

To Study and Evaluate the MRI and Arthroscopic Findings in Knee Problems with Special Attention towards False Positive & False Negative Reports

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Abstract

Introduction :- The purpose of this study was to evaluate the MRI and Arthroscopic findings in internal derangement of knee. Between May 2010 to November 2012, 40 patients with IDK were prospectively assessed. After the physical exam, MRI studies and arthroscopic surgery of the knee were performed. The sensitivity, specificity, positive and negative predictive values were estimated. Data was analyzed for the significance of correlation between MRI and arthroscopic findings of knee injury by Chi Square test. Out of 40 patients, 33 were males & 7 were females. Patients suffered knee injuries were ranging from 13 to 55 years of age. The sensitivity, specificity & accuracy of MRI for ACL was 100%, 43.75%, 77.5%, for PCL 80%, 85.71%, 85%, for medial meniscus 84.61%, 40.74%, 55%, for lateral meniscus 50%, 81.25%, 75% & for osteochondral injuries 70%, 100%, 92.5% respectively when compared with arthroscopy. There were high incidences of false positive & false negative MRI reports. From our study we can conclude that arthroscopy still remains the gold standard in diagnosing the internal knee lesions. The use of MRI as a supplemental tool in the management of meniscal and ligament injuries should be highly individualised by an experienced surgeon.

Key words: ACL, PCL, Medial meniscus (MM), Lateral meniscus (LM), Osteochondral Defects (OCD), Arthroscopy, MRI.

Introduction

Increased number of vehicles and poor road conditions has resulted in increased incidence of knee trauma. Sports injuries and even minor accidents at home also are adding in the knee injuries. The knee injuries have no boundaries of age and sex. Clinical tests used in the diagnosis of meniscal and cruciate ligament damage have limitations and it may not be possible to elicit objective signs repeatedly, more so in a busy orthopaedic clinic and being painful in an acute or subacute presentation.¹ Since the introduction of Magnetic Resonance Imaging for clinical use in 1984, the role of MRI in the diagnosis of knee lesions has now become more evident.^{2,3} The MRI is much better tool of investigation in internal derangement of knee. 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. In day to day clinical practice, MRI scan is routinely used to support the

diagnosis for meniscal or ACL injuries prior to recommending arthroscopic examination and surgery. But sometimes the MRI reports are inconsistent with actual diagnosis. Identification of meniscal tears can be difficult to interpret and can be observer dependent as well as dependent upon the sensitivity of the scanner.⁴ False positive and false negative reports can create dilemma in minds of patients as well as surgeons. Arthroscopy of the knee has been used since 1970s as a diagnostic and therapeutic tool in the management of knee injuries. Arthroscopy is considered as 'the gold standard' for diagnosing intraarticular knee problems.⁵ The arthroscopic evaluation is best possible tool in hands of reasonably experienced arthroscopist and gives a conclusive opinion on problem.¹ The arthroscopic evaluation is a dynamic investigative tool and at the same time it has got a therapeutic value.

The study overall deals with the evaluation of MRI & arthroscopic findings in knee problems & throws light on the perfect diagnosis to reduce the confusion in patients & surgeons.

Material and Method

This is a prospective comparative study carried out in Department of Orthopaedics, Dr D. Y. Patil Medical College & Hospital, Kolhapur. Fourty cases whose symptoms suggesting internal derangement of knee were selected for this study from May 2010 to November 2012. Though 40 patients were studied, these are

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representation of huge amount of patients where confusion do occur in MRI reports & arthroscopic findings. The patients with knee pathology other than traumatic knee injury were excluded from present study. MRI of the knee joint was done after admission and clinical examination. However some patients who had been referred from outside or taken treatment and MRI being done prior to admission in our hospital are considered with same MRI report and not subjected to fresh MRI investigation. However all the patients were subjected to clinical examination followed by arthroscopy after required investigations and consent. A thorough clinical examination was carried out. MRI images were studied for evidence of injuries to menisci, cruciate ligaments, articular cartilage, and bony contusions. These patients were then taken for diagnostic and therapeutic arthroscopy. All the arthroscopic procedures were performed under spinal anaesthesia. Per Operative findings were documented in the operation theatre, which included the anatomical structure involved with the presence or absence of tears, its location, status of the articular cartilage and additional details when available. Photographs and videos were taken and stored for later retrieval. Here we consider arthroscopy is gold standard & MRI findings are compared with arthroscopic findings. There are many studies which have already proved that Arthroscopy is gold standard in finding proper knee diagnosis. The composite data was tabulated and studied for correlation with MRI findings and grouped into four categories-

1. True-positive When MRI & arthroscopy both show positive lesion.
2. True-negative- When MRI & arthroscopy both show negative finding.
3. False-positive – When MRI shows lesion but the arthroscopy was negative.
4. False-negative -When arthroscopy was positive but the MRI was negative.

The accuracy, sensitivity, specificity, negative predictive value (NPV), and positive predictive value (PPV) of MRI were calculated to assess the reliability of the MRI results using the following equations, $PPV = TP / (TP + FP)$, $NPV = TN / (TN + FN)$, $Sensitivity = TP / (TP + FN)$, $Specificity = TN / (FP + TN)$, $Accuracy = (TP + TN) / (TP + TN + FP + FN)$.

The literature is reviewed and findings of our study is compared with findings of other studies done in past.

Result

The study had 40 patients, of which 33 were males and 7 were females. The patients who suffered injury were with age ranging from 13 to 55 years. The right knee joint was

Structures injured	MRI	Arthroscopy
ACL	33	24
PCL	9	5
Medial meniscus	27	13
Lateral meniscus	11	8
OCD	7	10

Table 1

found to be more commonly involved than the left knee joint and there were no cases with bilateral knee involvement in our series. Motor vehicle accident was the most common mode of injury. Anterior Cruciate Ligament was the most common structure injured in patients of our study. The structures injured are summarized in table 1. True positive, True negative, False positive & False negative cases were calculated from overall data. It is summarized in table 2.

Structure	TP	TN	FP	FN	Total
ACL	24	7	9	0	40
PCL	4	30	5	1	40
MM	11	11	16	2	40
LM	4	26	6	4	40
OCD	7	30	0	3	40

Table 2

ACL tear was most commonly injured structure in our study. MRI showed 33 ACL tears. Arthroscopy confirmed 24 cases of ACL tear. In 9 cases arthroscopy does not confirmed positive MRI findings. Arthroscopy confirmed 7 MRI negative cases. There were 9 PCL injuries according to MRI reports. Arthroscopy confirmed 5 PCL injuries out of which 4 cases were correlating MRI and in 1 case arthroscopy was positive but MRI was negative. 30 negative cases shown by MRI are confirmed by arthroscopy. MRI diagnosed 27 positive cases of medial meniscal injury. Arthroscopy confirmed 13 positive cases of medial meniscal injury. Out of 13 cases, 2 cases were not picked up by MRI. There were 16 false positive cases according to MRI reports. 11 negative cases of medial meniscus diagnosed by MRI were correlating with arthroscopy. Medial meniscus showed highest number of false positive cases. In case of lateral meniscus MRI was positive in 11 cases and arthroscopy was positive in 8 cases. Out of 8 positive cases 4 cases were true positive and 4 were false negative cases. True negative cases were 26. Lateral meniscus showed highest number of false negative cases. MRI diagnosed 7 positive cases of osteochondral injuries. Arthroscopy showed 10 positive cases. MRI failed to diagnose 3 cases of osteochondral injuries. 30 negative

cases diagnosed by MRI were confirmed by arthroscopy. The strength of correlation of MRI and arthroscopic findings were analysed by applying Chi Square test & Kappa statistics. The ACL, PCL, Lateral meniscus & Osteochondral defects were statistically significant while medial meniscal values were statistically insignificant. This probably may be because our data was very small. The sensitivity, specificity, Accuracy, positive predictive value (PPV) & negative predictive values (NPV) are summarized in table

Discussion

The goal of the study was to compare arthroscopy and MRI scans in the diagnosis of intra-articular knee injuries.

In the present study of 40 patients, 33 were males and 07 were females. Right knee injury (22 cases) was more common than left knee injury (18 cases) and there was no bilateral involvement. Though there are some studies showing bilateral involvement. Study done by P. G.

Structure	Sensitivity	Specificity	Accuracy	PPV	NPV
ACL	100%	43.75%	77.50%	72.72%	100%
PCL	80%	85.71%	85%	44.44%	96.77%
MM	84.61%	40.74%	55%	40.74%	84.61%
LM	50%	81.25%	75%	40%	90.90%
OCD	70%	100%	92.5%	100%	90.90%

Table 3

Kulkarni⁶ showed males are most likely to suffer knee injuries since they are active in sports. Another study done by Fritz et al showed males are most likely to suffer knee injuries and the right knee was more frequently injured than left. In the present study males comprise the predominant number of patients who suffered knee injuries who were actively involved in sports and our study supports findings of study done by P. G. Kulkarni & Fritz.

Different studies confirm that MRI has higher false positive results than false negative results. We also found this to be true when examining the combined results from meniscal lesions and cruciate tears.

In the our study sensitivity, specificity, positive and negative predictive value of MRI for medial meniscus were 84.61%, 40.74%, 40.74% and 84.61% respectively & for lateral meniscus were 50% ,81.25%, 40% , 90.90% respectively. Accuracy of MRI for medial & lateral meniscus was 55% & 75% respectively. A study by Pappenport et al showed accuracy rate of 90% for MRI in the detection of Meniscal tears compared with the arthroscopy. Elvenes et al⁷ in their study found the sensitivity, specificity, positive and negative predictive value of MRI for medial meniscus tears were 100%, 77%, 71% & 100% & for lateral meniscus were 40%, 89%, 33%, & 91% respectively. Overall, for medial meniscus MRI has a higher sensitivity (84.61%) than specificity 40.74%), and a higher NPV (84.61%) than the PPV (40.74%). MRI has a

higher specificity (81.25 %) than sensitivity (50%), and higher NPV (90.90%) than PPV (40%) in case of lateral meniscus. Our findings of medial meniscal injury confirm that MRI has higher false positive results than false negative results. In our study, medial meniscus has maximum false positive results (16 cases). 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%. Findings of our study are matching with little variation with findings of study done by Elvenes et al⁷ for lateral meniscus but for medial meniscus our findings differ from findings of Elvenes et al

In our study MRI has a higher false positives (MM – 16 cases & LM – 6) i.e. high sensitivity and low specificity in detecting meniscal tears. If MRI is used as the only form of pre-operative screening for this condition, then there may be unnecessary arthroscopies performed which is contradictory to studies saying that MRI prevents unnecessary arthroscopy.

There are explanations for this apparent discrepancy between findings at MR Imaging and arthroscopy described by Mink et al⁸

- * Misinterpretation of normal anatomy like meniscofemoral ligaments which can mimic meniscal tear.
- * The observer dependency of MRI and interobserver errors.
- * Radial meniscal tears are difficult to visualize on MRI; hence they account for a large number of tears missed by MRI
- * Meniscal tears and meniscal degenerative changes have the same appearance in MRI by giving high signals within the meniscus⁹
- * The most frequent cause for false positive MRI regarding the lateral meniscus is the misinterpretation of the signal coming from the inferior genicular artery¹⁰
- * Herman et al¹¹ accredited in his study about 38% of false positive MRI results often due to the popliteal bursa or Humphrey`s ligament may mimic posterior lateral meniscal tears. ^{11,12}
- * The false negative results seem to occur exclusively from misinterpretation of MRI.

Sensitivity, Specificity, Accuracy, PPV, NPV of MRI with respect to Arthroscopy for ACL is 100%,43.75% ,77.5, 72.72%.& 100% respectively in our study. Our study shows MRI has very good sensitivity (100%) which may be due to fact that ACL is relatively easy structure to see on MRI and because of ACL injuries are most common injuries in IDK , radiologists are very keen to see whether ACL is injured

or not. So there are fewer chances of interobserver errors in case of ACL injuries.

There was not a single false negative case of ACL in our study. But there are numerous studies which show MRI have false negative cases of ACL. However the accuracy of MRI in diagnosing ACL tear is increased with experience in field of radiology and coming of better quality MRIs in market. The sensitivity, specificity, PPV & NPV of MRI for ACL in various studies have shown to range between 61% to 100%, 82% to 97%, 70% to 76% and 70% to 100% respectively in different studies.¹³

The sensitivity, specificity, accuracy, positive predictive value and negative predictive value of MRI in case of PCL injuries are 80%, 85.71%, 85%, 44.44%, 96.77% respectively.

Accuracy, Sensitivity, specificity, PPV & NPV of MRI for osteochondral injuries is 92.5%, 70%, 100%, 100% & 90.90% respectively which shows good correlation with Arthroscopy in diagnosing articular cartilage injuries. In general our observation is that MRI is very accurate in diagnosis of osteochondral injury. According to Mori et al¹⁴ usage of modern, improved techniques can not only reveal the size of chondral lesions but also to distinguish partial from full depth chondral damages as well. MRI gives excellent performance in diagnosis of osteochondral injury even better than Arthroscopy especially when images are taken by latest high resolution MRI machines.

Simultaneous injury to several supporting structures is relatively common in the knee. When more than one lesion was present, completely correct diagnosis was rendered only 30%. This phenomenon was reported by Rubin¹⁵. Imhoff et al¹⁶ suggested that due to low positive predictive value of MRI, it should not be routinely used to confirm clinical diagnosis and its use should be limited to those cases where clinical examination is inconclusive. A diagnostic arthroscopy would be a better choice in those cases. Causes of false negative MRI scan of ACL described in various studies. Firstly in cases with ligament ruptures without mucosum rupture, MRI gives false negative results. Additionally ruptures near ligament's insertion may be missed and MRI examination reveals an intact ACL. From this we can conclude that even if MRI is negative & if patient's symptoms are persistent & genuine, still the arthroscopy is required to confirm the exact cause of pain & treatment in knee joint. On contrary, false positive ACL ruptures occur in cases of intrabody mucosal or eosinophilic degeneration of ACL¹⁷. 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. From this study, we believe that routine interaction of arthroscopist and radiologist with retrograde introspection about the diagnosis should be encouraged.

In our country routine use of MRI for diagnosing every knee injury is not acceptable considering the cost effectiveness of treatment. So in patients with obvious clinical diagnosis by experienced orthopaedic surgeon role of MRI is debatable.

Conclusion

This study has highlighted some controversial areas in the assessment of the diagnostic performance of MRI in knee injury. Although MRI and arthroscopic findings are usually in close agreement, there are still few discrepant results. Many of these discrepancies might be avoided by routine interaction of arthroscopist and radiologist with retrograde introspection about the diagnosis.

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