



## ROLE OF MRI EVALUATION & ARTHROSCOPIC CORRELATION IN LIGAMENTOUS INJURIES OF KNEE JOINT

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**(ABSTRACT)** **Background:** The accuracy, sensitivity and specificity of MRI to predict intraarticular knee pathology have been compared with findings of arthroscopic results in previous studies which show different results. This reflects the rapid changes in the MRI technology, different imaging sequences, radiologist expertise & diagnostic criteria. As a result of this variability, present study is undertaken to correlate between MRI & arthroscopy findings.

**Objective:** To evaluate the role of MRI in diagnosing and grading traumatic ligamentous injuries of knee & correlate the findings arthroscopically.

**Methodology:** 50 patients were subjected to 1.5T MR imaging followed by arthroscopy.

**Observations:** Sensitivity, specificity, PPV, NPV and accuracy of MRI compared to Arthroscopy for complete & partial ACL, PCL, medial meniscal & lateral meniscal tear.

**Conclusion:** As a noninvasive modality, MR can replace nontherapeutic arthroscopy in evaluation of menisci and cruciate ligaments & should be done in all patients suspected of ligamentous injury preventing unwanted arthroscopies.

**KEYWORDS :** MRI, Knee, Arthroscopy.

### INTRODUCTION

The principal intraarticular structures in knee are the two menisci – medial meniscus (MM) and lateral meniscus (LM), the two cruciate ligaments - Anterior cruciate ligament (ACL) and Posterior cruciate ligament (PCL), and the two collateral ligaments – Medial collateral ligament (MCL) and Lateral collateral ligament (LCL). The menisci serve to distribute joint fluid, cartilage nutrition, mechanical shock absorption, increasing the surface area of the joint and therefore serve to stabilize the joint, and a weight bearing function. The cruciate ligaments function as stabilizers of the knee in both forward and backward motions of the tibia on the femur and provide an axis around which both medial and lateral rotary movements are assisted.<sup>1</sup> The injury to these intraarticular structures is generally termed as “Internal derangement of knee”. Arthroscopy offers direct visualization of all intraarticular structures with high diagnostic accuracy, and the possibility to perform a therapeutic procedure in the same session.<sup>2</sup>

MRI 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.<sup>3</sup>

There are many indications however, this study is to evaluate the role of MRI in diagnosing ligamentous injuries of knee following trauma & correlate the findings arthroscopically subsequent to an MRI.

### METHODOLOGY

Type of Study- Observational

Study Setting- Tertiary Care Hospital

Study Period- December 2015-November 2016

Sample Size-50 patients.

Study Instrument- 1.5 Tesla, Philips MR Achieva (SENSE knee coil)

**Inclusion criteria:** Patients with history of traumatic knee joint injury with suspected internal derangement of knee joint who underwent both MRI and arthroscopy.

### Exclusion criteria:

Patients with ferromagnetic implants, pacemakers, and aneurysm clips.

Patient < 10 years of age.

Inflammatory, infectious and degenerative and neoplastic conditions of knee joint.

Patients lost to follow up.

### INTERPRETATION OF IMAGES:

Complete absence of ligament, abnormal signal intensity of the ligament, poor definition of its ligamentous fibers were all considered as complete ACL tear on T2W images. The detection of focus of increased signal intensity within the substance of the ACL was diagnosed as partial tear. Posterior cruciate ligament (PCL) tear was diagnosed as altered signal intensity in ligament on T2W images. The presence of intrameniscal high signal intensity on T2W images was regarded as a tear, and grading was done according to whether it reaches to the articular surface or not, Grade I, a non-articular focal intrasubstance increased signal intensity. Grade II, horizontal intrasubstance increased signal intensity extending from the capsular periphery of the meniscus without involving articular meniscal surface. Grade III when the area of increased signal intensity extends to at least one articular surface. Only grade III meniscal tears were compared as grade I/II do not reach up to the articular surface and hence invisible to Arthroscopic evaluation. For diagnosing bucket-handle tear following signs were evaluated: (a) The double PCL sign was positive when a band like meniscal fragment was visible under the PCL giving appearance of a double PCL on sagittal T2W MR images (b) The absent bow tie sign was positive when only one or no meniscal body segment was visible on two consecutive peripheral sagittal sections. MR evaluation of collateral ligament injuries was done on T2W coronal images, high signal intensity edema, hemorrhage superficial to the ligament was grade I injury, superficial and deep to the ligament was Grade II and complete loss of continuity of the ligamentous fibers was grade III injury. Arthroscopy was performed using a 30° whole-angle arthroscope. MRI findings were correlated with arthroscopic findings.

### RESULTS:

Out of 50 patients 45 patients (90%) showed ACL tears, 30 patients (60 %) showed MM tears, 16 patients (32%) showed LM tears and 5 patients (10%) showed PCL tears. 21 patients (42%) had MCL injury and 11 patients (22%) had LCL injury. (TABLE-1)

**TABLE – 1**  
**DISTRIBUTION OF LIGAMENTOUS INJURIES OF KNEE**

SR NO	ABNORMALITY	NO OF PATIENTS	PERCENTAGE
1.	Anterior Cruciate Ligament Tear	45	90%
2.	Posterior Cruciate Ligament Tear	05	10%
3.	Medial Meniscal Tear	30	60%

4.	Lateral Meniscal Tear	16	32%
5.	Medial Collateral Ligament Tear	21	42%
6.	Lateral Collateral Ligament Tear	11	22%
		n=50	

Out of 45 patients of ACL tear, 24 patients (53%) had complete tear while 21 patients (46%) had partial tear. 26 patients (57.7%) had mid substance tear, 14 patients (31.1%) had tear at the femoral attachment and 5 patients (11.1%) at the tibial attachment. PCL tears accounted for small number of cases 5 out of 50 patients all of which were partial tear. Of the 30 patients with medial meniscal tear, 3(10%) showed Grade I tear, 3(10%) showed Grade II tear, 16 (53.3%) showed Grade III tear and 8 (26.6%) showed bucket handle tear. Of the 16 patients with lateral meniscal tear, 3 (18.75 %) showed Grade I tear, 3 (18.75 %) showed Grade II tear, 9 (56.25 %) showed Grade III tear and 1 (6.25 %) showed bucket handle tear. Of the 21 patients with medial collateral ligament injuries, 12 showed grade I tear, 8 showed grade II tear, 1 showed grade III tear. Of the 11 patients with lateral collateral ligament injuries, 3 showed grade I tear, 3 showed grade II tear, 5 showed grade III tear. Out of 24 cases of complete ACL tear on MRI, complete ACL tear was seen at arthroscopy in 23 patients. 1 patient with complete tear on MRI showed partial tear on arthroscopy. Out of 21 patients with partial ACL tear on MRI, 1 patient had normal ACL at arthroscopy. 1 patient with partial tear on MRI had complete tear on arthroscopy. In 1 patient with normal ACL on MRI, arthroscopy revealed partial ACL tear. Out of 5 cases of partial tears of posterior cruciate ligament, arthroscopy showed 5 partial PCL tear. Out of 16 patients with grade III medial meniscal tears on MRI, 2 patients did not show medial meniscus tear on arthroscopy. 1 patient with grade II tear on MRI had grade III tear on arthroscopy. 1 patient with grade I tear on MRI had grade III tear on arthroscopy. Out of 9 patients with grade III lateral meniscal tears on MRI, 1 patient with grade III tear of lateral meniscus was found normal on arthroscopy. 1 patient with grade II lateral meniscal tear on MRI had grade III tear on arthroscopy. 9 patients had bucket handle tear of meniscus on MRI, all of which were positive on arthroscopy. The MRI findings of meniscal, anterior and posterior cruciate ligament injuries are compared with the arthroscopic results (considered the gold standard for diagnosis) and following parameters are calculated: sensitivity, specificity, accuracy, positive predictive value (PPV), negative predictive value (NPV). (TABLE-2)

**TABLE 2: RESULTS OF DATA ANALYSIS**

	MRI	Arthroscopy	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Complete ACL Tear	24	23	95.83	96.15	95.83	96.15	96
Partial ACL Tear	21	19	90.47	93.10	90.47	93.10	92
PCL Tear	05	05	100	100	100	100	100
Grade III Medial Meniscal Tear	16	14	87.5	94.11	87.5	94.11	92
Grade III Lateral Meniscal Tear	08	07	87.5	97.6	87.5	97.6	96
Bucket handle tear	09	09	100	100	100	100	100

**DISCUSSION**

Anterior cruciate ligament tears were most common followed by medial meniscal tear. Posterior cruciate ligament tears were least common. T2WI was preferable, as acute lesions were seen as high signal intensity (image) with great degree of accuracy which correlated with study by Mink et al.<sup>4</sup> Most common tear location was at mid-substance. Lakhar et al<sup>5</sup> in their study reported mid-substance tear as the most common type. In our study for 23 arthroscopically proven complete ACL tears, the sensitivity, specificity, PPV, NPV and accuracy of MRI was 95.83%, 96.15%, 95.83%, 96.15% and 96% respectively. In our study for 19 arthroscopically proven partial ACL tears, the sensitivity, specificity, PPV, NPV and accuracy of MRI was 90.47%, 93.10%, 90.47%, 93.10% and 92% respectively. Carlos Eduardo, Sanches Vaz, Olavo Pires de Camargo et al<sup>6</sup> found sensitivity, specificity, PPV, NPV and accuracy of MRI for ACL tears to be 99%, 95.4%, 91.9%, 99.5% and 96.6% respectively. In our study the sensitivity, specificity, PPV, NPV and accuracy of MRI for PCL tear (Figure 1) was 100%.



Figure 1: PDW SPIR image showing partial tear of PCL

In our study medial meniscal tears and degeneration were more common. Grade III tear of medial meniscus was the most common. In our study for 14 arthroscopically proven medial meniscal tears, the sensitivity, specificity, PPV, NPV and accuracy of MRI was 87.5%, 94.11%, 87.5%, 94.11% and 92%.

Grade III tear of lateral meniscus was the most common. In our study for 8 arthroscopically proven lateral meniscal tears the sensitivity, specificity, PPV, NPV and accuracy of MRI was 87.5%, 97.6%, 88.6%, 87.5%, 97.6% and 96% respectively. Bucket handle tear of medial meniscus (8 patients) was more common than lateral meniscus (1 patient). Bucket handle tear of meniscus were confirmed on arthroscopy in all patients identified as double PCL sign (Figure 2), and absent bowtie sign. Accuracy of MRI in detecting bucket handle tear of meniscus was 100%. Medial collateral ligament was more commonly injured collateral ligament. Grade I MCL sprain was most common. Grade III sprain was most common in lateral collateral ligament injury.



Figure 2: Sagittal T2W image showing double PCL sign (bucket handle tear of MM)

**CONCLUSION:**

Magnetic resonance imaging has high sensitivity, specificity and accuracy in diagnosing posterior cruciate ligament and complete anterior cruciate ligament tears. Sensitivity in detecting partial anterior cruciate ligament tears, medial and lateral meniscal tears was also satisfactory. There was high accuracy in detecting bucket handle tears of meniscus with all the cases correctly identified on arthroscopy. MRI should be done in all patients suspected of ligamentous injury, thus preventing unwanted arthroscopies. As a noninvasive modality, MR can replace non therapeutic arthroscopy in the evaluation of the menisci and cruciate ligaments.

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