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A study of the role of MRI and arthroscopy in the management of knee joint lesions

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Objectives: Aim of this study is to evaluate the types and incidence of injuries in internal derangement of the knee joint by MRI and to compare with arthroscopy findings in selected cases and to assess whether MRI can be used as a primary diagnostic tool for internal derangement of the knee joint. **Material and Method:** This prospective study was done in the Department of Radiodiagnosis Chirayu Medical College and Hospital Bhopal, Madhya Pradesh, India. A total of 100 patients who were referred to the department with strong clinical suspicion of internal derangements of knee joint, underwent magnetic resonance imaging evaluation of knee followed by arthroscopy in selected cases, wherever indicated from August 2014 to July 2019. **Results:** Majority of patients in the current study group belonged to the age group 20-29 years (31%) with a mean age of 24.3 years. In this study, the majority of patients were males constituting 76 % of cases. The most common clinical presentation was that of pain in knee joint seen in 79% of cases. The second most common presentation was swelling seen in 54%. The most common positive clinical test was McMurray's test for meniscal tear seen positive in 48% of cases. In the current study left knee involvement was more common than right knee, constituting 54%. Medial meniscal tears were more common than lateral meniscal tears 49 (73.2%). **Conclusion:** MRI is a useful non-invasive modality having high sensitivity, specificity and accuracy in the diagnosis of meniscal and cruciate ligament injuries. MRI should be done in every patient of suspected internal derangement of the knee joint, to save a patient from unnecessary arthroscopy.

Keywords: Arthroscopy, Cruciate ligament, MRI

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Introduction

Knee injury is the second most common problem in the musculoskeletal system for which patients consult their general physician. Since its introduction to musculoskeletal imaging in the early 1980s, MRI has revolutionized diagnostic imaging of the knee. Magnetic resonance imaging has an advantage in diagnosis of meniscus lesions and cartilage injuries particularly in the early detection of grade I and grade II lesions [1,2]. Arthroscopy of the knee has been used since the 1970s as a diagnostic and therapeutic tool in the management of acute, subacute and chronic knee complaints [3]. It is considered "the gold standard" for the diagnosis of intraarticular knee lesions [4,5]. However, arthroscopy of the knee is an invasive procedure with associated risks and leading to discomfort for the patient and it requires hospitalization and regional or general anaesthesia, thus presenting all the potential complications of an open surgical procedure. This study is aimed to evaluate the types and incidence of injuries in internal derangement of the knee joint by MRI and to compare with arthroscopy findings in selected cases and to assess whether MRI can be used as a primary diagnostic tool for internal derangement of the knee joint.

Material and Method

This prospective study was done in the Department of Radiodiagnosis Chirayu Medical College and Hospital Bhopal, Madhya Pradesh, India. A total of 100 patients who were referred to the department with strong clinical suspicion of internal derangements of knee joint, underwent magnetic resonance imaging evaluation of knee followed by arthroscopy in selected cases, wherever indicated from August 2014 to July 2019.

Inclusion criteria: Patients referred to the Radiodiagnosis Department with strong clinical suspicion of internal derangements of knee joint

Exclusion criteria

01. Patients with neoplasms, inflammatory or infectious disorders.
02. Patients who had previously undergone arthroscopy with the repair of ligaments and menisci.
03. Patients with ferromagnetic implants, pacemakers, and aneurysm clips.

Study protocol: A detailed history of the patient including signs and symptoms and detailed clinical examination findings were recorded and tabulated as in the proforma shown. The patients were briefed about the procedure. The noise due to gradient coils and the need to restrict body movements during the scan time was explained to the patient. The patient was placed in the supine position with the knee in a closely coupled extremity coil. The knee is externally rotated 15-20° (to facilitate visualization of the ACL completely on sagittal images and is also flexed 5-10° (to increase the accuracy of assessing the patella-femoral compartment). Imaging of knee joint was performed in all three standard planes (axial, sagittal and coronal). The field of view varied between 15 and 30cm depending on the patient´s size.

01. An axial acquisition through the patella-femoral joint is used as an initial localizer for subsequent sagittal and coronal images.
02. T1 weighted images (TR/TE= 500/11) were obtained in sagittal and coronal planes.
03. T2 weighted images (TR/TE= 3500/110) were obtained in axial, sagittal and coronal planes. T2 weighted oblique sagittal and coronal images were obtained for the cruciate ligament.
04. Fat suppressed images (TR/TE/TI= 5820/125/130) were used in axial and coronal planes to evaluate bone contusions, joint fluid and the ligaments.
05. Proton Density (TR/TE= 3500/35) sequences in sagittal and coronal planes were used to evaluate ligament tear as there is a loss in a tight spiral of the collagen fibres (ie, is a tear) causing increased mobility of water molecules. This increased water within the fibres prolong the T2 relaxation time and may be seen in short TE images.

Results

Majority of patients in the current study group belonged to the age group 20-29 years (31%) with a mean age of 24.3 years. In this study, the majority of patients were males constituting 76 % of cases. The most common clinical presentation was that of pain in knee joint seen in 79% of cases. The second most common presentation was swelling seen in 54%. The most common positive clinical test was McMurray's test for meniscal tear seen positive in 48% of cases. In the current study left knee involvement was more common than right knee,

Constituting 54%. Medial meniscal tears were more common than lateral meniscal tears 49 (73.2%)

Table-1: Age distribution of cases

Age (years)	No of cases	Percentage
Below 10-19	16	16
20-29	31	31
30-39	18	18
40-49	23	23
50-59	9	9
Above 60	3	3
Total	100	100

Majority of patients in this study group belonged to the age group 20-29 years (31%) with a mean age of 24.3 years.

Table-2: Sex Distribution of Cases

Sex	No of cases	% of cases
Male	76	76
Female	24	24
Total	100	100

In this study, the majority of patients were males constituting 76 % of cases

Table-3: MRI findings of lesions comprising internal derangement of knee joint

MRI finding	No. of cases	% of cases
Altered signal intensity within the meniscus	48	48
Abnormal meniscal morphology	19	19
Altered signal in ACL	25	25
Partial disruption of ACL fibres	7	7
Complete disruption of ACL fibres	21	21
An altered signal in PCL	3	3
Partial disruption of PCL fibres	1	1
Complete disruption of PCL fibres	6	6
An altered signal in MCL	9	9
Disruption of MCL fibres	2	2
An altered signal in LCL	2	2
Disruption of LCL fibres	3	3
Joint effusion	73	73
Chondral defects	19	19
Osseous injuries	26	26

Table-4: Distribution of Meniscal Tears

Side	No. of cases	% of cases
Medial meniscus	49	73.2
Lateral meniscus	18	26.8
Total	67	

In this study, medial meniscal tears (73%) were more common than lateral meniscal tears

Comparison of MRI with arthroscopy

Table-5: Results of data analysis of 31 patients where arthroscopy was available

	Medial Meniscus	Lateral meniscus	ACL	PCL	Chondral defect
True positive	15	4	13	2	4
True negative	13	24	16	29	19
False positive	2	2	1	0	3
False negative	1	1	1	0	3
Positive predictive value	88%	66.6%	92.8 %	100 %	57%
Negative predictive value	92%	96%	94.1 %	100 %	79.1%
Accuracy	90%	90%	93.5 %	100 %	74.15
Sensitivity	88%	80%	92.8 %	100 %	44.4%
Specificity	86%	92%	94.1 %	100 %	86%

Discussion

In the present study, the most common age group of patients presenting with internal derangement of the knee joint was in the 21-30 years range constituting 31% of the cases with the mean age of 24.3 years. Males were the majority of the patients constituting around 76 % of the cases. In the current study left knee joint (54%) involvement was more common than the right knee joint (46%). Bilateral knee involvements saw in 3 patients. These results are in concordance with the observations were seen by Vassilios [6]. The most common presenting complaint was a pain in knee joint seen in 79 % of the patients followed by the swelling of joint constituting 54% of cases. Patients presented with overlapping symptoms in most of the cases. On clinical examination, the most common positive clinical test was McMurray's test seen positive in 48% of cases followed by Lachman's Test constituting 26% of patients. These results are in concordance with the observations seen by Ruwe et al [7]. In this study out of 100 patients evaluated with MRI of the knee for internal derangement of the knee joint, 67 (67%) patients had a meniscal tear. Of these, 49 (73%) patients had a medial meniscal tear and only 18 (27%) patients had a lateral meniscal tear. Tears are more common in the medial meniscus, because the medial meniscus is less mobile, and it bears more force during weight-bearing than the lateral meniscus. This is similar to the study by Crues et al [8] in their study of meniscal tears in 142 patients found meniscal tears in 66% involving the medial meniscus and 33%

Involving the lateral meniscus. Zanetti et al [9] and Mesgazadeb et al [10] also found the same results in their study. Of the 49 medial meniscal tears noted in 100 patients, 32(66%) tears involved the posterior horn, 3 (5%) involved the anterior horn, 6 (12%) involved the body and 8 tears (16%) involved entire meniscus. Crues et al [8] in their study also found meniscal tears involving the posterior horns which accounts for 57% compared to the 16% involving the anterior horn. Weiss et al [11] also reported meniscal tears involving the posterior horn accounting for 50%-60% and tears involving the anterior horn accounting for 5%- 20%. D Smet et al [12] also found the same result in their study. Arthroscopy evaluation was performed only in 31 patients. Preoperative MRI of these patients showed grade -3 medial meniscal tears in 17 patients. On arthroscopy medial meniscal tears found in 16 patients. 2 cases diagnosed as a tear on MRI found to be normal on arthroscopy (false positive) and 1 case which was normal on MRI found to be torn on arthroscopy (false negative). This is similar to the study by M A Kelly et al [13] who found that false-positive results occurred more frequently than false-negative results. In the current study the positive predictive value, negative predictive value, sensitivity, specificity and accuracy for detecting medial meniscal tears were 88%, 92%, 88%, 86% and 90% respectively which were corresponding to the study of L P Cheung et al [14] and M A Kelly et al [13]. In the current study, the 2 false-positive MRI involved the posterior horn of the medial meniscus. On retrospective analysis of MRI, it was found that in one case, the presence of intra-meniscal tear was not communicating with the articular surface of the meniscus and it was misinterpreted as a grade-3 meniscal tear. In the second case, the exact cause of the false positives diagnosis of tear was not apparent. It may be attributed to the misinterpretation of normal meniscofemoral ligament as a meniscal tear or operator/ procedure dependant drawback of arthroscopy. On retrospective analysis of MRI in 1 false-negative case, it was found that the signal intensity of the tear was misinterpreted to reflect a transverse ligament. This is similar to the observation seen by Mesgarzadeb et al [10] Another study which was conducted stated that false-negative results exclusively occurred from the misinterpretation of MRI. Lateral meniscal tears were noted in 18 (18%) patients. 12 tears involved (66.6%) the posterior horn, 1 involved (5.5%) the anterior horn, 3 involved (16.6%) the body and 2 Tears (11.1%) involved entire meniscus. Mesgarzadeb et al [10] also found similar observation in their study with involvement of posterior horn (86%) in most of the tears of the lateral meniscus. Of the 18 meniscal tears involving the lateral meniscus, the maximum number of tears belonging to grade 3 (15 tears, 83.3%). 2 (11.1%) tears were classified as grade 1 tear and 1 (5.5%) tears as grade 2. This is similar to the study done by J. P. Singh et al [15] in their study of 54 patients with lateral meniscal tears, the maximum number of tears belonging to grade 3 (51%). Of the 15 grade -3 lateral meniscal tears, 2 (13.3%) tear was classified as horizontal tears, 6 (40%) tears as vertical tears, 3 (20%) tears as complex tears, 2(13.3%) tears as bucket handle tear, 1 (6.6%) tears as radial tear and 1 (6.6%)tears as flap tear. This is similar to the study by Naranje S et al [16] in their study; they found the vertical type of lateral meniscus tear as a most common tear (53%) in all lateral meniscus tears. Arthroscopy evaluation was performed in 31 patients. Preoperative MRI of these patients showed grade -3 lateral meniscal tears in 6 patients. On arthroscopy lateral meniscal tears found in 5 patients. 2 cases diagnosed as a tear on MRI found to be normal on arthroscopy (false positive) and 1 case which was normal on MRI found to be torn on arthroscopy (false negative). This is similar to the study by M A Kelly et al [13] who found that false-positive results occurred more frequently than false-negative results. In the current study the positive predictive value, negative predictive value, sensitivity, specificity and accuracy for detecting lateral meniscal tears were 66.6%, 96%, 92%, 88% and 90% respectively which were corresponding to the study of M A Kelly et al [13] and Mesgarzadeb et al [10]. In the current study, the 2 false-positive MRI involved the posterior horn of the lateral meniscus. On retrospective analysis of MRI, it was found that in one case, the presence of meniscofemoral ligament was misinterpreted as a meniscal tear. In the second case, the hiatus of the popliteus tendon was mistaken as the tear. Similar observations were seen by Mesgarzadebet al [10] in their study. On retrospective analysis of MRI in 1 false-negative case, it was found that the signal intensity of the tear was communicating with the articular surface of the meniscus and it was misinterpreted as a grade-2 meniscal tear. In this study out of 100 patients evaluated with MRI of the knee for internal derangement of the knee joint, 39 (39%) patients had cruciate ligament tear. Of these, 32 (82%) patients had anterior cruciate ligament

Tears and only 7 (18%) patients had posterior cruciate ligament tear. Tears are less common in the posterior cruciate ligament because it is stronger ligament than anterior cruciate ligament. This is similar to the study by Vassilios S et al [6] in their study of 26 patients with cruciate ligament tear; they found anterior cruciate ligament tears in 23 (88%) patients and posterior cruciate ligament tear in 3 (12%) patients. J. P. Singh et al [15] also found the same results in their study. Arthroscopy evaluation was performed in 31 patients. Preoperative MRI of these patients showed anterior cruciate ligament tears in 14 patients. On arthroscopy anterior cruciate ligament tears found in 13 patients. 1 case diagnosed as a tear on MRI found to be normal on arthroscopy (false positive) and 1 case which was normal on MRI found to be torn on arthroscopy (false negative). In the current study the positive predictive value, negative predictive value, sensitivity, specificity and accuracy for detecting anterior cruciate ligament tears were 92.8%, 94.1%, 92.8%, 94.1% and 93.5% respectively which were corresponding to the study of TP Ha et al [17]. Out of 100 patient's medial collateral ligament tears were seen in 11 patients. Of the 11 patients, 4 (36%) had grade 1 tear, 5 (45%) had grade 2 tear and 2 (18%) had grade 3 tears. A similar observation was seen by Schweitzer M [18]. A study was conducted on 76 patients, they found that the maximum number of patients with knee pain who had MCL tears belonged to grade 2. Of 100 patients included in the current study, the chondral defect was found in 19 patients (19%). A similar observation was seen by Vassilios et al [6] in their study of 46 patients, on MRI they found a chondral defect in 8 patients (17%) Arthroscopy evaluation was performed in 31 patients. Preoperative MRI of these patients showed chondral defects in 7 patients. On arthroscopy chondral defects found in 9 patients. 3 cases diagnosed as a defect on MRI found to be normal on arthroscopy (false positive) and 5 cases which were normal on MRI found to be injured on arthroscopy (false negative). In the current study the positive predictive value, negative predictive value, sensitivity, specificity and accuracy for detecting chondral defects were 57%, 79%, 44.4%, 86% and 74.4% respectively which were corresponding to the study of Ochi M et al [19], who found accuracy of MRI significantly inferior in the diagnosis of chondral lesions. Heron et al [20] described that MRI can satisfactory reveal the advanced chondral defects as well as damages at the patellar articular cartilage But is not accurate for smaller injuries like fibrilization or small fissuring in particular hyaline cartilage.

Conclusion

Thus, MRI is a useful non-invasive modality having high sensitivity, specificity and accuracy in the diagnosis of meniscal and cruciate ligament injuries.

What does the study add to the existing knowledge

MRI should be done in every patient of suspected internal derangement of the knee joint, to save a patient from unnecessary arthroscopy.

Author's contributions

Both the authors, **Dr. Laxman P. Ahirwar** and **Dr. Nitin Khantal** contributed equally in the design and conduct of the study, and in the preparation of the manuscript along with data analysis.

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