



## Radiodiagnosis

## MRI OF KNEE JOINT IN DETECTING INTERNAL DERANGEMENTS WITH ARTHROSCOPIC CORRELATION.

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**ABSTRACT**

**Background:** Knee is a complex condylar joint of the body consisting of complex articulations of femur and tibia and patella.

**Objective:** to observe the role of MRI in detecting internal injuries mainly involvements of ACL, PCL and Meniscii, which were subsequently correlated by arthroscopy

**Methodology:** We did prospective studied 100 patients with history of knee injury and presented with pain / instability/locking/giving away sensation of age between 16-60 years over a period of 1 years starting from 2015 to 2016.

**Results:** A total 100 patients taken under study, 80 had ACL tear on MRI out of which 75 showed similar results on arthroscopy. The sensitivity, specificity and accuracy for MRI for ACL came out to be 100%, 66% and 95% respectively. Similarly for PCL tear on MRI examination the sensitivity of 50%, specificity of 90% and accuracy of 98%. Also, MM injury in 45% patients while 32% had positive result arthroscopically. 29% patients showed MRI positivity for LM injury out of which 26% were positive arthroscopically. The sensitivity, specificity and accuracy for MRI for medial meniscal injury was found to be 68%, 82% and 73% and that for lateral meniscal injury was found to have 83%, 89% and 88%.

**Conclusion:** MRI has high accuracy in diagnosing ligamentous and meniscal injuries. It can be used as a screening tool before arthroscopic examination and treatment planning.

**KEYWORDS :** MRI, Meniscal injuries, cruciate ligaments, arthroscopy.**Introduction:**

The internal injuries of knee joint - ligaments and menisci are extremely common since it is highly dependent on its supporting ligamentous structures. Knee joint has two cruciate ligaments and two meniscii to stabilise the joint while walking or running or weight bearing.<sup>[2]</sup>

The cruciate ligaments provide an axis around which both medial and lateral rotatory movement are assiste.<sup>3</sup> Variations in stress, torque and inertia lead to complex injuries. These injuries results in knee pain and instability. [1] A detailed clinical examination with examination findings / test provide higher accuracy in clinically diagnosing pathology.

Many factors affecting the accuracy of MRI in detecting meniscal lesions like experience of radiologist in interpreting studies, technical factor while scanning and clinical correlation. Degenerative changes in elderly patients often exhibit high intra-meniscal / intra-ligamentous signal that can be mistaken for tear.

Arthroscopy is the gold standard among the currently available diagnostic modalities<sup>[7, 8]</sup> for diagnosis of traumatic internal knee derangements, however it is an invasive procedure and require admission.<sup>[9]</sup> Other advantages of arthroscopy are having therapeutic role, smaller incisions, reduced morbidity, early resume back to work, less intense inflammatory response.

The disadvantages of arthroscopy are secondary to invasive cause - intra-articular damage to surface, haemarthrosis, thrombophlebitis, infection, tourniquet paresis.<sup>[11]</sup>

The role of our study is to observe the accuracy of MRI in detecting meniscal and cruciate ligament tears and its correlation by arthroscopy

**Materials & Methods:**

After approval from the Ethical Committee, this prospective study was conducted in 100 patients with complaints of knee pain or instability/locking/giving away sensation with history of knee injury between the age group of 16-60 years over a period of 12 months starting from 2015 to 2016.

**Sample size**

Sample size N = 100

P= Diagnostic accuracy of MRI=95.5%

E= Precision, usually 5% i.e. 0.05

Z=1.96, Z value for 5% confidence level

**Inclusion Criteria**

All the patients with new and old knee injuries, recent symptoms of locking of knee, undiagnosed knee pain and doubtful knee injury.

**Exclusion Criteria**

Patients with signs of acute infection, ankylosis, severe osteo-arthritis, undergone previous arthroscopy, treated with Anti-tubercular treatment, knee joint neoplasm and Patients with ferromagnetic implants, pacemakers and aneurysm clip.

The MR Imaging in all the patients included in this study was performed on 1.5 T Siemens MAGNETOM Avanto 32 Channel Tim-Dot MRI Machine and Karl Storz arthroscope was used for arthroscopy. Proper history and detailed clinical examination were taken into consideration in performing MRI interpretation All the patients underwent Arthroscopy by a single qualified orthopaedic surgeon. Bias of surgeon with MRI findings were avoided. Subsequently the MRI and Arthroscopy findings were correlated and analysed.

**Statistical Analysis:** Statistical analysis were carried out using SPSS version 19.0. Significant difference was determined using Chi-square test or fisher's exact test. Sensitivity, Specificity, Positive predictive value and negative predictive value was used for comparison between MRI and Arthroscopy.

MRI diagnosis were placed into one of the four categories after arthroscopic evaluation.

- 1) True positive (TP): when MRI diagnosis of tear was confirmed on arthroscopic evaluation.
- 2) True negative (TN): If the diagnosis of no tear was confirmed on arthroscopy.
- 3) False positive (FP): If MRI showed a tear but arthroscopy was negative.
- 4) False negative (FN): If MRI images were negative but arthroscopy showed a tear.

**Results:**

Our study population comprised of 100 patients with age ranged between 16-60 yrs. 11 patients were below 20 years, 54 were between 21-30 years (majority), 27 between 31-40 years, 5 were between 41-50 years and 3 of the study population were more than 50 years. The mean age was 29 years. Male: Female ratio comprised 84:16.

MRI finding showed MM injury in 50 patients while 35 had positive

result arthroscopically. 30 patients showed MRI positivity for LM injury out of which 26 were positive arthroscopically.

The accuracy of medial meniscal injury by MRI examination in concordance with arthroscopic finding was found to be 73% while sensitivity was 82% and specificity 68% as shown in Tables below.

**TABLE 1: correlation between MRI and arthroscopic findings for MM tear**

MM Tear	Arthroscopy		Total
	+ve	-ve	
MRI +ve	27	23	50
MRI -ve	8	42	50
Total	35	65	100

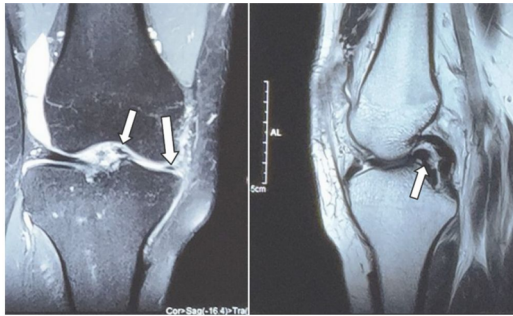


Figure 4: STIR cor and T2 Sagittal images showing Bucket handle tear of body of medial meniscus

In our study MRI examination for lateral meniscal injury was found to have accuracy of 88%, with sensitivity of 83% and specificity of 89% as depicted in Tables below

**TABLE 2: correlation between MRI and arthroscopic findings for LM tear**

LM Tear	Arthroscopy		Total
	+ve	-ve	
MRI +ve	20	10	30
MRI -ve	6	64	70
Total	26	74	100

A total 100 patients taken under study, 80 had ACL tear on MRI out of which 75 showed similar results on arthroscopy. The sensitivity, specificity and accuracy for MRI for ACL came out to be 100%, 66% and 95% respectively. Similarly for PCL tear on MRI examination the sensitivity of 50%, specificity of 90% and accuracy of 98%.



Figure 1: T2 Sagittal MRI knee showing mid substance ACL tear



Figure 2: T2 sagittal MRI knee showing ACL tear from femoral attachment

**TABLE 3: showing structure injured in MRI and arthroscopy**

Arthroscopy	MRI	
	ACL	PCL
ACL	80	75
PCL	1	2

Out of 80 patients showing positive findings in MRI 75 showed ACL tear in arthroscopy while 5 were false positive. 20 patients who showed intact ACL in MRI had same result arthroscopically.



Figure 4: Arthroscopic image showing Mid substance ACL tear

**TABLE 4: Correlation between MRI and arthroscopic findings for ACL tear**

ACL	Arthroscopy		Total
	+ve	-ve	
MRI +ve	75	5	80
MRI -ve	0	20	20
Total	75	25	100

MRI showed 100% sensitivity and negative predictive value for ACL tear while specificity was 66.67% and accuracy of 95.52% with positive predictive value of 95.08%.

Out of 2 patients showing positive findings in Arthroscopy only 1 showed positive findings in MRI. 66 patients who showed intact PCL in MRI had 65 patients with true negative result while only 1 was false negative.



Figure 3: T1 Sagittal MRI Knee showing PCL tear from tibial attachment

**TABLE 5: correlation between MRI and arthroscopic findings for PCL tear**

PCL	Arthroscopy		Total
	+ve	-ve	
MRI +ve	1	0	1
MRI -ve	1	98	99
Total	2	98	100

MRI showed 100% positive predictive value for PCL tear while negative predictive value was 98%, along with sensitivity of 50% with specificity of 100% and accuracy of 98%.

In our study, Medial meniscus was injuries more than lateral meniscus, Posterior horn was major involved segment of meniscus than the body

and anterior horn.

For the cruciate ligaments, anterior cruciate was far more affected than the posterior cruciate ligament. Mid segment ACL tear was more frequent, followed by femoral attachment and least were tibial attachment tear. Also, all PCL tears were associated with concurrent ACL injuries.

Among females, meniscal injuries were more common than cruciate ligament injuries.

#### Discussion:

The accuracy of medial meniscal injury by MRI examination in concordance with arthroscopic finding was found to be 73% while sensitivity was 82% and specificity 68%. Previous studies of Gupta MK et al<sup>[12]</sup>, S Gupta et al<sup>[14]</sup> and Ali Akbar Jah et al<sup>[13]</sup> showed sensitivity between 80-90% where as Singh JP et al<sup>[16]</sup> found sensitivity between 90-100%. Specificity between 60-80% was found by previous studies like S Gupta et al<sup>[14]</sup>, while 80-100% was found in studies done by Oei and colleagues<sup>[15]</sup>, Gupta MK et al<sup>[12]</sup>, Singh JP et al<sup>[16]</sup> Accuracy of MRI examination for medial meniscal tear between 70-85% was found in Ali Akbar Jah et al<sup>[13]</sup>, Rose et al<sup>[17]</sup>, while that between 86-100% was found by Singh JP et al<sup>[16]</sup>, Gupta MK and colleague.<sup>[12]</sup>

In our study MRI examination for lateral meniscal injury was found to have accuracy of 88%, with sensitivity of 83% and specificity of 89%. Similar results were found in studies like: Gupta MK et al<sup>[12]</sup>, 49- 91%, S Gupta et al<sup>[14]</sup> while F Rayan et al<sup>[18]</sup> found accuracy of 85 %. The sensitivity of lateral meniscal tear by MRI examination was found to be 79% in a meta-analysis done by Oei and colleagues<sup>[15]</sup> Studies showing specificity around our result were Ali Akbar Jah and colleague<sup>[13]</sup> with 86 %, S Gupta and colleague<sup>[14]</sup> with 91% , F Rayan and colleague<sup>[18]</sup> had specificity of 92%.

In our study there were false-positive interpretations of meniscal tears on MRI when compared with arthroscopy. Either degenerative changes or vascular red zone of the meniscus (significant lag time between injury and MRI) might be the cause. Other causes can be healed tears or intrasubstance tears which can be missed on arthroscopy.

In case of ACL tears diagnostic accuracy of MRI examination came out to be 95% with sensitivity of 100% and specificity of 66%. There were false positive interpretation of ACL tear on MRI compared with arthroscopy possibly due to presence of partial tears which may be missed on arthroscopies. Similar study conducted by Singh J P et al<sup>[13]</sup> showed accuracy of 98% with sensitivity of 98% and specificity of 98%. Gupta MK<sup>[15]</sup> and colleagues conducted identical studies on 40 patients with knee injuries with comparable objectives found accuracy of MRI for ACL tear to be 90% with sensitivity of 91% and specificity of 88%. Similarly Ali Akbar Jah et al<sup>[17]</sup> also found MRI accuracy for ACL tear to be 88% and sensitivity and specificity of 78% and 95% respectively. S Gupta<sup>[15]</sup> and colleagues found MRI accuracy to be 90% with sensitivity of 88.89% and specificity of 98%. Our MRI diagnostic accuracy and sensitivity in ACL tear is similar to that reported by above mentioned studies while specificity has been slightly inferior which might be because of the degenerative changes that tend to increase the signal intensity.

Diagnostic accuracy of MRI for PCL tears to be 98% with sensitivity of 50% and specificity of 100%. Oei<sup>[19]</sup> and colleagues conducted a meta-analysis by combining 29 studies from 1991 - 2000 found sensitivity of 91% with specificity of 99%. Riel et al<sup>[15]</sup> also found similar results with accuracy, sensitivity and specificity all to be 100 %. Manoj MK et al<sup>[20]</sup> and S Gupta et al<sup>[18]</sup> both found MRI accuracy of 100% for PCL tear, the sensitivity and specificity found by S Gupta et al<sup>[18]</sup> for PCL injury was also 100%. Our result as mentioned above has comparable accuracy and specificity for PCL tear however the sensitivity was low might be due to less positive cases.

#### Conclusion:

MRI is high accurate in diagnosing meniscal and cruciate ligament derangements in case of knee injuries. The sensitivity for ACL tear is higher as compared to PCL. This makes it most appropriate screening tool before therapeutic arthroscopy.

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