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Correlation Between Clinical Findings MRI and Arthoscopic Findings in Anterior Cruciate Ligament and Meniscal Injuries of the Knee

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ABSTRACT

This prospective study involved 30 patients with knee injuries, revealing that pain and instability were the predominant complaints. The data indicated a higher incidence of knee injuries among males, particularly affecting the right knee. The most frequently observed injury was an anterior cruciate ligament (ACL) tear, followed by medial meniscal injuries. Clinical assessments demonstrated excellent sensitivity for detecting ACL injuries, average sensitivity for medial meniscal injuries and good sensitivity for lateral meniscal tears. In contrast, magnetic resonance imaging (MRI) exhibited good sensitivity for ACL injuries, average sensitivity for medial meniscal injuries and poor sensitivity for lateral meniscal injuries. Previous studies suggesting that MRI is superior to arthroscopy for diagnosing meniscal and cruciate ligament tears were not corroborated by the findings of this study. Nonetheless, MRI remains a valuable non-invasive diagnostic tool, exhibiting moderately high sensitivity, specificity and accuracy for meniscal and cruciate ligament injuries. The majority of patients were aged between 20 and 30 years, comprising 28 males and 2 females. The most common injuries identified were ACL tears and medial meniscal tears. The accuracy rates for MRI in diagnosing medial meniscal, lateral meniscal and ACL injuries were 70%, 70% and 80%, respectively. In comparison, the accuracy of clinical examinations for these injuries was 67%, 80% and 90%, respectively. For suspected ACL injuries, patients may be directed to undergo arthroscopy rather than MRI, given the higher accuracy of clinical evaluations. The study found that the number of cases with combined injuries (ACL and medial meniscus) exceeded those with isolated injuries. Additionally, the detection of medial meniscal tears in conjunction with ACL injuries was lower via MRI. These findings reflect the typical challenges faced by orthopedic surgeons in daily practice. MRI proves beneficial in scenarios where arthroscopy may not be effective, such as in cases of peripheral meniscal tears and inferior surface tears. Numerous anatomical variations may resemble tears on magnetic resonance imaging (MRI). It is not necessary to perform MRI on every patient with suspected ligamentous injury, particularly when clinical signs are clearly evident.

INTRODUCTION

The knee joint is a common site of injury, mainly due to trauma, repetitive activities and sports activities. Clinical diagnosis, encompassing an accurate history, thorough examination and interpretation of investigations, is an art all doctors are expected to master during their career. A number of previous studies have examined the accuracy of clinical diagnosis in traumatic meniscal or ligamentous injuries of the knee. Multiple imaging modalities are currently used to evaluate pathologic conditions of the knee like conventional radiography, fluoroscopy, sonography, nuclear medicine and MR imaging. The use of fluoroscopy and sonography to guide interventional procedures and Computerized Tomography (CT) to evaluate complex fractures has become a routine practice[1]. Magnetic resonance imaging has a better soft tissue contrast and multi planar slice capability which has revolutionized and has become the ideal modality for imaging complex anatomy of the knee joint[2,3]. Another advanced modality in the management of internal derangement of knee joint is Arthroscopy, which can be used in its dual mode, either as diagnostic and/or as therapeutic tool[4]. It is considered to be the 'gold standard' investigative method. Its high diagnostic accuracy allows it to be used as a benchmark when assessing the usefulness and sensitivity of other diagnostic methods.

Aims:

- To determine accuracy of clinical diagnosis by comparing with arthroscopic findings in meniscal and ACL injury of knee.
- To determine accuracy of MRI findings in meniscal and ACL injury in comparison with arthroscopic findings.
- To correlate diagnostic accuracy of clinical and MRI findings in ACL and meniscal injuries.
- To study the feasibility of performing arthroscopy procedure based on clinical judgement alone without MRI in meniscal and ACL injuries of the knee.

MATERIALS AND METHODS

This is a prospective study involving 30 patients with history of knee injuries who have admitted in Department of Orthopaedics. MRI of the knee joint was done for all these patients either before or after admission. The patients were then subjected to diagnostic and therapeutic arthroscopy in the department of Orthopaedics.

Sources of Data: 30 cases of knee trauma admitted in department of Orthopaedics. All patients were subjected to clinical examination followed by arthroscopy after required investigations and consent.

Study Population: Patients who were reported with knee symptoms suggestive of ACL and meniscal injury, undergone clinical and MRI evaluation and subjected to Arthroscopy were subjects of the study.

Inclusion Criteria:

- Patients suffering from knee problems like pain, instability.
- Patients with recent symptoms of locking of knee or effusion.
- Patient with chronic knee pain and doubtful knee injury.
- Patient aged between 20-40 years.

Exclusion Criteria: Following patients were excluded from our study:

- Cases with severe osteoarthritis.
- Patients with signs of acute infections.
- Cases of ankylosed knee.
- Cases who have undergone previous arthroscopy.
- Cases treated for chronic septic arthritis or with ATT as doubtful TB knee.
- Patient below the age of 20 years and above 40 years.

Methods of Assessment:

Before Surgery:

- Presenting complaints.
- History of presenting complaints.
- Medical/surgical co-morbidities.
- General physical examination.
- Complete examination of knee with particular emphasis on tests for ACL tears like anterior. Drawer test, lachman test. Tests for meniscal tears like joint line tenderness, Mc Murrays test, Apleys grinding test.
- Pre-operative work up.
- X-ray of involved knee AP and lateral view to rule out any bony injury.
- Routine-haemogram, biochemical parameters of blood, ECG, Imaging protocol.

MRI Knee-Included Following Sequences:

- **Axial:** T2.
- **Sagittal:** T1, PDFS.
- **Coronal:** PDFS, T2.
- Pre anesthetic check-up and ASA grading for fitness for surgery.

Surgery: All the Arthroscopic procedures were performed under spinal anesthesia. Per-operative findings were documented in the operation theater, which included the anatomical structure involved with presence or absence of tears, its location, status of the articular cartilage and additional details when available.

Patient Positioning: Under spinal anesthesia, patient in supine position a tourniquet and a lateral post were applied. Thoroughly scrubbed from ankle to mid thigh, knee flexed to 900 with help of lateral post and surgically prepared.

Portal Placement: The standard portals for arthroscopy i.e. anteromedial and anterolateral portals were used in all cases. Anterolateral portal was located approximately 1cm above the lateral joint line and approximately 1 cm lateral to margin of patellar tendon. A 4mm diameter, 30 degree oblique forelens arthroscopy through the anterolateral portal was used through which almost all the structures within the joint could be seen. Antero-medial portal located 1cm above medial joint line, 1 cm inferior to the tip of patella and 1 cm medial to the edge of patellar tendon. It was used for additional viewing of lateral compartment and for insertion of a probe for palpation of medial and lateral compartment structures.

Irrigation System: Joint distention was maintained by normal saline during arthroscopy. The inflow and outflow passed directly through the arthroscopic sheath.

Arthroscopic Examination of the Knee: The knee was divided routinely into the following compartments for arthroscopic examination.

- Suprapatellar pouch and patella femoral joint.
- Medial gutter.
- Medial compartment.
- Inter condylar notch.
- Posteromedial compartment.
- Lateral compartment.
- Lateral gutter and posterolateral compartment.

After performing arthroscopy of knee, the pathological lesion was identified and further surgery was carried out accordingly (partial/subtotal meniscectomy for meniscal tears, ACL, reconstruction for ACL tears).

Documentation: Operative findings were documented in the operation theater which included the survey of entire joint and anatomical structures. Lesions involved with presence or absence of tears, its location, status of articular cartilage and others. The composite data was tabulated and studied for correlation with clinical and MRI findings and grouped into four categories.

True Positive: Where positive clinical or MRI diagnosis are confirmed by positive intra operative arthroscopic evaluation.

True Negative: Where the absence of pathological findings in clinical examination or MRI could be confirmed by arthroscopy.

False Positive: Where a positive clinical or MRI diagnosis are negative with arthroscopy findings.

False Negative: Where a positive intra operative arthroscopy finding present, but clinical or MRI diagnosis was found to be negative.

Method of Analysis of Data: Statistical analysis was used to calculate the sensitivity, specificity, positive predictive value (PPV) and the negative predictive value (NPV) in order to assess the reliability of MRI results. From the study we extracted the relevant data, we calculated true positive, true negative, false positive and false negatives values. The accuracy, sensitivity, specificity, negative predictive value (NPV) and positive predictive value (PPV) were calculated using the following equations, PPV=TP/(TP+FP), NPV=TN/(TN+FN), Sensitivity=TP/ (TP+FN), Specificity =TN/(FP+TN) and Accuracy=(TP+TN)/(TP+TN+FP+FN).

Table 1 : Interpretation of Sensitivity

90%-100%	Excellent
80%-90%	Very Good
70%-80%	Good
60%-70%	Average
<60%	Poor

RESULTS AND DISCUSSIONS

Sex Distribution: The study had 30 patients, of which 28 were males and 02 were females. The right knee joint was found to be more commonly involved than the left knee joint and there were no cases with bilateral knee involvement in our series.

Table 2: Anterior Cruciate Ligament (ACL) Tears

Assessment	ACL injury		Total
	Positive n (%)	Negative n (%)	N (%)
Clinical finding	22(73.3)	8(26.7)	30(100.0)
MRI	19(63.3)	11(36.7)	30(100.0)
Arthroscopy	23(76.6)	7(23.3)	30(100.0)

Table 3: Diagnostic Value of Clinical Findings in Comparison to Arthroscopic Findings

	Medial Meniscus	Lateral Meniscus	Anterior Cruciate Ligament
Sensitivity	68.1%	75.0%	91.3%
Specificity	62.5%	83.3%	85.7%
PPV	83.3%	75.0%	95.4%
NPV	41.6%	83.3%	75.0%
Accuracy	66.6%	80.0%	90.0%

The sensitivity and specificity of clinical findings with respect to arthroscopy for medial meniscus tear is 68.1% and 62.5% respectively. The sensitivity and specificity of clinical findings with respect to arthroscopy for LATERAL meniscus tear is 75.0% and 83.3% respectively. The sensitivity and specificity of clinical findings with respect to arthroscopy for ACL injury is 91.3% and 85.7% respectively.

Table 4: Diagnostic Value of MRI Findings in Comparison to Arthroscopic Findings

	Medial Meniscus	Lateral Meniscus	Anterior Cruciate Ligament
Sensitivity	68.1%	50.0%	78.2%
Specificity	75.0%	83.3%	85.7%
PPV	88.2%	66.6%	94.7%
NPV	46.1%	71.4%	54.5%
Accuracy	70.0%	70%	80.0%

The sensitivity and specificity of MRI with respect to arthroscopy for MEDIAL meniscus tear is 68.1% and 75.0% respectively. The sensitivity and specificity of MRI with respect to arthroscopy for LATERAL meniscus tear is 50.0% and 83.3% respectively. The sensitivity and specificity of MRI with respect to arthroscopy for ACL injury is 78.2% and 85.7% respectively.

Table 5: True Positive, True Negative, False Positive and False Negative of Clinical Findings, Using Arthroscopic Finding as the Reference Data

Clinical Findings	True Positive	False Positive	False Negative	True Negative
Medial Meniscus	15	03	07	05
Lateral Meniscus	09	03	03	15
ACL	21	01	02	06

Table 6: True Positive, True Negative, False Positive and False Negative of MRI Findings, Using Arthroscopic Finding as the Reference Data

MRI Findings	True Positive	False Positive	False Negative	True Negative
Medial meniscus	15	02	07	06
Lateral meniscus	06	03	06	15
ACL	18	01	05	06

The purpose of this study is to compare the accuracy of clinical findings and MRI in diagnosing the most common injuries of the knee i.e. meniscal and ACL injuries, with Arthroscopy as gold standard investigation. This is a prospective study involving 30 patients with history of knee injury, who were admitted in Department of Orthopaedics. Clinical examination was performed to patients, suspected to have ligaments and meniscal injury were subjected for MRI of the knee joint followed by diagnostic and therapeutic arthroscopy in the Department of Orthopaedics. MRI images are studied for evidence of injuries to menisci, cruciate ligaments, of the knee joint. Arthroscopy was performed to confirm the clinical and MRI findings. In the current study of 30 patients, 28 were males and 02 were females. The age groups ranging from 20-40 years .Among the males youngest was 21 years and oldest was 40 years. Among females youngest was 22 years and the oldest female was 37 years. This showed that there was a tendency of males being injured and getting operated at the earlier age. A Study done by Fritz *et al* showed males are most likely to suffer knee injuries as they are active in sports and the Right knee was are more frequently injured than left. In current study patients, of age group 20-30 years, the maximum patients who suffered from knee injuries are predominantly males. Right knee was involved in 17 cases and left was involved in 13cases and no bilateral involvement. Meniscal tears were classed as torn or not torn. Anterior cruciate ligaments (ACL) either completely torn or not. In current study of 30 patients,22cases of medial meniscal tears were identified arthroscopically, Clinically 18 cases, 17 were through MRI. The sensitivity and specificity of clinical diagnosis with respect to arthroscopy is 68.1% and 62.5% for medial meniscal tears. The sensitivity and specificity of MRI with respect to arthroscopy is 68% and 75% for MM tears. Medial meniscal tear is the second most common type of ligament tear followed by lateral meniscal tears. This is corresponding with, La Prade and colleagues who reported that medial meniscal tears are twice as common as lateral meniscal tears[5]. In our study MRI detected 09 cases of lateral meniscal injury, clinical examination and arthroscopy positive cases are 12 out of 30 cases. Sensitivity and specificity of MRI in LM are 50% and 83.3%.PPV and NPV are 67% and 71%. Accuracy of clinical examination is 70% Sensitivity, specificity, PPV, NPV and accuracy of clinical examination in lateral meniscal tears are 75%, 83.3%, 75%, 83.3%, 80% respectively. Over all in clinical findings and MRI have higher specificity than sensitivity and a higher NPV than PPV with good sensitivity for clinical examination and average sensitivity for MRI. Elvenes[6] in their study found that sensitivity, specificity, positive and negative predictive value of MRI for MM were 100%, 77%, 71% and 100% respectively, while values for LM were 40%, 89%, 33 %, and 91% respectively. Overall accuracy of MRI for MM and LM combined was 84%. On basis of high negative predictive value, they concluded that MRI is useful to exclude patients from unnecessary arthroscopy. In our study MRI has a higher false negatives i.e. low sensitivity and high specificity in detecting lateral meniscal tears. Similar to above study both clinical and MRI have high NPV (71.4% and 83.3%) useful to exclude patients from unnecessary arthroscopy. ACL injury is most common among involved knee injuries clinically 22 cases are positive, one is false positive which are confirmed by arthroscopy. Sensitivity, specificity, PPV, NPV of clinical findings in reference to arthroscopy are 91.3%, 85.7%, 95.4%, 75%. Sensitivity and PPV of clinical findings are in fair correlation with arthroscopic findings. MRI able to detect 19 cases as true positive and one is false positive among 30 patients. Sensitivity, specificity PPV, NPV of MRI in correlation to arthroscopy are 78.2%, 85.7%, 94.7%, 54.5% respectively. Accuracy of clinical findings in identifying ACL injuries (90%) is higher than in MRI findings (80%). In one of our chronic IDK knee MRI

shows ACL incompetence but intact fibers, however clinically patient had instability and at arthroscopy showed a chronic tear partially healed by fibrosis which was inefficient and required a reconstruction[7]. The sensitivity and specificity in various studies have shown the range between 61% and 100% and 82% and 97% respectively[7]. In our study the positive predictive value and negative predictive value was 95% and 75% respectively. The positive predictive value and negative predictive value range from 70-96% and 70-100% respectively. The accuracy, sensitivity and specificity values for knee lesions vary widely in literature. Rubin[8] reported 93% sensitivity for diagnosing isolated ACL tears. Similarly several prospective studies have shown a sensitivity of 92-100% and specificity of 93-100% for the MR imaging diagnosis of ACL tears[9-11]. In our study clinical examination is more accurate (90%) than MRI findings (80%) in ACL tears. The summary of different studies showing correlation between clinical findings and MRI findings in meniscal injuries. These studies showing importance of pre-operative clinical examination which makes MRI unnecessary before doing arthroscopy. In present study similar findings are seen with medial meniscal injuries.

CONCLUSION

Arthroscopy has remained the reference standard for the diagnosis of internal derangements of the knee, against which alternative diagnostic modalities should be compared. The strength of correlation between MRI and arthrosporic findings confirms the value of MRI in assessing internal knee structures. However, skilled clinical examination rates similarly to MRI. Whereas modern imaging techniques can be invaluable in diagnosis, where a complete and repeated physical examination can sometimes play the same role. By obtaining correlation between clinical examination, MRI scan and arthroscopy for meniscal and ACL injuries. The study concludes thorough clinical examination infer equal and better diagnosis of meniscal and ACL injuries in comparison to MRI scan. Although MRI is being used with increasing frequency, it doesn't outweigh the clinical diagnosis. It is used in connection with clinical findings and history to provide a more complete picture, especially in complex injuries, history and examination alone can't be reliable in less clinically evident situations, however MRI helps to diagnose in an acute/painful knees. The routine use of MRI's confirmed diagnosis is not indicated, for all lesions. In the presence of positive clinical signs, proceeding to arthroscopy is recommended. The negative predictive value of a scan was found to be high for lateral meniscus of the knee joint and hence a 'normal' scan can be used to exclude a pathology, thus sparing patients from expensive and unnecessary surgery and also freeing up valuable theater time. In this scenario the accurate and careful clinical examination remains the primary necessity in diagnosing knee injuries.

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