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Radio Diagnosis

To Assess the Utility of MRI in Menisci and Ligamentous Injuries of Knee in Correlation with Arthrosopy

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Abstract **Original Research Article**

***Background*:** The knee joint is a very common site of injury. Most cases are attributable to trauma, repetitive activities and due to sports. Meniscal injuries are most common among knee injuries. MRI is an accurate, non-invasive imaging modality for evaluating knee injuries and determines patient management, saving them from unnecessary arthroscopy. Our study focuses on the utility of MRI and its various sequences in assessing the most common knee injuries. ***Methods*:** A prospective, cross-sectional study was done on 50 patients who were clinically suspected of internal derangement of the knee joint underwent MRI after taking written consent. Out of 50 patients in the study, 35 patients underwent knee arthroscopy after MRI .The findings were recorded on pre-structured proforma and correlation was done with arthroscopic findings. ***Results*:** Out of 50 patients who underwent MRI, ACL injury was the most frequent, observed in 35 [70%] patients followed by medial meniscus injury, seen in 20 [40%] patients. The sensitivity and Specificity of MRI with respect to arthroscopy in detection of ACL injury are 100% and 88.88%, respectively; thus, MRI is excellent in detecting ACL injury. ***Conclusion*:** The study reveals high sensitivity (95-100%) and high specificity (88-100%) for the meniscus and ligament injuries of the knee joint in comparison to arthroscopy. MRI is an appropriate screening tool for therapeutic arthroscopy, making diagnostic arthroscopy unnecessary in most patients.

Keywords: MRI- Magnetic Resonance Imaging, Ligament, Meniscus, PDFS- Proton density fat saturation sequence, GRE- Gradient sequence, Arthroscopy.

INTRODUCTION

Significant advances have been made in knee imaging in Magnetic Resonance Imaging (MRI), which has emerged as a primary tool in evaluating knee injuries and for proper management [1-3]. With the development of new sequences with an improved Signal-to-noise ratio (SNR), better resolution, reduced artefacts, lesser imaging times, and improved accuracy, MRI has altered the traditional algorithm for the workup of knee joint pathology, particularly when internal derangement in cases of twisting injuries to the knee is suspected [1-4].

MRI is an accurate, non-invasive imaging modality for evaluating knee injuries and determines patient management, saving them from unnecessary arthroscopy [5].

Our study focuses on the utility of MRI and its various sequences in assessing the most common knee injuries. It is a non-invasive diagnostic modality that lacks the radiation issues associated with a radiograph and is non-operator- dependent, unlike ultrasound.

The knee joint is a very common site of injury. Meniscal injuries are most common among knee injuries seen in young male adults. The most commonly injured site in the meniscus is the posterior horn. Medial meniscal tears are twice more common than lateral meniscal tears [6].

Anterior cruciate ligament (ACL)- Acute tears of ACL are one of the most common causes of large acute hemarthrosis in the athletic population, and 41%–75% of acute knee injuries with hemarthrosis have an ACL tear [6, 7].

Posterior cruciate ligament (PCL)- Injuries of PCL

represent 2%-23% of all knee injuries. In 30% of cases, PCL injury is isolated; in the remaining cases, there is some coexistent ligamentous injury [8, 9].

The Medial collateral ligament (MCL)- MCL injuries are one of the most common ligamentous injuries of the knee [10], accounting for 40% of knee ligament injuries. It occurs mainly in athletes; accounts for 8% of all athletic knee injuries.

The Lateral collateral ligament (LCL) When LCL is disrupted; it is common to see associated tears in PCL. Secondary findings such as joint space widening, effusion, meniscal tears, cruciate tears, and bone bruises are not unusual.

Studies suggest that, of all the routine MRI sequences, fat-suppressed PDFS sequence of the traumatic knee can be an accurate and time- saving protocol as an alternative to non-FS-PDW TSE and T2 images [11].

Another advanced modality in managing internal derangement of the knee joint is arthroscopy, which serves dual purpose as a diagnostic or therapeutic tool [12].

By following a systemic approach, our study will evaluate the spectrum of imaging features in traumatic knee injury, classify various tear patterns, and compare the diagnostic value of proton density with fat suppression (PDFS) and T2 gradient echo (T2 GRE) MRI sequences.

METHODOLOGY

This is a prospective, cross-sectional study on the patients clinically suspected of internal derangement of the knee joint referred to the department of Radio-diagnosis at Sri Aurobindo Medical College & P.G. Institute, Indore. The study included 50 patients conducted from April 2021-30 to September 2022, after approval from the institutional research & ethical committee.

The radiological findings of the patient were collected using a Siemena1.5 T MAGNETOM ® Symphony® with Tim technology MR Machine. Routine MR pulse sequences PD fat saturation in axial, PD fat saturation sagittal ,PD fat saturation coronal plane PD fat saturation sagittal gradient coronal T1WI ,T2 sagittal plane were obtained using a phased- array head coil.

RESULTS

Out of the 50 patients enrolled in the study with clinical suspicion of knee injury undergoing knee MRI &/or arthroscopy,38 %of the patients were from the 21-30 age group, followed by 30 % of the patients were from 31-40 age group.

In the study 36 patients were male and 14were female. Out of 50 patients in the study, 35 patients underwent knee arthroscopy after MRI.

Table 1: Internal Derangement observation based on MRI

Lesion	No of Cases	%
Anterior Cruciate Ligament	35	70
Posterior Cruciate Ligament	5	10
Medial Collateral Ligament	5	10
Lateral Collateral Ligament	2	4
Medial Meniscus	20	40
Lateral Meniscus	9	18
Bony Contusion	15	30
Joint Effusion	20	40

ACL injury was the most frequent, observed in 70% patients. The second most common injury observed was medial meniscus injury, seen in 40% patients.

Table 2: Anterior Cruciate Ligament (ACL) Tears

MRI	Arthroscopy		
	Positive	Negative	Total
Positive	26	1	27
Negative	0	8	8
Total	**26**	**9**	**35**

The Fisher exact test statistic value is < 0.00001. The result is significant at $p < .05$. Sensitivity – 100%Specificity – 88.88%Positive predictive value – 96.3% Negative predictive value – 100% Positive likelihood ratio – 8.33 Negative likelihood ratio – 0.

The sensitivity and Specificity of MRI with respect to arthroscopy are 100% and 88.88%, respectively; thus, MRI is excellent in detecting ACL injury. MRI detected more cases than arthroscopy since grade I and grade II injuries may not be picked up by arthroscopy.

Table 3: Posterior Cruciate Ligament (PCL) Tears

MRI	Arthroscopy		
	Positive	Negative	Total
Positive	4	0	4
Negative	0	31	31
Total	**4**	**31**	**35**

The Fisher exact test statistic value is 0. The result is significant at $p < .05$. Sensitivity – 100%Specificity – 100%Positive predictive value – 100% Negative predictive value – 100% Positive likelihood ratio – 1 Negative likelihood ratio – 0 Both sensitivity and specificity of MRI in relation to arthroscopy are 100%.

Table 4: Medial Collateral Ligament (MCL) Tears

MRI	Arthroscopy		
	Positive	**Negative**	**Total**
Positive	2	1	3
Negative	0	32	32
Total	**2**	**33**	**.35**

The Fisher exact test statistic value is 0.005. The result is significant at p < .05. Sensitivity – 100% Specificity – 96.96% Positive predictive value – 66.66% Negative predictive value – 100% Positive likelihood ratio – 25 Negative likelihood ratio – 0 The sensitivity and Specificity of MRI with respect to arthroscopy are 100% and 96.96%, respectively; thus, MRI is excellent in detecting MCL injury.

Table 5: Lateral Collateral Ligament (LCL) Tears

MRI	Arthroscopy		
	Positive	**Negative**	**Total**
Positive	1	0	1
Negative	0	34	34
Total	**1**	**34**	**35**

The Fisher exact test statistic value is 0.0286. The result is significant at p < .05. Sensitivity – 100% Specificity – 100% Positive predictive value – 100% Negative predictive value – 100% Positive likelihood ratio – 1 Negative likelihood ratio – 0 Both sensitivity and specificity of MRI in relation to arthroscopy are 100%

Table 6: Medial meniscus tears

MRI	Arthroscopy		
	Positive	**Negative**	**Total**
Positive	15	0	15
Negative	0	20	20
Total	**15**	**30**	**35**

The Fisher exact test statistic value is < 0.00001. The result is significant at p < .05. Sensitivity – 100% Specificity – 100% Positive predictive value – 100% Negative predictive value – 100% Positive likelihood ratio – 1 Negative likelihood ratio – 0 Both sensitivity and specificity of MRI in relation to arthroscopy are 100%.

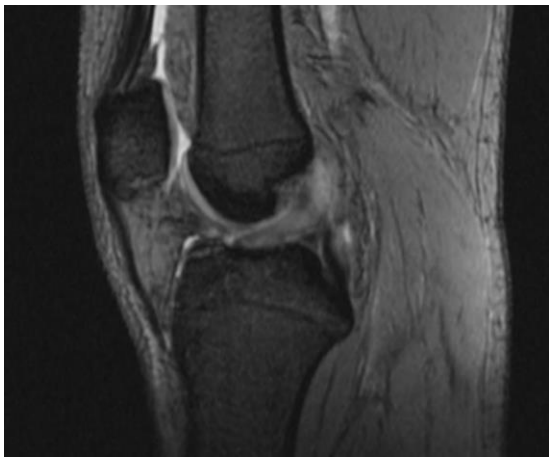
Table 7: Lateral Meniscus Tears

MRI	Arthroscopy		
	Positive	**Negative**	**Total**
Positive	4	1	5
Negative	0	30	30
Total	**4**	**31**	**35**

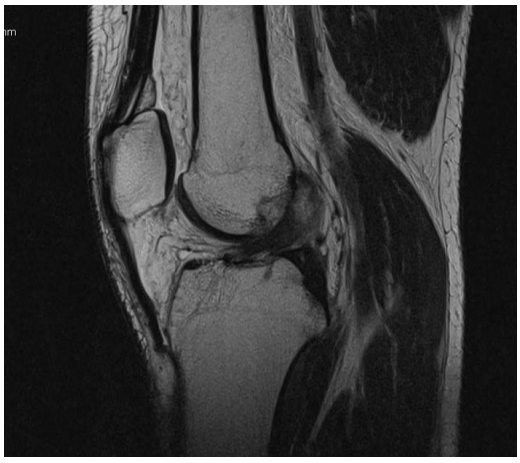
The Fisher exact test statistic value is 0.0001. The result is significant at p < .05. Sensitivity – 100% Specificity – 96.77% Positive predictive value – 80% Negative predictive value – 100% Positive likelihood ratio – 30.9 Negative likelihood ratio – 0.

The sensitivity and Specificity of MRI with respect to arthroscopy are 100% and 96.77%, respectively; thus, MRI is excellent in detecting MCL injury. MRI has excellent negative predictive value in detecting Lateral meniscal tears.

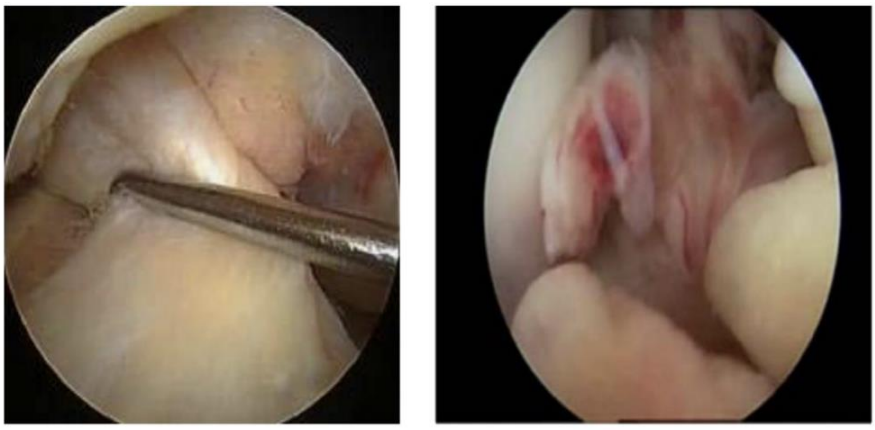
IMAGE GALLERY



a

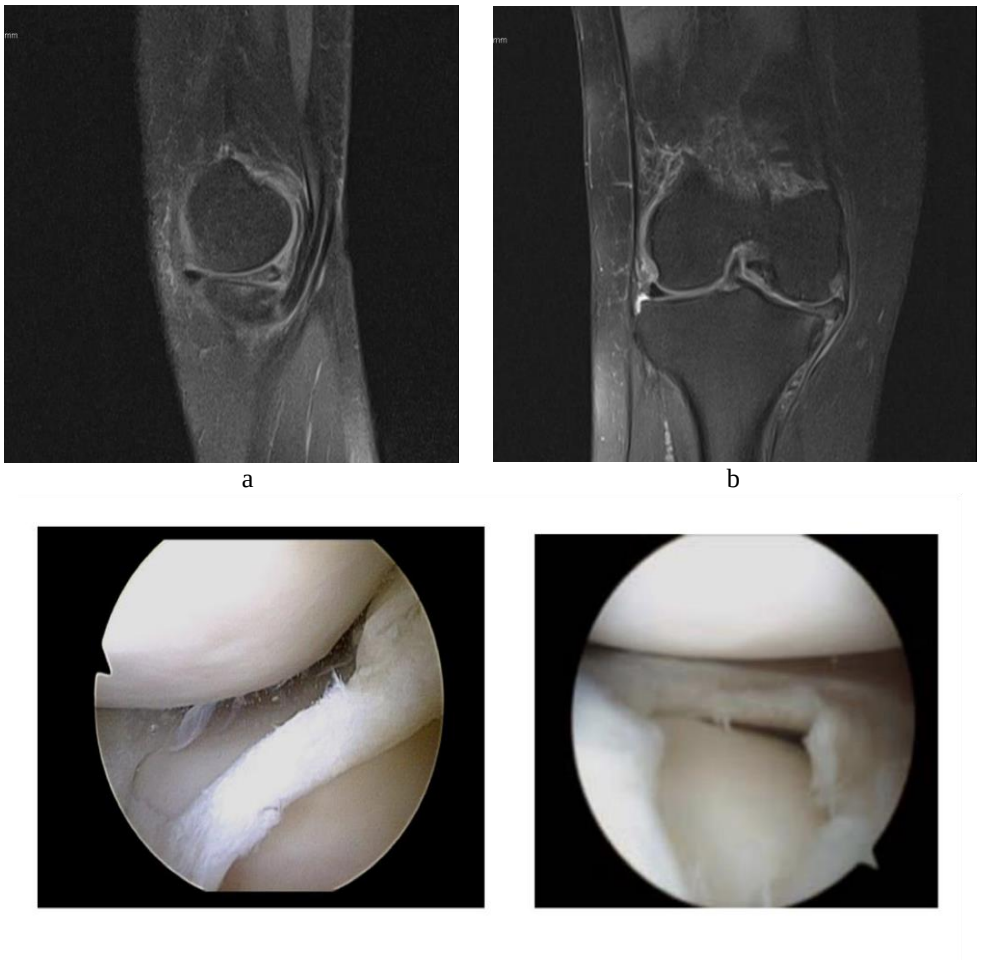


b



c d

Image 1a–d: T2PDFS and T2GRE sagittal sequence with hyperintense signals in anterior cruciate ligament suggestive of near complete thickness tear is seen in the proximal fibers of ACL, near its femoral attachment. Arthroscopy image showing normal ACL tendon and tear in ACL tendon



a b

c d

Image 2a-d: T2PDFS sagittal and coronal section image section showing linear hyperintense signal in posterior horn of medial meniscus parallel to tibial plateau, suggestive of horizontal tear in the posterior horn of the medial meniscus. Arthroscopy image showing normal medial meniscus and medial meniscus tear

DISCUSSION

MRI is reliable and safe, and due to its noninvasive nature, it offers advantages over diagnostic arthroscopy, which is currently the gold standard for diagnosing internal derangements of the knee joint. Arthroscopy is invasive, which poses a risk and discomfort to the patients. It should preferably be performed only for therapeutic purposes provided that alternative noninvasive modalities such as MRI are available.

In a study done by Oei and colleagues [13] which combined 29 studies from 1991 to 2000 that evaluated the validity of MRI with respect to meniscal and cruciate ligament disorders of the knee. The pooled medial and lateral menisci sensitivities were 93% and 79%, while the pooled specificities were 88% and 95%, respectively. For ACL and PCL tears, pooled sensitivities and specificities were 94%, 91%, and 94%, and 99%, respectively. Our study is in concordance with the study done by Oei and colleagues.

Quinn and Brown [14] retrospectively analyzed the arthroscopic videotapes of false- positive MR imaging results and found that the suspected area of the meniscus was never visualized in these cases. Therefore, false-negative findings at arthroscopy could potentially account for many false-positive MR imaging results. Our study is in discordance with the study done by Quinn and brown, showing 42% (15 out of 35) of the total ACL injuries were isolated. While the rest 58% were associated with other injuries, the most common of which were medial meniscus injuries.

The PCL is not usually visualized during arthroscopy if the ACL is intact. Arthroscopy is ideally performed with knowledge of the findings from the preceding MRI. In our study, 5 out of 50 cases were found to have PCL tears on MRI, and arthroscopy was done in 4 of those 5 patients and confirmed the same findings.

In a study done by Nobel J [15], 45% of the medial meniscus and 50% of lateral meniscus tears were associated with an ACL tear. In our study, 75% of the medial meniscal tears and 44.44% of lateral meniscal tears were associated with other injuries. Our study is in discordance with the study done by Nobel J, showing more percentage of medial meniscus tears are associated with ACL injury than lateral meniscus tears associated with ACL injury.

CONCLUSION

In the present cross-sectional study of 50 patients with knee injuries, our study shows Males commonly suffered knee injuries.

The most common age group affected was between 21-30 years of age The anterior cruciate ligament is the most common type of injury suffered The medial meniscus is the second most common, followed by the lateral meniscus injury. MRI shows excellent sensitivity in detecting knee injuries. MRI detected more lateral meniscus injuries compared to arthroscopy since grade I and grade II injuries of menisci may not be picked up in arthroscopy. MRI detected more ACL and MCL tears compared to arthroscopy because MRI can give false positive results, and arthroscopy may not detect partial tears. MRI shows excellent sensitivity and specificity in relation to arthroscopy for detecting PCL, LCL, and medial meniscal tears and good correlation.

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