Trauma Mon. 2015 February; 20(1): e18635. DOI: 10.5812/traumamon.18635

Published online 2015 January 7. **Research Article**

Correlation Between Magnetic Resonance Imaging and Arthroscopic Findings in the Knee Joint

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Received: February 28, 2014; **Revised:** May 13, 2014; **Accepted:** May 19, 2014

Background: The knee joint is the largest and the most complex joint of the human body. It is not covered by any thick muscular covering anteriorly.
Objectives: The purpose of this study was to explore the diagnostic capabilities of clinical examination, magnetic resonance imaging (MRI), and arthroscopy in traumatic disorders of the knee joint, to seek correlation between clinical findings, MRI findings and arthroscopic.
Patients and Methods: A total of 26 patients with a presentation suggestive of traumatic knee pathology were studied prospectively. A detailed history was taken and relevant clinical examination was done, which was followed by MRI of the knee. The patients were scheduled for arthroscopy under general/spinal anesthesia, whenever indicated.
Results: Keeping arthroscopic examination as standard, the correlation between clinical and arthroscopy showed a sensitivity of 80%, specificity of 86%, accuracy of 63.16%, negative predictive value of 93.48%; whereas MRI *vs.* arthroscopy showed a sensitivity of 74.42%, specificity of 93.10%, accuracy of 84.21%, and negative predictive value of 88.04%.
Conclusions: The clinical examination is an important and accurate diagnostic modality for evaluation of traumatic derangement of the knee joint. It is noninvasive, easy, available, and valuable diagnostic modality. The MRI is an accurate diagnostic modality. It can be used whenever there is an uncertain indication for arthroscopy. However, costs have to be kept in mind, especially in patients with low socio-economic status.

Keywords: Medial Meniscus; Injury; Lateral Meniscus; Anterior Cruciate Ligament; Posterior Cruciate Ligament

1. Background

The knee joint is the largest and the most complex joint of the human body. Anteriorly, the knee joint is not covered by any thick muscular covering and because of this structural weakness and very thin anterior covering, this joint is prone to injuries from direct trauma and rotation. These twisting injuries cause tearing of the meniscus and ligaments. The meniscal and ligament tears and osteoarthritic changes cannot be diagnosed completely by clinical examination; therefore, we have to use extra noninvasive or invasive measures to diagnose these changes, e.g. magnetic resonance imaging (MRI) and or arthroscopy. Currently, MRI is the noninvasive examination of choice in evaluation of internal derangement of the knee. Arthroscopy can be used for both diagnosis and treatment, but this technique is invasive and costly and is less efficacious for the evaluation of the extracapsular soft tissues (1-5). MRI can be used as an effective screening study in those patients with uncertain indications for arthroscopic surgery because the high negative predictive value (NPV) of MRI can spare many of these patients an unnecessary arthroscopic examination (1, 2, 5-9). In patients with clearly defined indications for arthroscopy, routine use of preoperative MRI is more controversial (10). Traditionally, arthrography and arthroscopy have been diagnostic gold standards for evaluation of internal derangements and other lesions of the knee. Although MRI has played an increasing role in the evaluation of knee lesions in recent years, its diagnostic potential is fallible.

2. Objectives

The present study aimed to explore the diagnostic capabilities of clinical examination, MRI, and arthroscopy in traumatic disorders of the knee joint and to seek any correlations among them.

3. Patients and Methods

This prospective study was conducted at the Department

of Orthopedics of the Holy Family Hospital, from March 2011 to May 2012. A total of 26 patients with presentation suggestive of traumatic knee pathology or symptomatic knees with complaints of pain, locking, giving way, or swelling were referred from the outpatient/Emergency Department of Orthopedics. A detailed history was taken and relevant clinical examination was done followed by MRI of the knee, whenever possible. The imaging consisted of multiple surveys in all planes and were reported by the senior radiologists. The patients were examined and prepared for arthroscopy under general or spinal anesthesia, which was performed by the senior authors. From 94 patients who agreed to MRI, 14 were lost to follow up and 54 patients refused, hence, only 26 patients completed the study.

4. Results

Keeping arthroscopic findings as the standard reference, each of the findings of these three diagnostic modalities (clinical examination, MRI, and arthroscopy) was marked as separate entities. The results of clinical examination and MRI were analyzed in terms of the true and false positive and negative diagnoses. The sensitivity and specificities were calculated for each diagnostic modality. A total of 26 patients (20 males and six females) were evaluated. The youngest patient was 13 and the oldest was 50 years old. There was a predominance of patients in their third decade of life. The mode of injury sustained by the patients in the study was commonly due to twisting of the lower leg as a result of athletic injury, roadside accident, or falling from stairs. Overall, 18 patients (70%) complained of pain, 5 (20%) had history of locking, 9 (36%) had history of giving way, 13 (50%) complained of click, and 18 (70%) presented with more than one complaint (Tables 1 - 4).

Table 1. Findings of the Clinical Examination, Magnetic Resonance Imaging, and Arthroscopic Examination [a,b]

Diagnosis	Normal Findings	Medial Meniscal Injury	Lateral Meniscal Injury	ACL Injury	PCL Injury
Clinical examination	0	15	1	14	0
MRI	0	20	5	18	0
Arthroscopy	4	14	4	16	0

[a] Abbreviations: ACL, anterior cruciate ligament; MRI, magnetic resonance imaging; PCL, posterior cruciate ligament.
[b] Data are presented as No.

Table 2. Findings of Clinical Examination and Their Comparison With Findings of Arthroscopy [a,b,c]

	Total Arthroscopy	Total Clinical Examination	True Positive	False Positive	True Negative	False Negative
Normal findings	4	0	0	0	22	4
Medial meniscal injury	14	15	9	6	6	5
Lateral meniscal injury	4	1	1	0	22	3
ACL injury	16	14	14	0	10	2
PCL injury	0	0	0	0	26	0

[a] Abbreviations: ACL, anterior cruciate ligament; PCL, posterior cruciate ligament.
[b] On analyzing the above data the sensitivity, specificity, accuracy, and negative predictive values of 80%, 86%, 63.16% and 93.48% were calculated respectively.
[c] Data are presented as No

Table 3. Magnetic Resonance Imaging Findings and Their Correlation With Findings of Arthroscopy [a,b,c]

	Total Arthroscopy	Total MRI	True Positive	False Positive	True Negative	False Negative
Normal findings	4	0	0	0	22	4
Medial meniscal injury	14	19	14	6	6	0
Lateral meniscal injury	4	5	2	3	19	2
ACL injury	16	18	16	2	8	0
PCL injury	0	0	0	0	26	0

[a] Abbreviations: ACL, anterior cruciate ligament; PCL, posterior cruciate ligament; and MRI, magnetic resonance imaging.
[b] On analyzing the above data the sensitivity, specificity, accuracy, and negative predictive values of 74.42%, 93.10%, 84.21%, and 88.04% were calculated respectively.
[c] Data are presented as No.

Table 4. Clinical Examination and Magnetic Resonance Imaging Findings of the Knee Joint in Comparison to Arthroscopic Findings [a]

	Clinical Examination	MRI
Sensitivity	80	74.42
Specificity	86	93.10
Accuracy	63.16	84.21
Negative Predictive Value	93.48	88.04

[a] Data are presented as %.

5. Discussion

In the present study, efforts were directed to select those patients who had definite history of functional symptoms of the joints. Clinically, 15 patients were diagnosed to have medial meniscus injury, 14 of which were confirmed on arthroscopy, whereas one had a normal knee joint. Only one patient was diagnosed to have lateral meniscal injury, which was confirmed on arthroscopy. Furthermore, this patient had an additional ruptured anterior cruciate ligament (ACL). Three lateral meniscal injuries were not detected on clinical examination while 14 ACL injuries were diagnosed on clinical examination; all of which were subsequently confirmed on arthroscopy. However, two ACL injuries were not detected on clinical examination. None of the patients had normal findings on clinical examination, whereas four had normal findings on arthroscopy. In the present study, the sensitivity and specificity of clinical examination of the knee were 80% and 86%, respectively. The accuracy and the NPV were 63.16% and 93.48%, respectively. The clinical examination depends largely on the experience of the doctor; i.e. how well he can perform the examination and arrives at the correct conclusion. If the clinical examination is performed correctly, it can yield high true positive and low false positive results. In this study, it had promising results in the form of higher true positive and lower false positive results. The ratio of true negatives was also higher, which resulted in high NPV. Thus, the above advantages prove that clinical examination is an important prerequisite for evaluation of knee disorders. It is noninvasive, easy, and highly specific, without any added cost to the patient. On MRI, 19 medial meniscus injuries were diagnosed but only 14 were confirmed on arthroscopy. Five lateral meniscus injuries were diagnosed on MRI but only two were confirmed on arthroscopy. Instead, two out of above five patients were diagnosed to have medial meniscus injury and one was diagnosed as normal on arthroscopy. Two cases of lateral meniscus injury were not detected on MRI. Among 18 ACL injuries diagnosed on MRI, 16 were confirmed on arthroscopy and two were diagnosed as normal knees on arthroscopy. None of the patients had normal findings on MRI, whereas four patients had normal findings on arthroscopy. As with other authors, the results of MRI evaluation of the knee joint have been promising (1, 6-15) despite the fact that the number of the patients who took MRI were less in comparison to previous studies. The sensitivity of MRI in this study was 74.42% and specificity was 93.10%. Currently, arthroscopy is used as the gold standard to determine the diagnostic accuracy of methods that investigate internal knee derangements. Arthroscopy is not 100% accurate and is extremely operator dependent (2, 7-9, 11, 12, 14, 16). At the present time, however, arthroscopy is the diagnostic test with which all others must be compared with to determine the diagnostic effectiveness (15). The accuracy of MRI in the present study was 84.21%, which is lower in comparison to other studies (1, 7-19). The NPV of MRI in this study was 88.04%, and slightly lower than rates in other studies (1, 7-9, 11-18, 20). This discrepancy can be discounted if we consider the fact that fewer numbers of patients were included in the study and arthroscopy is operator dependent. Even though MRI is the noninvasive examination of choice in evaluation of internal knee derangement, the routine use of preoperative MRI (10) is not recommended. It can be used as an effective screening study in those with uncertain indications for arthroscopic surgery (1, 2, 5-9). Arthroscopic knee surgeries are performed worldwide and many studies with a large number of patients are being published (21-25). The stress, however, is always on the clinical examination because of the varying arthroscopic and MRI findings. In countries with low socioeconomic status, where the MRI or arthroscopy are not readily available, the clinical examination should be the gold standard for selecting patients for arthroscopy. Healthcare systems of these countries should have special packages to cover the expenses of MRI and arthroscopies so that the general population may benefit from them.

The clinical examination is one of the most important and accurate diagnostic modalities for evaluation of traumatic derangement of the knee joint. All patients with knee injury should be subjected routinely to a thorough clinical examination to make a provisional diagnosis. It is noninvasive, easy, available, and inexpensive but valuable diagnostic modality. The MRI is an accurate diagnostic modality. It can be used whenever there is an uncertain indication for arthroscopy. All patients can benefit from preoperative MRI, if the cost is not a limiting factor. Further study of the sensitivity and specificity of the MRI is warranted with a larger series of patients.

Acknowledgements

The authors express their thanks to Bal Gopal Nair, MS Ortho, MCH Ortho, for his support during the initial write up and subsequent revision of the paper.

Authors' Contributions

Study concept and design: Pradeep Sharma and Pankaj Bajaj; analysis and interpretation of data: Hayat Ahmad

Khan, Humayun Ahad, and Younis Kamal; drafting the manuscript: Hayat Ahmad Khan; critical revision of the manuscript for important intellectual content: Hayat Ahmad Khan, Humayun Ahad, Nazia Hassan, Younis Kamal, and Pankaj Bajaj; study supervision: Pradeep Sharma.

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