



## International Journal of Orthopaedics Sciences

ISSN: 2395-1958  
IJOS 2017; 3(1): 85-88  
© 2017 IJOS  
www.orthopaper.com  
Received: 15-11-2016  
Accepted: 16-12-2016

**Dr. Chiranjib Murmu**  
Department of Radiodiagnosis  
Command Hospital, Kolkata-27,  
West Bengal, India

**Dr. PK Tiwari**  
Department of Radiodiagnosis  
Command Hospital, Kolkata-27,  
West Bengal, India

**Dr. S Sircar**  
Department of Orthopedics  
Command Hospital, Kolkata-27,  
West Bengal, India

**Dr. VK Agrawal**  
Professor & Head of Dept of  
Community Medicine, Rajshree  
Medical Research Institute,  
Bareilly, Uttar Pradesh, India

**Correspondence**  
**Dr. VK Agrawal**  
Professor & Head of Dept of  
Community Medicine, Rajshree  
Medical Research Institute,  
Bareilly, Uttar Pradesh, India

### Accuracy of magnetic resonance imaging in diagnosis of knee injuries

**Dr. Chiranjib Murmu, Dr. PK Tiwari, Dr. S Sircar and Dr. VK Agrawal**

DOI: <http://dx.doi.org/10.22271/ortho.2017.v3.i1b.15>

#### Abstract

**Introduction:** Apart from clinical examination multiple modalities (conventional radiography, MRI and arthroscopy) are currently used to evaluate knee injuries. This study is intended to compare the sensitivity and specificity of MRI in correlation of arthroscopy in diagnosing of knee injuries.

**Material & Methods:** This is a prospective study involving 51 patients with history of knee injuries who were admitted in the Department of Orthopaedics, in a tertiary care hospital of Kolkata between April 2013 and June 2014. MRI of the knee joint was done for all these patients either before or after admission. The patients were then subjected to diagnostic and therapeutic arthroscopy. Statistical analysis was used to calculate the sensitivity, specificity, positive predictive value and the negative predictive value, in order to assess the reliability of the MRI results.

**Results:** The sensitivity and specificity of MRI with respect to arthroscopy in anterior cruciate ligament tear is 87.5% and 66.6%. Positive predictive value is 87.5%. Negative predictive value is 66.6%. Accuracy is 81.82%. The sensitivity and specificity of MRI with respect to arthroscopy in medial meniscal tears is 85.7% and 70.8% respectively. Positive predictive value is 63%; Negative predictive value is 89.4%; Accuracy is 76.3%.

**Conclusion:** The present study supports that MRI is helpful in diagnosing medial meniscal and anterior cruciate ligament injuries. The negative predictive value of a MRI was found to be high for all structures of the knee joint and hence a MRI can be used to exclude a pathology, thus sparing patients from expensive and unnecessary surgery.

**Keywords:** Knee injuries, MRI, arthroscopy

#### 1. Introduction

Multiple imaging modalities are currently used to evaluate pathologic conditions of the knee like conventional radiography, fluoroscopy, sonography, nuclear medicine and MR imaging. The use of fluoroscopy and sonography to guide interventional procedures and Computerised Tomography (CT) to evaluate complex fractures has become a routine practice<sup>[1]</sup>. Magnetic resonance imaging has a better soft tissue contrast, bone marrow involvement and multi planar slice capability which has revolutionized and has become the ideal modality for imaging complex anatomy of the knee joint<sup>[2,3]</sup>. Another advanced modality in the management of internal derangement of knee joint is Arthroscopy, which can be used in its dual mode, either as diagnostic and or as therapeutic tool<sup>[4]</sup>. Menisci and anterior cruciate ligaments (ACL) are commonly injured in knee trauma, especially in road traffic accident and amongst young males in the sports field. Medial Meniscus is more commonly injured than lateral meniscus and sometime associated with anterior cruciate ligament tear. Individuals who experience a blunt trauma knee with suspected internal derangement usually complain of pain and swelling as their primary symptoms. However, sometime they may be confusing and delay in diagnosis may result in a worse prognosis. Therefore, confirmation of injuries requires further evaluation by arthroscopy or magnetic resonance imaging. The clinical examination and standard tests to determine instability and internal derangements still stands as preliminary and gold standard, more reliable and cost effective way of diagnosing such knee problems. Hence this study is intended to determine the benefits of arthroscopy directly and also to compare the sensitivity and specificity of MRI and arthroscopy in diagnosing internal derangements of the knee.

**2. Materials and Methodology**

This is a prospective study involving 51 patients with history of knee injuries who were admitted in the Department of Orthopaedics, in a tertiary care hospital of Kolkata between April 2013 and June 2014. Informed consent and approval of institutional Ethical committee was taken for the study. Purposive random technique was used to select 51 patients with history of knee trauma admitted and treated in the department of Orthopaedics. MRI of the knee joint was done for all these patients either before or after admission. The patients were then subjected to diagnostic and therapeutic arthroscopy in the department of orthopedics at this hospital. Study participants were patients suffering from knee problems like pain, instability for more than 6wks duration, patients with recent symptoms of locking of knee or effusion, patients who have undergone MRI due to any other indication which confirms IDK, patients with chronic knee pain and doubtful knee injury and patients aged between 18-60yrs. Patients with signs of acute infections, cases with severe osteoarthritis, cases with ankylosed knee, cases who have undergone previous arthroscopy, cases treated for chronic septic arthritis or doubtful TB KNEE and patients below the age of 18yrs and above 60yrs were excluded from study. Complete examination of knee was carried out with particular emphasis on tests for meniscal tears like medial joint line tenderness, McMurrays test, Apleys grinding tests, tests for cruciate ligament tears like Lachman test, anterior and posterior drawer tests, Pivot shift tests. Pre- Operative workup included routine-hemogram, urine routine, biochemical parameters of blood, ECG. The protocol for imaging the knee (MRI Knee) included; localizer sequences in sagittal, coronal and axial planes, fat suppressed T2 axial turbo spin echo, T1 spin echo sagittal, T1W, PD/T2W & STIR coronal and sagittal. and Pre- anaesthetic check-up for fitness for arthroscopy. Operative findings were documented in the operation theatre, which included the survey of the entire joint and anatomical structure, lesions involved with the presence or absence of tear, its location, status of the articular cartilage and others. The composite data was tabulated and studied for correlation with MRI findings and grouped into four categories: 1. True-positive -if the MRI diagnosis was confirmed by arthroscopic evaluation, 2. True-negative -when MRI negative for lesion and confirmed by arthroscopy, 3. False-positive – when MRI shows lesion but the arthroscopy was negative, 4. False- negative- result when arthroscopy was positive but the MRI showed negative. Statistical analysis was used to calculate the sensitivity, specificity, positive predictive value (PPV) and the negative predictive value (NPV), in order to assess the reliability of the MRI results. Data was analyzed for the significant correlation between MRI knee and arthroscopic findings by kappa statistics.

**3. Results**

The study had 51 patients, of which 40 (78.43%) were males and 11 (21.57%) were females. The patients who suffered injury were with age ranging from 18 to 60 years. Mean age of patients was 38.17 years with standard deviation 8.66 years. Maximum number 22 (43.14%) of patients who suffered knee injuries were in the age group of 30-40 years followed by 40-50 years age group (33.33). Right Knee was involved in 32 (62.75%) cases and left knee was involved in 19 (37.25%) cases and there were no cases with bilateral knee involvement. Mode of injury was sports in 36(70.59%) cases, motor vehicle accident in 3(5.89%) cases, and domestic falls in 6 (11.76%) cases and others in 6(11.76%) cases. ACL was detected in 32 cases by MRI and arthroscopy.

Medial meniscus was injured in 19 cases as per MRI and 12 cases as per arthroscopy. Diagnosis of anterior cruciate ligament tears by MRI and Arthroscopy has been shown in table 1 to calculate sensitivity and specificity. The sensitivity and specificity of MRI with respect to arthroscopy in ACL tear is 87.5% and 66.6%. Positive predictive value is 87.5%. Negative predictive value is 66.6%. Accuracy is 81.82%. Kappa value is 0.542. P value is 0.0009 and it is significant. Diagnosis of medial meniscus tear by MRI and arthroscopy has been shown in table 2. The sensitivity and specificity of MRI with respect to arthroscopy in medial meniscal tears is 85.7% and 70.8% respectively. Positive predictive value is 63%; Negative predictive value is 89.4%; Accuracy is 76.3%; Kappa= 0.526; and P value is 0.0019 which is very significant. Accuracy of MRI in diagnosis of ACL and medial meniscus tear was 81.8% and 76.3% respectively (table3).

**Table 1:** Diagnosis anterior cruciate ligament tears by MRI and Arthroscopy

MRI	Arthroscopy		
	Positive	Negative	
Positive	28	4	32
Negative	4	08	12
	32	12	44

Sensitivity – 87.5%; Specificity – 66.67%; Positive predictive value – 87.5%  
 Negative predictive value – 66.6%; Accuracy – 81.82%; Kappa – 0.542 – moderate  
 P value – 0.0009 – extremely significant

**Table 2:** Diagnosis Medial meniscus tears by MRI and arthroscopy

MRI	ARTHROSCOPY		
	Positive	Negative	
Positive	12	07	19
Negative	02	17	19
	14	24	38

Sensitivity – 85.7%; Specificity – 70.8%; Positive predictive value – 63%;  
 Negative predictive value – 89.4%; Accuracy – 76.3%; Kappa = 0.526 – moderate; P value 0.0019 – very significant

**Table 3:** Accuracy of MRI in diagnosis of ACL and medial meniscus tear

Structure	Sensitivity	Specificity	Accuracy
	Sensitivity	Specificity	Accuracy
ACL	87.5%	66.7%	81.8%
Medial meniscus	85.7%	70.8%	76.3%

**4. Discussion**

In the everyday practice, based on clinical examination that comes first, surgeons decide whether must proceed to further laboratory tests, MRI, conservative or surgical treatment. But how precise can clinical examination be? There seems to be disagreement regarding the answer to this question. Magnetic resonance imaging (MRI) has a great role in the diagnosis of knee lesions. Most diagnostic studies comparing MRI and arthroscopy have shown good diagnostic performance in detecting lesions of the menisci and cruciate ligaments. The sensitivity for diagnosing isolated medial meniscal tears in Rubin’s series [5] was 98% and it decreased when other structures were also injured. The specificity in isolated lesions was 90%. In a multicentric analysis Fisher [6] reported an accuracy of 78-97% for the anterior cruciate ligament and 64-95% for medial meniscus tears. The menisci are composed of fibrocartilage and appear as low signal structures on all pulse sequences. The sensitivity and specificity of MRI in detecting

meniscal tears exceeds 90% [7]. Ryan *et al* [8] in a prospective study of comparison of clinical examination, MRI, bone SPECT to detect meniscal tear reported high diagnostic ability of MRI along with bone SPECT to detect meniscal tears, with a sensitivity and specificity of 80% and 71% respectively. 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% the time. This phenomenon was reported by Rubin [5]. In a prospective study reported by Imhoff *et al* [9] the negative predictive value was 94% but the positive predictive value was only 54%. They concluded that due to high negative predictive value, a normal MRI scan allows eliminating a menisci lesion and so there is no need for a diagnostic arthroscopy. They 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. However, in our study, MRI showed false results in significant proportion. For example as far as medial meniscus concerns there were 04 false positive and 04 false negative diagnoses. There are several explanations for the misleading results of MRI regarding the menisci. Firstly, meniscal tears and meniscus degenerative changes have the same appearance in MRI, by giving high signals within the meniscus [10]. Diagnosis then depends on the expansion of the high signal line towards meniscus articular surface [11]. Helman *et al* [12] accredited in this structure about 38% of false positive MRI results. Often, the popliteal bursa or Humphreys' ligament may mimic posterior lateral meniscal tears as well [13]. McKenzie *et al* [14] summarized the four most common reasons for false positive diagnosis; i) wrong diagnosis due to variable anatomic structures, ii) overestimation of pathology countered as meniscus tear (for example chondral injuries that mimic meniscus tears), iii) false negative arthroscopic findings and tears within the meniscus without expansion to the articular surface. On the other hand the false negative results seem to occur exclusively from misinterpretation of MRI [15].

As far as the cruciate ligaments are concerned, our study showed that from the 28 ACL ruptures diagnosed during arthroscopy 04 of them were negative; leading to NPV of MRI for ACL ruptures of 66.6%. The accuracy, sensitivity and specificity values for knee lesions vary widely in literature. Rubin *et al* [5] reported 93% sensitivity for diagnosing isolated ACL tears. Similarly several prospective studies have shown a sensitivity of 92-100% and specificity of 93-100% for the MR imaging diagnosis of ACL tears [16]. Similar results were reported from Ochi *et al* [17] who showed that the sensitivity of MRI increased (from 40%-71%) when MRI reading was done retrospectively, after the arthroscopic findings were registered. Especially, in chondral lesions with full thickness loss of cartilage and large deep erosions the retrospectively calculated MRI sensitivity was 100% and 75% respectively. On the other hand site surface injuries, fibrilization or shallow small cuts were not well described, not even post arthroscopically. Furthermore, according to Mori *et al* [18] usage of modern, improved techniques, can not only reveal the size of chondral lesions but to distinguish partial from full depth chondral damages as well.

## 5. Conclusion

The present study supports that MRI is helpful in diagnosing medial meniscal and anterior cruciate ligament injuries. Taking into account that MRI false or misleading results can

be as high as 20-30 percent in specific knee pathologies, it is concluded that arthroscopy still remains the gold standard in diagnosing the internal knee lesions. The routine use of MRI scan to confirm diagnosis is not indicated, as the positive predictive value of the scan is low for all lesions. The negative predictive value of a scan was found to be high for all structures of the knee joint and hence a 'normal' scan can be used to exclude a pathology, thus sparing patients from expensive and unnecessary surgery.

## 6. References

1. Gray SD, Kalpan PA, Dussalt RG. Imaging of Knee: current status. *OCNA* 1997; 28(4):643-658.
2. Kaplan PA, Walker CW, Kilcoyne RF, Brown DE, Tusek D, Dussault RG. Occult fractures patterns of the knee associated with ACL tears. Assessment with MR imaging. *Radiology* 1992; 183:835-838.
3. Kean DM, Worthington BS, Preston BJ. Nuclear MRI of knee: examples of normal anatomy and pathology. *Br J Radiol.* 1983; 56:355-361.
4. Boden SD, Labropoulos PA, Vailas JC. MR Scanning of the acutely injured knee: sensitive, but is cost effective? *Arthroscopy.* 1990; 6:306-308.
5. Rubin DA, Kettering JM, Towers JD, Britton CA. MR imaging of knee having isolated and combined ligament injuries. *AJR.* 1998;170:1207-1213
6. Fisher SP, Fox JM, Del Pizzo W, Freidman MJ, Snyder SJ, Ferkel RD. Accuracy of diagnosis from magnetic resonance imaging of the knee; a multicentric analysis of one thousand and fourteen patients. *JBJS.* 1991; 73-A:2-10.
7. Miller RH. In Campbell's operative orthopaedics. S. Terry Canale (Ed) St Louis Mosby, 1998.
8. Ryan PJ, Reddy K, Fleeteroft J. A prospective comparison of clinical examination, MRI, bone SPECT, and arthroscopy to detect meniscal tears. *Clin s Nucl Med,* 1999; 23:803-06
9. Imhoff A, Buess E, Holder J. comparison between magnetic resonance imaging and arthroscopy for the diagnosis of knee meniscal lesion. *Rev Chir Orthop.* 1997; 83.
10. Dixon AK. Magnetic resonance imaging of meniscal tears of the knee *JBJS Br.* 1996; 78:174-176.
11. Tyrrell RL, Gluckert K, Pathria M, Modic MT. Fast three dimensional MR imaging of the knee: comparison with arthroscopy. *Radiology.* 1988; 166:865-872.
12. Herman LJ, Beltran J. Pitfalls in MR imaging of the knee. *Radiology.* 1988; 167:775-781
13. Watanabe AT, Carter BC, Teitelbaum GP, Bradley WG. Jr. Common pitfalls in magnetic resonance imaging of the knee. *JBJS Am-1989;* 71:857-862.
14. Mackenzie R, Keene GS, Lomas DJ, Dixon AK. Errors at knee magnetic resonance imaging: true or false? *Br J Radiol.* 1995;68:1045-51
15. Ireland J, Trickey EL, Stoker DJ. Arthroscopy and arthrography of the knee: A critical review. *JBJS Br.* 1980; 62-B:3-6.
16. Lee JK, Yao L, Phelps CT, Wirth CR, Czajka J, Lozman J. Anterior cruciate ligament tears. MR imaging compared with arthroscopy and clinical tests. *Radiology* 1998; 166:861-64
17. Ochi M, Sumen Y, Kanda T, Ikuta Y, Itoh K. The diagnostic value and limitation of magnetic resonance imaging on chondral lesions of the knee joint. *Arthroscopy.* 1994; 10:176-183.

18. Mori R, Ochi M, Sakai Y, Adachi N, Uchio Y. Clinical significance of magnetic resonance imaging(MRI) for local chondral lesions. Magn Reson Imaging. 1999; 17:1135-1140. Doi:10.1016/S0730-725X(99)00033-8