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ORIGINAL RESEARCH

Role of MRI in evaluation of traumatic internal derangements of knee joint-A study of 50 cases

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ABSTRACT

Aims & objectives:

a) To assess the diagnostic utility of MRI in patient with suspected pathological lesion of knee joint in patients presented with trauma.
b) To correlate the clinical findings of knee joint injury with findings of magnetic resonance imaging technique.

Materials and methods: A cross sectional study was conducted on 50 patients referred from indoor/outdoor patient department of orthopaedics to the department of radiodiagnosis for MRI. **Results:** Our study showed the correlation of clinical findings with MRI findings and correlation of MRI findings with arthroscopy findings. Clinical examination findings compared to MRI findings came significant for PCL, LCL, MM.MRI findings in the study for the comparison with Arthroscopy findings and their respective P values came highly significant findings for ACL, PCL, MM, LM. The study showed Arthroscopy findings in comparison with clinical findings came significant for all except for LM**. Conclusion:** The study showed clinical examination findings in comparison with MRI findings which came significant for PCL, LCL, MM.MRI findings in the study for the comparison with Arthroscopy findings and their respective P values came highly significant findings for ACL, PCL, MM, LM.

INTRODUCTION

The knee joint, being the largest in the human body, is intricate and susceptible to a variety of injuries affecting its ligaments, menisci, and bones. These injuries are commonly seen in athletes and young individuals due to the joint's exposure to significant mechanical stresses. Joint damage is well acknowledged as a significant risk factor contributing to the onset of osteoarthritis.[1]

Magnetic Resonance Imaging (MRI) offers distinct benefits compared to other imaging methods when assessing traumatic soft tissue injuries in the knee joint, because to its exceptional ability to provide clear imaging of soft tissues and its capacity to capture images from several angles.[2]

The imaging techniques suitable for knee imaging in coronal, axial, and sagittal planes include T1, proton density with or without fat saturation, T2, spin echo, rapid (turbo) spin-echo, and gradient-echo sequences.[3] Initial evaluation of acute knee injuries typically starts with plain film radiographs. If these do not reveal suspected fractures or soft tissue injuries, further assessment with CT or MRI is advised based on the injury type. CT is best for bone damage, while MRI helps in assessing soft tissues like cartilage, menisci, ligaments, and tendons. CT arthrography with intraarticular contrast is an alternative to MRI in cases involving metallic foreign bodies or implants near the knee.[4]

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Role of MRI: MRI (Magnetic Resonance Imaging) stands out as the preferred imaging modality for evaluating soft tissue injuries within the knee joint.

Soft Tissue Injuries: MRI accurately detects and classifies ligament tears, including ACL and PCL injuries, which are common in sports-related trauma. It also identifies meniscal tears, crucial for determining appropriate treatment strategies.

Bone Marrow Edema and Bruising: MRI is sensitive to bone marrow edema and bruising, visualizing patterns indicative of underlying ligamentous injuries, such as "kissing contusions" seen in ACL ruptures.[5]

MATERIALS AND METHODS

A cross sectional study was conducted on 50 patients referred from indoor/outdoor patient department of orthopaedics to the department of radiodiagnosis for MRI.

MR scan in all the patients included in this study were carried out on Siemens MagnetomAera 1.5 Tesla machine in the department of Radiodiagnosis and Imaging, Govt. Medical College, Amritsar.

TECHNIQUE OF MRI OF KNEE JOINT :

MRI PROTOCOL:

- Localizer was taken in axial, sagittal and coronal planes after making proper positioning of the patient. The MRI protocol will consist of T1, T2, PD and PDFS. All examinations will be performed on a 1.5 Tesla magnet.
- A three-plane localizer was taken at the beginning to localize and plan the sequences. Localizers are usually T1-weighted low-resolution scans that last less than 25 seconds.

Data was entered in to Microsoft Excel and analysis was done using IBM Statistical Package for the Social Sciences (SPSS) version 21 (IBM Corp., Armonk, NY, USA). Frequency and percentage was used to summarize categorical variables and continuous data was presented as mean and standard deviation (SD) or as median and interquartile ranges depending on the normality of the data, after testing normality of the data by using Kolmogorov Smirnov test. Proportions were compared using Chi-Square test with or without Yate's correction or Fisher's exact test. The mean values between two groups was compared using independent t test. For all the comparisons pvalue of less than 0.05 was considered statistically significant.

RESULTS

Out of 50 cases, on clinical examination, majority had anterior cruciate ligament injury. The proportion of posterior cruciate ligament was very less. Medial meniscal injuries were relatively prevalent among the cases studied. Lateral meniscal injuries were relatively less common compared to Medial meniscal injuries.**On MRI,** ACL tear was diagnosed in 37 cases, PCL tear in 4 cases, MCL in 15 cases, LCL in 5 cases, MM in 35 cases and LM in 24 cases.

TABLE 1: CLINICAL EXAMINATION FINDINGS IN COMPARISON WITH MRI FINDINGS

Pathology	Sensitivity (%)	Specificity (%)	Accuracy (%)	Agreement (Kappa score)	P value
ACL	89.2	23.1	72.0	0.14	0.273
PCL	50.0	95.7	92.0	0.45	0.001*
MCL	40.0	82.9	70.0	0.24	0.083
LCL	20.0	100.0	92.0	0.31	0.002*
MM	59.5	92.3	68.0	0.38	0.002*
LM	8.3	84.6	48.0	0.07	0.443

***Significant**

The table compared clinical examination findings with MRI findings. Sensitivity varied widely: highest for ACL (89.2%) and lowest for LM (8.3%). Specificity was highest for LCL (100.0%) and PCL (95.7%). Accuracy ranged from 48.0% (LM) to 92.0% (PCL and LCL). Kappa scores indicated fair to moderate agreement (0.07 to 0.45). Significant P values (*P < 0.05) were found for PCL, LCL, and MM.

TABLE 2: MRI FINDINGS IN COMPARISON WITH ARTHROSCOPY FINDINGS AND THEIR RESPECTIVE P VALUES

Pathology	Sensitivity (%)	Specificity (%)	Accuracy (%)	Agreement (Kappa score)	P value
ACL	100.0	50.0	74.0	0.49	**<0.001****
PCL	80.0	100.0	98.0	0.87	**<0.001****
MM	95.7	100.0	96.0	0.77	**<0.001****
LM	87.5	70.6	76.0	0.51	**<0.001****

****Highly significant**

- **ACL:** Perfect sensitivity, moderate specificity; moderate accuracy and agreement.
- **PCL:** High sensitivity, perfect specificity; very high accuracy and excellent agreement.
- **Medial Meniscus:** Very high sensitivity and specificity; very high accuracy and excellent agreement.
- **Lateral Meniscus:** High sensitivity, moderate specificity; moderate accuracy and fair agreement.

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TABLE 3: ARTHROSCOPY FINDINGS IN COMPARISON WITH CLINICAL FINDINGS

Pathology	Sensitivity (%)	Specificity (%)	Accuracy (%)	Agreement (Kappa score)	P value
ACL	100.0	26.9	62.0	0.26	**0.006***
PCL	40.0	95.6	90.0	0.39	**0.005***
MM	87.0	88.9	88.0	0.75	**<0.001****
LM	6.3	85.3	60.0	-0.10	0.391

***Significant; **highly significant**

- **ACL:** Perfect sensitivity, low specificity; moderate accuracy, poor agreement.
- **PCL:** Low sensitivity, high specificity; high accuracy, fair agreement.
- **Medial Meniscus:** High sensitivity and specificity; high accuracy, excellent agreement.
- **Lateral Meniscus:** Very low sensitivity, moderate specificity; moderate accuracy, negative agreement.

DISCUSSION

The study showed clinically among the total 50 cases, majority had (ACL)anterior cruciate ligament injury. Tamburrini et al[6]showed that anterior cruciate ligament injury was seen in 90.4% of the cases.

Lateral meniscal (LM) injuries were relatively less common compared to Medial meniscal injuries in the study.Similar study was done by Sanders et al[5]

Among the cases for the study assessed for ACL tears using MRI, 74.0% showed evidence of a tear in the ACL. Whereas Study done by Monto et al[7]showed that 91% of the cases had anterior cruciate ligament insertional avulsions.

The study showed 92.0% with no tear, 8.0% with a complete tear in the PCL. Study done by Monto et al[7] showed that 18% had distal posterior cruciate ligament avulsions.

Regarding distribution of MCL tears, majority had no tear, while Grade II and Grade III tears represent smaller percentages of the total cases. Monto et al[7]showed that there were three instances of type I fractures, three instances of type II fractures, twelve instances of type III fractures.

The study showed for LCL (Lateral Collateral Ligament) tears, 92.0% with no tear in the LCL. 18% had lateral meniscal tears as per study done by Monto et al[7]

According to MRI in the study, medial meniscal tear was distributed almost equally along the three sites. Similar findings was seen by study done by Knox et al[8]

The study demonstrated that according to MRI, more than half of the cases had grade II injury, followed by grade III and grade I. Study done by Li et al[9] showed majority of grade II injury.

MRI detected lateral meniscal tear in nearly half of the cases in the study.Su et al[10]showed similar study findings.The study showed the proportion of lateral meniscal tear in posterior horn to be more as 41.7%, followed by anterior horn (37.5%) and mid zone (20.8%).Van Dyck et al [11] showed 46% involvement in anterior horn followed by mid zone.

As per MRI, more than fifty percent of the cases had diagnosed with grade II tear (62.5%) in the lateral meniscus, followed by grade I injury (33.3%). Very few had grade III injury (4.2%). Cellar etal[12]showed similar findings in his study.

The study showed other additional findings as cystic lesions (20.0%), contusion (20.0%) followed by fracture of tibia/femur(8.0%), osteoarthritic changes (4.0%) and loose bodies (2.0%).Schub et al[13] showed such additional cystic lesions of 12%.

The study showed clinical examination findings compared to MRI findings came significant for PCL, LCL, MM.MRI findings in the study for the comparison with Arthroscopy findings and their respective P values came highly significant findings for ACL, PCL, MM, LM. The study showed Arthroscopy findings in comparison with clinical findings came significant for all except for LM. Similar findings was seen by study done by Miller et al[14]

The study showed the correlation of clinical examination with MRI findings for ACL with specificity and sensitivity of 89%,23.1% and an accuracy of 72%. As per Hughes and Houlihan-Burne et al [15]study the sensitivity, specificity accuracy & negative predictive value (NPV) in detecting the complete tear of the ACL injury were 90.9%, 84.6%, 88.6% and 84.6%.

The study showed MRI findings in comparison with Arthroscopy findings with sensitivity and specificity, accuracy of 80%,100%,98%As per Hughes and Houlihan-Burne et al[15] study There were 100%, 97.1%, 97.5% in that order, for diagnosis of complete PCL tear.

The study showed the correlation of clinical examination with MRI findings for medial meniscus with specificity and sensitivity of 59.5% ,92.3%, and an accuracy of 68%.As per Hughes and Houlihan-Burne et al[15] study medial meniscus tear uncovered 100% in sensitivity, 52.6% in specificity, 64% in accuracy & 100% in NPV.

The study showed the correlation of clinical examination with MRI findings for lateral meniscus with specificity and sensitivity of 84.6%,83% and an accuracy of 48%.As per Hughes and Houlihan-Burne et al[15] study lateral meniscus, it produced 55.6%, 83.3%, 75.8% and 83.3%.

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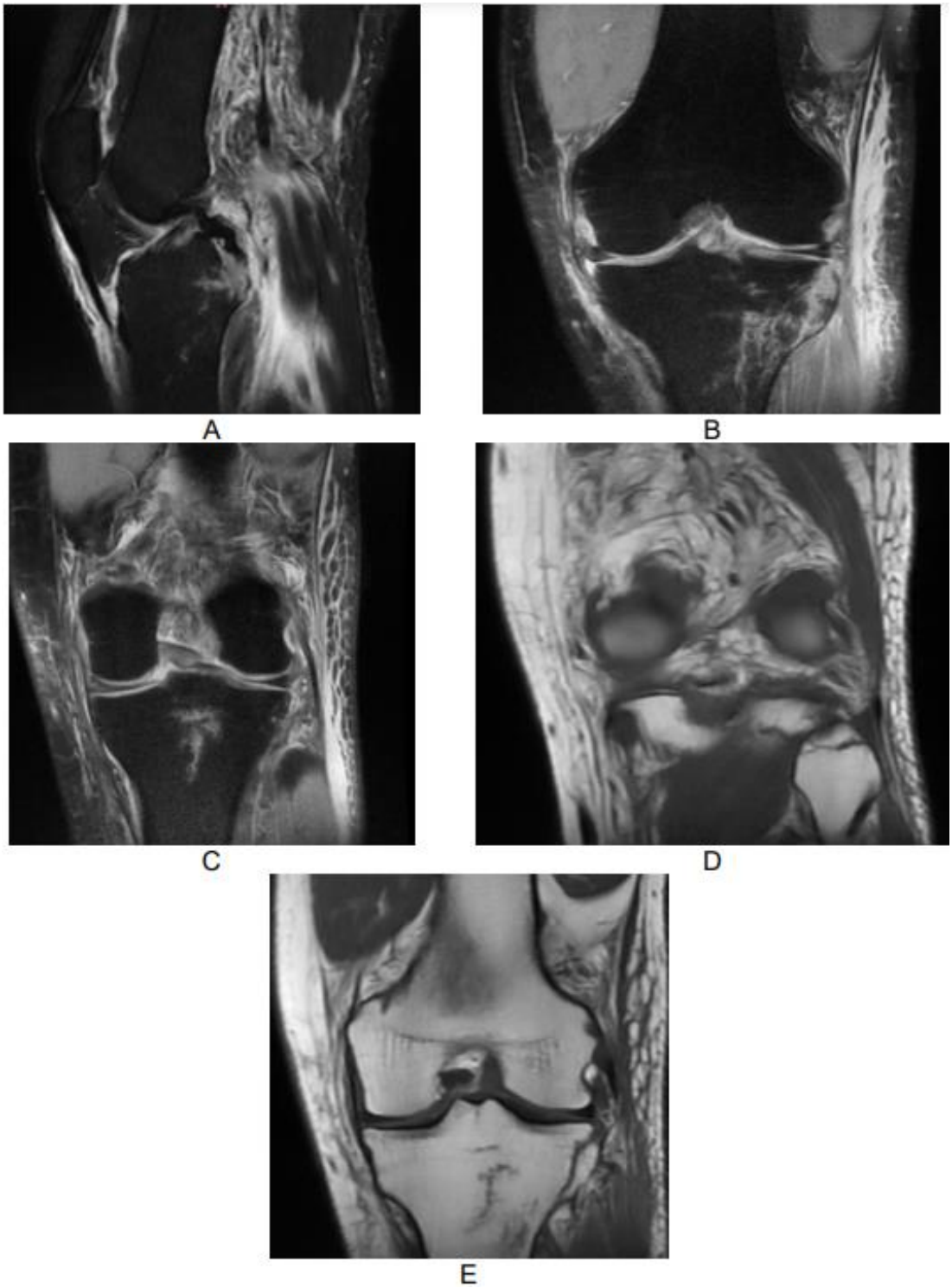
Case:



PDFS SAGITTAL(A), CORONAL(B), CORONAL(C) IMAGES SHOWING PCL AVULSION FRACTURE OF THE POSTERIOR ARTICULAR SURFACE OF TIBIA WITH RETRACTION AND HIGH SIGNAL IN ITS DISTAL PORTION ASSOCIATED WITH FLUID IN THE INTERCONDYLAR NOTCH. T1 CORONAL(D), CORONAL(E) IMAGES SHOWING FRACTURE OF LATERAL TIBIAL PLATEAU AND HEAD OF FIBULA

SUMMARY AND CONCLUSIONS

SUMMARY

The study confirms MRI's effectiveness in diagnosing knee injuries in trauma patients, highlighting its ability to reveal detailed soft tissue and hidden bone/cartilage damage. MRI's superior imaging capabilities allow it to accurately assess injury extent and location, potentially replacing diagnostic arthroscopy for cases with post-traumatic pain and inconclusive radiographs.

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CONCLUSION

The study of 50 knee injury cases found MRI highly effective in diagnosing traumatic internal derangements. Most patients were aged 16-30, with a predominance of males (72%). MRI frequently identified ACL injuries and lateral meniscal tears, while medial meniscal injuries were also notable. Radiographs showed fractures in 14% of cases, and MCL tears were rare. MRI detected ACL tears in 74% and PCL tears in 8%, with LCL tears in 8% of cases. Arthroscopy confirmed PCL tears in 20% and revealed 23 medial and 16 lateral meniscal tears. Additional findings included cystic lesions (20%) and contusions (20%). MRI findings significantly correlated with arthroscopy results, particularly for ACL, PCL, and meniscal injuries.

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