



CORRELATION OF MAGNETIC RESONANCE IMAGING FINDINGS WITH ARTHROSCOPIC FINDINGS IN INTERNAL DERANGEMENT OF KNEE.

Orthopaedic

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ABSTRACT

Introduction: The knee joint is a common site of injury. Multiple imaging modalities are currently used with Magnetic Imaging Resonance (MRI) being the ideal modality for imaging. Another advanced modality is arthroscopy.

Aim: 1) To evaluate the accuracy of MRI and to compare MRI and arthroscopy in diagnosing Internal Derangements of Knee (IDK)

Sample size: 200 cases

Results: MRI is advantageous in conditions like peripheral menisci tears and inferior surface tears. MRI is more sensitive in detection of multiple meniscal tears and less sensitive in detecting Anterior Cruciate Ligament (ACL) tears.

Conclusion: Though MRI is a great aid in diagnosing IDK it is unlikely to replace clinical diagnosis and should be used in conjunction with arthroscopy since the misleading results of MRI are high, hence arthroscopy still remains the gold standard.

KEYWORDS:

Arthroscopy, IDK, MRI

INTRODUCTION:

The knee joint is a common site of injury mainly due to trauma, repetitive activities and sports activities.

The knee is a complex joint allowing flexion, extension, anterior-posterior gliding and internal-external rotation and consisting of the articulation between the femur and tibia, articulation between the patella and the femur and two fibro cartilaginous menisci, Lateral Menisci (LM) and Medial Menisci (MM), one on each side. In addition, two very strong ligaments, the Anterior Cruciate Ligament (ACL) and the Posterior Cruciate Ligament (PCL) interconnect the adjacent ends of the femur and tibia and maintain their opposed position during movement.

Multiple imaging modalities are currently used to evaluate pathologic conditions of the knee like conventional radiography, sonography, nuclear medicine and MR imaging¹.

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 IDK is arthroscopy, which can be used in its dual mode, either as diagnostic and/or as therapeutic tool⁴.

The term internal derangement is loosely applied clinically to describe a variety of intra-articular disturbances with or without extra articular disturbances, usually of traumatic origin. It comprises of injuries to menisci, cruciate ligaments, collateral ligaments and other structures of the knee joint⁵.

AIM:

1) To evaluate the accuracy of MRI and to compare MRI and arthroscopy in diagnosing Internal Derangements of Knee (IDK)

MATERIALS AND METHODS:

Study design: Prospective study

Sample size: 200 patients

Location: DY PATIL Medical College & Hospital, Pimpri

Duration: April 2012 to October 2016

All patients were subjected to MRI followed by arthroscopy. Equipment used

- 1) Siemens Magnetom Avanto 1.5 Tesla (8 channel knee coil)
- 2) Arthroscope (Stryker).

Operative Procedure:

All the arthroscopic procedures were performed under spinal anaesthesia. Per Operative findings were documented in the operation theatre, after through scrubbing and draping, the patient was placed supine with the prepared and draped limb angled off the lateral aspect of the table, so that the limb dangled at 90 degrees. Stryker arthroscope of our hospital was used. Anterolateral and Anteromedial portals were used.

Irrigation Systems:

Joint distension was maintained by normal saline during arthroscopy. The inflow and outflow passed directly through the arthroscopic sheath.

Observations and Results:

The composite data was tabulated and studied for correlation with MRI findings and grouped into four categories:-

1. True-positive - MRI diagnosis was confirmed by arthroscopic evaluation.
2. True-negative - MRI negative for lesion and confirmed by arthroscopy.
3. False-positive - MRI shows lesion but the arthroscopy was negative.
4. False-negative - arthroscopy was positive but the MRI showed negative findings



Fig 1: Patient positioning



Fig 2: Portal placement

Method Of Analysis Of Data:

Collected data was presented in the form of tables. Sensitivity, specificity and predictive values were calculated. Data was analysed by kappa statistics.

Table 1: Interpretation of sensitivity

| | |
|--------------|-----------|
| 90 % - 100 % | Excellent |
| 80% - 89% | Very good |
| 70% - 79% | Good |
| 60 %– 69% | Average |
| < 60% | Poor |

Table 2: Interpretation of Kappa Statistics

| | |
|-------------|------------------|
| 0.00 | Poor agreement |
| 0.01 – 0.20 | Slight agreement |
| 0.21 - 0.40 | Fair agreement |
| 0.41 – 0.60 | Moderate |
| 0.61 – 0.80 | Substantial |
| 0.81 – 1.00 | Almost perfect |

Interpretation of 'P' value:

- P<0.05- Significant
- P<0.01- Highly significant
- P>0.05- Not significant

RESULTS:

1) Sex Distribution/ Age distribution & Side involved:

Table 3: Incidence of sex,age and side distribution

| Sex | Number of cases | % |
|---------------|-----------------|------|
| Male | 145 | 72.5 |
| Female | 55 | 27.5 |
| AGE | Number of cases | % |
| 11-20 | 17 | 8.4 |
| 21-30 | 89 | 44.5 |
| 31-40 | 67 | 33.3 |
| 41-50 | 22 | 11.1 |
| 51-60 | 5 | 2.7 |
| Side Involved | Number of cases | % |
| Right | 111 | 55.5 |
| Left | 89 | 44.5 |

2) Structures Involved:

Table 4: Incidence of structures involved

| Structures injured | Clinical Exam | MRI | Arthroscopy |
|--------------------|---------------|-----|-------------|
| ACL | 133 | 139 | 139 |
| PCL | 00 | 06 | 06 |
| Medial Meniscus | 50 | 100 | 61 |
| Lateral Meniscus | 22 | 44 | 33 |

From the study we extracted the relevant data, we calculated True Positive(TP), True Negative(TN),False Positive(FP) and False Negatives(FN) values. The accuracy, sensitivity, specificity, negative predictive value (NPV), and positive predictive value (PPV) were calculated using the following equations,

$PPV = TP / (TP + FP)$,
 $NPV = TN / (TN + FN)$,
 $sensitivity = TP / (TP + FN)$,
 $specificity = TN / (FP + TN)$
 $accuracy = (TP + TN) / (TP + TN + FP + FN)$.

3) Correlation of MRI and Arthroscopy in terms of a)Anterior Cruciate ligaments(ACL),b)Posterior Cruciate ligaments (PCL), c)Medial meniscus(MM) and d) Lateral Meniscus(LM).

Table 5: Correlation of MRI and Arthroscopy

| MRI (ACL) | ARTHROSCOPY(ACL) | | |
|-----------|-------------------|----------|-------|
| | Positive | Negative | Total |
| Positive | 137 | 2 | 139 |
| Negative | 2 | 59 | 61 |
| Total | 139 | 61 | 200 |
| MRI (PCL) | ARTHROSCOPY(PCL) | | |
| | Positive | Negative | Total |
| Positive | 06 | 00 | 06 |
| Negative | 00 | 194 | 194 |
| Total | 06 | 194 | 200 |
| MRI (MM) | ARTHROSCOPY (MM) | | |
| | Positive | Negative | Total |
| Positive | 50 | 50 | 100 |
| Negative | 11 | 89 | 100 |
| Total | 61 | 139 | 200 |
| MRI (LM) | ARTHROSCOPY (LM) | | |
| | Positive | Negative | Total |
| Positive | 22 | 22 | 44 |
| Negative | 11 | 143 | 154 |
| Total | 33 | 167 | 200 |

Table 6: Statistical analysis of the structures:

| Structu res (%) | Sensitivity (%) | Specificity (%) | PPV (%) | NPV (%) | Accura cy (%) | Kappa value | p value |
|-----------------|-----------------|-----------------|---------|---------|---------------|--------------------|----------------------|
| ACL | 92 | 81.8 | 92 | 81.8 | 88.8 | 0.737(substantial) | 0.001-significant |
| PCL | 100 | 100 | 100 | 100 | 100 | 1-almost perfect | 0.0238 - significant |
| MM | 81.8 | 64 | 50 | 88.8 | 69.4 | 0.0323-fair | 0.0488 - significant |
| LM | 66.6 | 86.6 | 50 | 92.8 | 83.3 | 0.0746-substantial | 0.0001 - significant |
| OD | 100 | 100 | 100 | 100 | 100 | 1-almost perfect | 0.0238 - significant |

DISCUSSION:

1. Age & Sex:

In the present study,145 were males and 55 were females. The age groups ranged from 18 to 60 years with the youngest male being 18 yrs and the oldest, 45yrs respectively and the youngest female being 34yrs and the oldest female being 58years respectively. This showed that

there was a tendency of males being injured and getting operated at the earlier age.

A Study done by Fritz et al⁶ showed males are most likely to suffer knee injuries since they are active in sports. In the present study males comprise the predominant number of patients who suffered knee injuries who are actively involved in sports.

2: Side Involved:

Right knee was involved in 111 cases (55.5%) and left knee was involved in 89 cases (44.5%) There were no bilateral involvement.

3. Meniscal Injuries:

a) Medial Meniscus:

In our study MRI detected 100 cases of medial menisci injury, arthroscopy confirmed 61 cases. Sensitivity and specificity of MRI with respect to Arthroscopy is 81.8% and 64% showing an average correlation with arthroscopy in diagnosing medial meniscal injuries.

Elvenes et al⁷ in their study found the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of MRI for medial meniscus tears were 100%, 77%, 71% & 100% respectively.

In the present study sensitivity, specificity, positive and negative predictive value are 86.6%, 66.6%, 50% and 88.8.

In our study we found that sensitivity, specificity, positive and negative predictive value of MRI compared to arthroscopy was less compared to the other studies.

b) Lateral Meniscus:

In our study MRI detected 44 cases of lateral meniscal injury and arthroscopy detected 33 cases. Sensitivity and specificity of MRI in relation to Arthroscopy is 66.6% and 86.6%. It had a fair correlation with arthroscopy in diagnosing lateral meniscal injuries. PPV of MRI in detecting lateral meniscus injuries is 50% with NPV of 92.85%.

Overall, MRI has a higher specificity (86.6%) than sensitivity (66.6%), and a higher NPV (92.85) than the PPV (50%).

Elvenes et al⁷ in their study found that sensitivity, specificity, positive and negative predictive value of MRI for MM were 100%, 77%, 71% & 100% respectively, while values for LM were 40%, 89%, 33% & 91% respectively. Overall accuracy of MRI for MM & 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 positives i.e. high sensitivity and low detecting meniscal tears. If MRI is used as the only form of pre-operative screening for this condition, then there may well be unnecessary arthroscopies performed.

4. Cruciate Ligament Lesions:

a) Anterior Cruciate Ligament:

Among the structure involved in knee injuries ACL injury is the most common accounting for 139 cases in MRI of which 2 were false positives and arthroscopy detected 137 of the 139 cases plus 2 new cases from the remaining (false negative of MRI). Sensitivity and Specificity of MRI with respect to Arthroscopy is 92% and 81.8%, PPV of MRI is 92% while NPV is 81.8%.

b) Posterior Cruciate Ligament:

Out of 200 cases MRI detected 6 PCL injury which was confirmed by arthroscopy and hence Sensitivity, specificity and positive and negative predictive values remains at 100% and shows excellent correlation in detecting PCL injuries.

MRI is accurate in identification of ACL tears, ranging from 93% to 97. The sensitivity and specificity in various studies have shown to range between 61% and 100%, and 82% and 97% respectively⁸.

In our study the positive predictive value and negative predictive value was 92% and 81.8% respectively. The positive predictive value and negative predictive value range from 70% to 76% and 70% to 100% respectively⁸.

There are studies that support the view that the diagnostic accuracy of the MRI could affect in a critical way the treatment pathway of knee injuries.

Mc Kenzie et al⁹ have studied 332 patients' diagnosis before and after MRI. The diagnosis was initially based on the clinical examination and the therapeutic procedure was decided before MRI. 57 from 113 clinically positive before MRI meniscal tears were not confirmed with MRI. This result lead to reevaluation and differentiation of treatment in 62 percent of the patients. From those patients programmed for surgery only 38 percent finally underwent arthroscopy.

As far as the cruciate ligaments are concerned, our study showed that from the 139 ACL ruptures diagnosed during arthroscopy 02 of them were missed by the MRI; leading to NPV of MRI for ACL ruptures of 81.8%. Causes of that target loss are easily recognised; firstly; in cases with ligament ruptures without mucosum rupture, MRI gives false negative results. Additionally, ruptures near ligaments' insertion may be missed and MRI examination reveals an intact ACL. On contrary, false positive ACL ruptures occur in cases of intrabody mucosal or eosinophilic degeneration of ACL^{10,11}.

There is no doubt that the radiologist's experience and training are very important factors in interpretation of MRI. At the same time, reliable statistical data of the diagnostic value of the MRI are also related to the independent base of reference. Regarding knee MRI, in most of the studies and in our study as well, the base of reference is arthroscopy. This presupposes that arthroscopy is 100% accurate and allows for the diagnosis of every possible knee pathology. This is not always the case^{12,13}. Arthroscopy is a technically demanding procedure and the results are varying according to surgeon's experience, especially in difficult cases. Nowadays, the overall accuracy of arthroscopy varies between 70-100% depending on the surgeon's experience^{14,15,16}.

CONCLUSION:

Knee joint injuries are common. The need to accurately evaluate the knee injuries is very crucial for the proper management and outcome; otherwise it will lead to chronic debility to the patient.

Magnetic resonance imaging (MRI) is of great aid in the diagnosis of knee lesions. Most diagnostic studies comparing MRI and arthroscopy have shown good diagnostic performance in detecting lesions of the menisci and cruciate ligaments. Nevertheless, arthroscopy has remained the reference standard for the diagnosis of internal derangements of the knee, against which alternative diagnostic modalities should be compared. Although MRI is being used with increasing frequency, it is unlikely to replace clinical diagnosis. It should be used in connection with clinical findings and history to provide a more complete picture, especially in complex injuries, as history and examination alone may be unreliable in less clinically evident situations, however MRI still remains the only available means to diagnose in a acute/painful knees. Also it is difficult to assess the injury status and the severity in a multiligamentous knee injuries by clinical methods alone. In these situations MRI becomes mandatory for the treating clinician. But in situations of chronic instabilities with clinically noticeable findings MRI may not be of significant value and hence can be avoided in clinically proven cases of knee instabilities.

The present study supports that MRI is helpful in diagnosing meniscal and cruciate ligament injuries. Nowadays patients' expectations are maximal and taking into account that MRI false or misleading results can be as high as 20-30 percent in specific knee pathologies, it is concluded that arthroscopy still remains the gold standard in diagnosing the internal knee lesions.

Our study found that the accuracy of the MRI scan in diagnosing IDK is in the order of PCL, ACL and MENISCAL lesions. The routine use of MRI scan to confirm diagnosis is not indicated, as the positive predictive value of the scan is low 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 all structures of the knee joint and hence a 'normal' scan can be used to exclude a pathology, thus sparing patients from expensive and unnecessary surgery. In this scenario the accurate and careful clinical examination remains the primary necessity in diagnosing IDK.

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