascended in significance to such an extent that it is presently regarded as the gold standard for the assessment of knee lesions. It is employed in both pre-operative and post-operative evaluations. This technique is characterized by its non-invasive nature, which does not depend on the operator's skill and does not necessitate the administration of contrast agents (17). No imaging technique possesses the capability to elucidate the intricate structures of the knee with the same level of precision as radiographs, arthrograms, and ultrasound. In instances where the articular cartilage remains intact, arthroscopy may not consistently detect osteochondritis dissecans, inferior surface tears, or peripheral meniscal tears (17).

In this research, we included 45 individuals who were clinically thought to be suffering from a meniscal injury. The mean age was consistent

with relatively young individuals indicating that this lesion is mainly encountered in young athletes and heavy activity working individuals in accordance with the observations of previous authors (8,17). There were more men than women (55.4% versus 45.6%) in this research. In this investigation, we were aiming at evaluating the accuracy of MRI in detecting meniscal lesions via calculation of sensitivity, specificity, PPV, and NPV and correlating MRI findings to that obtained by arthroscopy. We found very few instances of both false positives and false negatives in our research and this is in line with previous findings described by many authors (18,19). However, due to differences in MRI sensitivities, a lot of meniscal injuries may pass unnoticed or be incorrectly diagnosed (20,21). Therefore, even when the results of MRI are normal, one is still in need for solid clinical evidence.

In this study we reported a kappa level of agreement value of 0.56. Khandelwal (8) reported a kappa level of agreement of 0.88 which appears greater than that reported in our study, probably because of enrolling a relatively larger sample size. The sensitivity and PPV in our study (94.3% and 90.9%) were comparable to that seen in Khandelwal et al (2018); however, we reported lower levels of specificity and NPV. Overall accuracy in our study was 87.7% which is slightly lower than that reported by previous in Khandelwal et al (2018) study (8).

Based on the observation of Kim et al. (22), the kappa level of agreement between arthroscopic findings and that of MRI and was 0.717, referring to accepted agreement, the sensitivity and specificity of MRI, done pre-operatively, in evaluating meniscus injury were 80.74% and 85.35% and the accuracy level was 83.1%. Indeed, these figures are relatively supportive to our findings. It should be emphasized that, the particular location and types of meniscus lesions were not easy to predict using MRI; whereas, this job was easy when considering arthroscopy and this observation was stated also by Kim et al. (22).

CONCLUSION

The concordance rate between MRI and arthroscopy is great with respect to diagnosis of meniscal tear; however, detailed evaluation of extent and severity of lesions requires arthroscopic examination.

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Competing Interest: None

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