

# MRI Evaluation of Internal Derangements of the Knee Joint In a Tertiary Care Hospital of Deccan India

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**Abstract:** Background: Internal derangement of the knee joint (IDK) involves destruction of ligaments/cartilages causing significant morbidity in the young, active individuals. An accurate assessment of the type/extent of injuries is important. Most widely used diagnostic modalities are arthroscopy and magnetic resonance imaging (MRI). MRI is reliable, safe and offers advantages over diagnostic arthroscopy, a standard reference for the diagnosis of IDK. Objectives: To evaluate the types & incidences of injuries in the knee on MRI and to compare with arthroscopy in selected cases. Study: Prospective, cross sectional & open label study. Materials & Methods: Patients suspected of an IDK by the orthopedician, were referred for a knee MRI, to the Department, of Radiodiagnosis, who came consecutively during 2014-2016, were included in the study. These patients were examined clinically and underwent a knee MRI, a few selected cases also were taken up for diagnostic arthroscopy. Results: 111 patients were evaluated, anterior cruciate ligament tear was seen in 76 patient (68 %), with complete tears more common seen in 40 patients (52.6 %). Posterior cruciate ligament tears were the least common type of injury, seen in 4 patients (3.6 %). Medial meniscus (MM) tears, seen in 33 patients (29.7 %), were more common, as compared to lateral meniscus (LM) tears, seen in 20 patients (18.1 %). Grade 3 type of tears was more common in both, MM seen in 29 patients (87.8 %) and the LM injuries, seen in 12 patients (60 %). Medial collateral ligament (MCL) injuries seen in 11 patients (9.9 %) outnumbered the lateral collateral ligament injuries, seen in 3 patients (2.7 %). Grade 3 type of tears was common in MCL tears, seen in 5 patients (45.5 %). Osseous/osteochondral lesions were seen in 52 patients (46.8 %). Most of these were bony contusions involving the femoral-tibial condyles. Arthroscopy was done in 25 patients (22.5 %) and the findings correlated in 22 patients (88 %), which was statistically significant with a 95 % CI 70.04-95.83 %. Conclusion: MRI is an excellent, non-invasive imaging modality with multi-planar capabilities used to detect, localize and characterize IDK and correlates well with arthroscopy thus avoiding unnecessary invasive arthroscopy for diagnostic purpose.

**Keywords:** Anterior cruciate ligament, Posterior cruciate ligament, Medial collateral ligament, Lateral collateral ligament, Lateral meniscus, Medial meniscus, Arthroscopy, internal derangements of the knee

## Abbreviations

MRI-Magnetic resonance imaging, IDK- Internal derangement of the knee joint, ACL- Anterior cruciate ligament, PCL- Posterior cruciate ligament, MCL- Medial collateral ligament, LCL- Lateral collateral ligament, MM- Medial meniscus, LM - Lateral meniscus

## 1. Introduction

Internal derangement of the knee joint (IDK) is a blanket term that covers a group of disorders involving destruction of ligaments and cartilages. It is a mechanical disorder which interferes with the normal joint motion. IDK is a significant cause of morbidity in the young, active individuals and thus an accurate assessment regarding the type and extent of injuries is important for an early operative and a non-operative treatment. An accurate clinical history, thorough physical examination and complimentary diagnostic tests are required. The most

widely used diagnostic modalities to assess the joint injury are arthroscopy and magnetic resonance imaging (MRI).

Arthroscopy is usually considered as the gold standard for the evaluation of knee injury, the accuracy of which is as high as 95-98 %. However, it is an invasive and an expensive tool, requiring hospitalization and anaesthesia, thus carrying risk of complications.

Since its introduction for clinical use in the mid-1980s, the role of MRI in the diagnosis of knee lesions has been established. MRI has proved reliable, safe and offers

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advantage over diagnostic arthroscopy, which is currently regarded as the reference standard for the diagnosis of IDK. MRI provides an excellent soft tissue contrast and is capable of examining the area of interest in multiple planes, which is an advantage over other imaging modalities. It is an accurate, non-invasive, cost-effective and a highly sensitive tool for detection of early and subtle changes in the soft tissues. MRI is advantageous in conditions where arthroscopy is not useful, like peripheral meniscal tears and inferior surface tears. Thus MRI has completely revolutionized the diagnosis and management of intra-articular pathology and is being increasingly used for the same over the past decade.

## 2. Aims

To evaluate the types & incidence of injuries in the knee on MRI and to compare with arthroscopy in selected cases.

## 3. Objectives

- Study of the spectrum of lesions in suspected cases of IDK.
- Grading of the various ligamentous and meniscal injuries.
- Arthroscopic correlation, in selected cases, to establish the efficacy of MRI in diagnosing IDK.

## 4. Materials and Methods

Cases with suspected IDK, who were referred consecutively for MRI knee during 2014-2016 by orthopedician, to the Department of Radiology, served as subjects for this study.

### Inclusion Criteria

1. Patients with history of pain in the knee with or without swelling.
2. Patients with clinically suspected tears.
3. Patients with restriction of movement at the knee joint.
4. Both males and females were included in this study.
5. Adults between 18-80 years of age were included.

### Exclusion Criteria

1. Patients with cardiac pacemakers and metallic implants were not subjected to MRI
2. Patients below the age of 18 years.
3. Patients above the age of 80 years.
4. Post-operative cases
5. Patients in which study could not be completed due to motion disorder and claustrophobia were not included in the study.
6. Patients with acute traumatic fractures on plain X-rays.
7. Patients those were diagnosed with osteochondritis on a plain X-ray.

All patients were subjected to MRI (Table 1) and were followed by arthroscopy in selected cases. MRIs were evaluated for joint effusion, anterior cruciate ligament

tear, posterior cruciate ligament tear, medial collateral ligament tear, lateral collateral ligament tear, medial meniscal tear, lateral meniscal tear, osseous/osteochondral lesions along with grading of tears grade 1/2/3.

### Arthroscopy

Was carried out by orthopedic surgeons in selected cases, where indicated for diagnostic or therapeutic purposes.

### Research Hypothesis

Findings of MRI of the knee are well correlated with the arthroscopic findings in patients with IDK.

### Statistical Methods

Descriptive statistical analysis and correlation evaluation was carried out. Results on continuous measurement are presented on Mean +/- SD (Min-Max) and results on categorical measurements are presented in Number (%). 95 % Confidence interval has been to find the significance in the present study.<sup>1,2</sup>

95 % Confidence Interval

$p \pm 1.96 * SE (P)$ , where SE (P) is the standard error of proportion =  $P * Q/n$

## 5. Results

Study Design: Prospective, cross sectional & open label study.

A descriptive statistical analysis and correlation evaluation study consisting of 111 patients with IDK was undertaken to study the spectrum of MRI findings in all consecutive cases from the Orthopedic Department and a comparison of findings on MRI was made with that of arthroscopic findings in selected cases.

The mean age of patients was 30.66 +/-10.58 yrs. The most common age group to be involved was between 21-30 yrs with 51 (45.9 %) patients followed by 30 (27.1 %) patients in the age group 31-40 years. The least common age group involved was above 50 years of age, with 6 (5.4 %) patient only.

The duration of symptoms prior to undergoing MRI showed that maximum number of patients, 25 (22.5 %), were having symptoms from 1 month-6 months, closely followed by 24 patients (21.6 %) with symptoms present upto 1 week, over 6 months symptoms were seen in 23 patients (20.7 %) and 19 patients (17 %) had symptoms for 1-2 weeks. Least number of patients 9 (8.1 %) had symptoms for 2-3 weeks.

Joint effusion was the most common finding on MRI, seen in 89 patients (80.2 %). The 95 % CI was (71.8-86.5) which is statistically significant. The most common injury was ACL tears which were present in 76 patients (68.5 %) with a 95 % CI, 59.3-73.4, of which complete tears were

more common, seen in 40 patients (52.6 %) and partial tears in 36 patients (47.4 %). The PCL tears were less common, seen only in 4 patients (3.6 %). MCL tears, present in 11 patients (9.9 %) outnumbered the LCL tears, present in 3 patients (27 %). Grade 3 type tears were commonly seen in the MCL, present in 5 patients (45.5 %), followed by grade 1 tears in 4 patients (36.4 %) and only 2 patients (18.2 %) had grade 2 injury. Grade 1, 2 and 3 LCL tears were seen in one patient each.

Among the meniscal injuries, MM injuries were more commonly seen than LM injuries, 33 patients (29.7 %) former and 20 patients (18.1 %) latter. Grade 3 tears were the commonest type of tears in both the mensici. 29 patients (87.8 %) with a MM tear had grade 3 tear type of injury, with 95 % CI, 72.6-95.2, which was significant statistically. Of the 12 patients (60 %) with LM tear, 5 patients (25 %) had grade 3 tear followed by 3 patients (15 %) with grade 1 tear.

Osseous/osteochondral lesions were seen in 52 patients (46.8 %) with 95 % CI of 43.9-62.3. Most of these were bony contusions, involving the femoral and tibial condyles.

Other abnormalities like discoid meniscus was seen in 1 patient (0.90 %), hemarthrosis in 2 patients (1.80 %), joint effusion in 89 patients (80.2 %) and other myotendinous tears were accurately detected and characterized with the help of MRI.

The spectrum of lesions showed that the maximum number of patients (89) had joint effusion, followed by ACL tear in 76 patients and osseous/osteochondral lesions in 52 patients. The least common injuries were those of the LCL (in 3 patients) and PCL (in 4 patients) (Table 2).

The multiple/ combined injuries showed maximum cases had two injuries in 41 patients (39.04 %) followed closely by isolated injury in 40 patients (38.09 %). There was only 1 patient (0.9 %) with five injuries (Table 3).

Arthroscopy was done in 25 patients (22.5 %). Statistically good correlation was seen between findings in arthroscopy and MRI, which was seen in 22 patients (88 %) with 95 % CI 70.04-95.83 (Table 4).

## 6. Discussion

The role of MRI has steadily increased and now it has become the first line of investigation for most lesions of the knee.<sup>3, 4</sup> It is also being increasingly used for preoperative and post-operative evaluation<sup>5</sup>. MRI can separate surgically significant from non-significant meniscal lesions and is useful in the non-invasive pre-operative screening of suspected meniscal tears.<sup>6</sup> The accuracy of MRI allows more appropriate targeting of arthroscopy to those patients likely to obtain therapeutic benefits, thus eliminating the need for arthroscopy in many of those considered, on clinical grounds, to have meniscal or cruciate derangement.<sup>7</sup>

MRI is now a well-accepted imaging modality in the diagnostic work up of patients with knee complaints and has largely replaced diagnostic arthroscopy for this purpose. It is regarded as the top imaging and diagnostic tool for the knee joint as a result of its ability to evaluate a wide range of anatomy and pathology varying from ligamentous injuries to articular cartilage lesions.<sup>5</sup> There are areas in the knee that are usually not visualized on arthroscopy. Hence, in some cases there may be some false positives from arthroscopy and so many orthopedic surgeons are now increasingly turning to MRI as a non-invasive means of diagnosing knee problems.<sup>8</sup>

In this study, joint effusions are the most common finding affecting 89 patients (80.5 %). Among the ligamentous and meniscal injuries, ACL tear is the most common, seen in 76 patients (68.5 %), followed by the MM injuries, seen in 33 patients (29.7 %), with Grade 3 type of injury being the commonest.

### Cruciate Ligaments:

Out of the 76 (68.5 %) patients with an ACL tear, 36 (47.4 %) patients had a partial tear of the ACL and 40 (52.6 %) patients were seen to have complete ACL tears. However, Singh JP *et al*<sup>9</sup> in their study of 173 patients, found 78 (45.08 %) patients to have an ACL tear, among these patients, 52 (66.67 %) patients showed partial tears, 16 (20.51 %) patients had complete tears and 10 (12.82 %) patients showed non visualization of ACL. On basis of their study, the authors concluded that ACL tears were commoner than other ligamentous injuries, and partial type of tears were commoner than complete tears.

Posterior cruciate ligament injuries were found to be relatively uncommon. In this study, PCL injury was seen in 4 (3.6 %) patients and all these were seen as thickening of the ligament with abnormal signal intensity, suggestive of a partial tear. Also, Maurer *et al*<sup>10</sup> carried out a study with a sample size of 350 patients, among them, only 10 patients showed PCL injury, thus the incidence of these injuries in their study was 3 %.

In a study by Naranje S *et al*<sup>11</sup> where they analyzed findings of 510 consecutive MRI of knee joint with an emphasis on PCL tear; 11 (2 %) patients had different grades of tear on MRI which was confirmed correctly by arthroscopy. Of the other 202 patients who had undergone MRI as well as arthroscopy for IDK, none of the patients had any PCL tear on arthroscopy, as correctly predicted by MRI.

### Collateral Ligaments:

In this study, MCL tears (9.9 %) were found to be more common than LCL tears (2.7 %). All these cases had a history of trauma and were associated with multiple injuries. This suggests that the presence of a single injury should prompt search for other subtle associated injuries, which was further confirmed by Bin Abd Razak HR *et al*<sup>12</sup>.

In this study, the incidence of a Grade 3 type of MCL tear was seen to be 45.5 %, and was thus the commonest type.

### Menisci Lesions:

In this study, MM tears were found in 33 (29.7 %) patients, out of which, Grade 1 type of tears was not seen in any patient, Grade 2 type of tears was seen in 4 (12.1 %) patients and Grade 3 type of tears was seen in 29 (87.8 %) patients.

LM tears were seen in 20 (18.1 %) patients, of which, Grade 1 type of tears was seen in 3 (15 %) patients, Grade 2 type of tears was seen in 5 (25 %) patients and Grade 3 type of tears was seen in 12 (60.0 %) patients. Thus, Grade 3 type of tears was seen to be the commonest in both MM and LM; incidence of which was 87.8 % in MM and 60.0 % in LM.

This study thus shows a preponderance of MM tears over LM tears which is well correlated with the study carried out by Singh JP *et al*<sup>9</sup> in a series of 173 cases of which they found MM tears in 57 (38.32 %) patients and LM tears in 28 (29.41 %) patients.

In this study, lateral discoid meniscus with appearance of bow tie configuration in more than three contiguous slices on sagittal images was found in one patient.

The cystic lesions encountered were meniscal cyst, parameniscal cyst and popliteal cyst (Baker's cyst). The meniscal cyst and parameniscal cysts were found to be associated with tear of the LM in 6 (5.71 %) patients and of that of the MM in 3 (2.85 %) patients. In the two cases of popliteal cysts, its location, relation to the joint space and its communication with joint space were clearly demonstrated on sagittal T2-weighted images. These findings were correlated well with the findings described by Berquist TH<sup>2</sup>.

### Osseous and Osteochondral Lesions

In this study, osseous/ osteochondral lesions were seen in 52 (46.8 %) patients. Most of these were bony contusions involving the femoral and tibial condyles. Osteochondral lesions were seen in nine patients. In this study, cases of comminuted bicondylar fracture of the proximal end of tibia with intra-articular and intra-condylar extension was seen. There was also a fracture of the medial tibial condyle in the postero-lateral aspect which is displaced antero-medially. A case of second fracture of the lateral tibial rim with bony contusion of the lateral femoral condyle was also seen. These findings were correlated well with the findings described by Berquist TH.<sup>2</sup>

In this study, a case of spontaneous osteonecrosis of the medial femoral condyle was seen, which was well depicted on the MRI before it became evident on a radiograph. It was seen as a focus of altered signal in the antero-medial aspect of the medial femoral condyle with a thin rim of sclerosis and associated marrow edema involving the entire medial femoral condyle and flattening of the articular surface with evidence of subchondral

collapse. These findings correlated well with the findings of Berquist TH.<sup>2</sup>

The finding of haemarthrosis and lipohemarthrosis was associated in two cases with presence of intercondylar fractures. These findings were correlated with findings described by Berquist TH.<sup>2</sup>

The findings of a partial tear of the proximal fibres of the medial head of the gastrocnemius muscle were seen in two patients in this study. These findings are seen to be well correlated with those described by Thomas H. Berquist.<sup>2</sup>

In this study, a correlation of MRI findings with arthroscopic findings was done in 25 patients (22.5 %). Among these patients, in 22 patients (88 %) MRI findings were well correlated with the arthroscopic findings with a 95 % Confidence Interval. Correlation between MRI and arthroscopic findings are statistically significant with 95 % CI (70.04 - 95.83 %).<sup>1,2</sup>

In this study, 65 patients (81.9 %) of combined injuries and 40 patients (38.09) of isolated injuries were found. The predominant pattern, in this study, was seen to be ACL tear with MM tear in 23 (21.90 %) patients, followed by ACL tear with LM tear in 12 (11.42 %) patients, which is well correlated with a study by Esmaili Jah AA *et al*<sup>13</sup>, in a series of 17 cases of concomitant injuries at MRI and arthroscopy. The predominant pattern was ACL ruptures with MM tear (5 patients), followed by ACL tear with LM tear (4 patients) and ACL tear with MM tear and LM tear (4 patients).

This study thus reveals the ability of MRI in evaluating various IDK, including their detection, localization, characterization and assessment of the extent of damage and the strength of correlation between MRI and arthroscopic findings confirms the value of MRI in assessing internal knee structures.

## 7. Conclusion

MRI is an excellent, non-invasive, multi-planar modality with capabilities that can be used to detect, localize and characterize IDK. It correlates well with arthroscopy thus avoiding unnecessary invasive arthroscopy for a diagnostic purpose.

### Credit Author Statement

Dr. Japnit Singh: Conceptualization, Methodology, Investigation, Software, Data curation, Writing- Original draft preparation, Reviewing and Editing.

Dr Ashutosh Chitnis: Visualization, Supervision, Validation, Writing- Reviewing and Editing

Final approval of the version to be published: Dr Japnit Singh, Dr Ashutosh Chitnis

Guarantor – Integrity of work as a whole from inception to publication- Dr Japnit Singh, Dr Ashutosh Chitnis

References

[1] Khan KM, Bonar F, Desmond PM, et al. Patellar Tendinosis (Jumper's Knee): findings at Histopathologic Examination, US and MR imaging. Victorian Institute of Sport Tendon Study Group. Radiology 1996 Sep; 200 (3): 821-827.

[2] Berquist TH. Osseous and myotendinous injuries about the knee. RadiolClin North Am 2007 Nov;45 (6):955-968.

[3] Waleed Hetta, Gamal Niazi. MRI in assessment of sports related knee injuries. The Egyptian Journal of Radiology and Nuclear Medicine. 2014 Dec; 45 (4): 1153-1161.

[4] Bahaddur A and Reddy Patil SS. MRI and arthroscopic correlation in internal derangement of knee joint. Am J Oral Med and Radiol. 2015; 2 (4): 259-264.

[5] Ruth Crawford, Gayle Walley, Stephen Bridgman, Nicola Maffauli. Magnetic resonance imaging versus arthroscopy in the diagnosis of knee pathology, concentrating on meniscal lesions and ACL tears: a systemic review. British Medical Bulletin. 2007 Dec, 84 (1): 5-23.doi.org/10.1093/bmb/ldm022

[6] CruesJV 3rd, Mink J, Levy TL, Lotysch M, StollerDW. Meniscal tears of the knee: accuracy of MR imaging. Radiology. 1987Aug; 164 (2):445-8.

[7] Boeree NR, Watkinson AF, Ackroyd CE, Johnson C. Magnetic resonance imaging of meniscal and cruciate injuries of the knee. J Bone Joint Surg Br. 1991 May;73 (3):452-7.

[8] Bradley D, Bradley KE. The value of diagnostic medical imaging. N C Med J. 2014 Mar-April;75 (2):121-5. Doi:10.18043/ncm.75.2.121:24663134.

[9] Singh JP, Garg L, Shrimali R, SetiaV, Gupta V. MR imaging of the knee with arthroscopic correlation in twisting injuries. Indian J of Radiol and Imaging. 2004; 14 (1): 33-40.

[10]Maurer EJ, Kaplan PA, Dussault RG, Diduch DR, Schuett A, McCue FC, Hornsby PP, Hillman BJ. Acutely injured knee: effect of MR imaging on diagnostic and therapeutic decisions. US National Library of Medicine National institutes of Health. 1997 Sept; 204 (3):799-805.

[11]Naranje S, Mittal R, Nag H, Sharma R. Arthroscopic and magnetic resonance imaging evaluation of meniscus lesions in the chronic anterior cruciate ligament-deficient knee. US National Library of Medicine National institutes of Health. Arthroscopy 2008 Sept;24 (9):1045-51.

[12]Bin AbdRazak HR, Sayampanthan AA, Koh TH, Tan HC. Diagnosis of ligamentous and meniscal pathologies in patients with anterior cruciate ligament injury: comparison of magnetic resonance imaging and arthroscopic findings. Ann Transl Med. 2015 Oct; 3 (17): 243.

[13]Esmaili Jah AA, Keyhani S, Zarei R, Moghaddham AK. Accuracy of MRI in comparison with clinical and arthroscopic findings in ligamentous and meniscal injuries of the knee. ActaOrthopBelg. 2005 Apr;71 (2):189-196

Table 1: Routine Knee Imaging Protocol

SEQUENCE	FOV	Matrix/ NEX	Slice	TR	TE	ETL	BW
Sag PD FSE Non fatsat	14-16	512 X 256 2	4/ 0.5	3000	15-20	8	16
Sag T2 FSE FatSat	14-16	256 x 256 2	4/ 0.5	2000	70-80	8	16
Cor T1 SE Non FatSat	16-18	256 X 192 1	3/ 0.5	400-800	Minimal		16
Cor T2 FSE FatSat	16-18	256 X 256 2	3/ 0.5	>2000	70-80	8	16
Axial T2 FSE FatSat	14-16	256 X 256 2	3/ 0.5	>2000	70-80	8	16

Table 2: Spectrum Of MRI Findings in IDK

MRI findings	Positive findings n (%)
Joint effusion	89 (80.2)
ACL tear	76 (68.5)
PCL tear	4 (3.6)
MCL tear	11 (9.9)
LCL tear	3 (2.7)
MM tear	20 (18.1)
Osseous/ osteochondral lesions	52 (46.8)

**Table 3:** Combined /Multiple injuries in IDK

Combined / Multiple injuries	Number n (%) n=105
Isolated	40 (38.09)
Two injuries	41 (39.04)
Three injuries	18 (17.14)
Four injuries	5 (4.8)
Five injuries	1 (0.9)

**Table 4:** Correlation of MRI Diagnosis with Arthroscopic Findings

Correlation	No. of cases n (%)	95 % CI
Yes	22 (88)	70.04-95.83
No	3 (12)	4.17-29.96