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ORIGINAL RESEARCH

Pattern recognition of soft tissue injury in knee trauma using MRI: A prospective study in tertiary care center at Barabanki

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ABSTRACT

Background: The knee is a major weight-bearing joint that provides mobility and stability during physical activity as well as balance while standing. The present study was conducted to assess pattern recognition of soft tissue injury in knee trauma using MRI. **Materials & Methods:** 90 patients of both genders presented with painful or unstable knee joints after knee trauma at the outpatient department (OPD) of the department of Radiology at Hind Institute of Medical Sciences, during the study period of 18 months was selected. MRI was performed in all patients. **Results:** The ACL tear detection has a high sensitivity of 93.75% and a specificity of 73.08%. The negative predictive value (NPV) and positive predictive value (PPV) are 82.61% and 89.55%, respectively. The overall accuracy for ACL tear detection stands at 87.78%. Similarly, Meniscus tear detection has a comparable sensitivity of 93.85%, slightly lower specificity of 68.00%, NPV of 80.95%, PPV of 88.41%, and an accuracy of 86.67%. **Conclusion:** MRI is a reliable method for identifying, localizing, and characterizing different types of ligament rips in the knee joint by thoroughly comparing MRI knee results with clinical evaluation. As a result, it non-invasively directs the patient's further care for their knee ailment. To avoid unnecessary arthroscopies, every patient with a suspected ligamentous injury should have an MRI before being scheduled for one.

Keywords: ACL, Knee, MRI

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INTRODUCTION

The knee is a major weight-bearing joint that provides mobility and stability duringphysical activity as well as balance while standing.[1] The human knee is thebiggest and most intricately designed joint in the body. It is often damaged, whichmay contribute to long-term disability and have an effect on the socioeconomicsystem. Injury incidence is 2.3 per 1000 on average, with the greatest rate amongthose aged 15 to 24.[2]Men are roughly twice as likely as women to have athleticinjuries, despite the total frequency showing only a small male majority. Certain sports pose a higher risk for knee injuries due to the nature of themovements involved.[3] Football, basketball, and volleyball, for example, have been found to have a higher prevalence of knee sports injuries, affecting knee bones and surrounding structures. Football, handball, and Jiu-jitsu account for approximately 50% of ACL injury cases, while meniscal injuries are the second most common injury in football players.[4]

MR imaging is an effective technique for longitudinal patient assessment after acute knee injuries because it can identify early morphologic deterioration in joint structures. When employing high-field strength scanners and sophisticated imaging techniques, MRI imaging is sensitive for identifying early cartilage deterioration.[5]The present study was conducted to assess pattern recognition of soft tissue injury in knee trauma using MRI.

MATERIALS & METHODS

This descriptive cross-sectional study was conducted over 90 patients of both genders presented with painful or unstable knee joints after knee trauma at the Outpatient Department (OPD) of the Department of Radiology at Hind Institute of Medical Sciences, during the study period of 18 months.

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The technical examination for ligament imaging involved a systematic approach utilizing various pulse sequences and imaging planes. Firstly, imaging of ligaments was conducted in all three standard planes: sagittal, coronal, and axial. The field of view was adjusted between 14 and 16 cm, depending on the patient's size, to ensure optimal visualization. An axial acquisition through the patellofemoral joint served as the initial localizer for subsequent sagittal and coronal plane images, facilitating accurate localization of ligament structures.The collected data were analyzed with IBM. Statistical Package for Social Sciences (SPSS) version 23.0 for Windows.

RESULTS

Table I Baseline characteristics

Variables		No. of cases (n=90)	Percentage (%)	Pvalue
Mean Age in years		30.4±8.7	-	
Gender	Male	68	75.6%	0.05
	Female	22	24.4%	
Side involved	Right	50	55.6%	0.026
	Left	40	44.4%	
Education	Primary	18	20.0%	0.05
	Secondary	37	41.1%	
	Graduate	35	38.9%	
Occupation	Self-employment	22	24.4%	0.05
	Formal employment	65	72.3%	
	Student	3	3.3%	
Mode of injury	RTA	50	55.6%	0.05
	Sports Injury	35	38.8%	
	Miscellaneous	5	5.6%	

A total of 90 patients, aged 18-60 years, mean age 30.4±8.7 years were involved in this study. The gender distribution showed a higher representation of males 68 (75.6%) compared to females 22 (24.4%). In terms of sides involved, right-sided injuries were slightly more prevalent 50 (55.6%) than left-sided injuries 40 (44.4%). Education-wise, a larger proportion had secondary education 37 (41.1%) followed closely by graduate level 35 (38.9%), while 18 (20.0%) had primary education. Occupation-wise, formal employment was predominant 65 (72.2%), with a smaller portion being self-employed 22 (24.4%) and a very small portion being students 3 (3.3%). Regarding the mode of injury, road traffic accidents (RTA) were the most common 50 (55.6%), followed by sports injuries35 (38.9%) and miscellaneous causes 5 (5.6%).

Table II The incidence of individual ligament tear on MRI.

Findings	No. of cases (n=90)	Percentage (%)	Pvalue
Medial meniscus	46	51.1%	0.05
Lateral meniscus	23	25.6%	
Anterior cruciate Ligament	67	74.4%	
Other ligaments	10	11.1%	

The most commonly torn ligament was the anterior cruciate ligament (ACL), affecting 67 (74.4%) of patients. Medial meniscus tears were also frequent, affecting 46 (51.1%) of patients, followed by lateral meniscus tears at 23 (25.6%). Other ligaments were less commonly injured, affecting only 10 (11.1%) of patients.

Table IV The case-wise distribution of meniscal & ACL tears on MRI

Findings	No. of cases (n=90)	Percentage (%)	Pvalue
Medial Meniscus(MM) only	15	16.7%	0.005
Lateral Meniscus(LM) only	4	4.4%	
Ant. Cruciate Ligament(ACL) only	28	31.1%	
MM+LM	4	4.4%	
MM+ACL	23	25.6%	
LM+ACL	11	12.2%	
MM +LM+ACL	5	5.6%	

Among the 90 patients, 31.1% (28) had ACL tears. Medial Meniscus tears were more frequent than Lateral Meniscus tears, affecting 16.7% (15) and 4.4% (4) of patients, respectively. Combinations of

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tears were also observed, with the most common being a combined medial meniscus and ACL tear, affecting 23 (25.6%) of patients. Combined tears involving both MM and LM were found in 4 (4.4%) of cases, while LM combined with ACL tears were noted in 11 (12.2%) of cases. The least frequent pattern was the involvement of all three structures (MM, LM, and ACL), seen in 5 (5.6%) of cases.

Table V Distribution of studied patients based on ACL tear

		Clinical		
		Tear	**Normal**	**Total**
MRI	Tear	60	7	67
	Normal	4	19	23
Total		64	26	90

Out of the total 90 patients, 67 were diagnosed with ACL tears clinically, out of which 60 were confirmed through MRI. Additionally, 4 patients clinically assessed as normal showed ACL tears on MRI. On the other hand, 23 patients wereclinically diagnosed as normal, out of which 19 were also found to be normal through MRI, while 7 were identified with ACL tears.

Table VI Distribution of studied patients based on Meniscus tears

		Clinical		
		Tear	**Normal**	**Total**
MRI	Tear	61	8	69
	Normal	4	17	21
Total		65	25	90

Out of the total 90 patients, 69 were identified with meniscus tears clinically, with61 of them confirmed through MRI. However, 4 patients who were clinically diagnosed as normal were found to have meniscus tears on MRI. On the other hand, 21 patients clinically assessed as normal had 17 confirmed as normal through MRI, while 4 were identified with meniscus tears.

Table VII Sensitivity, specificity NPV and PPV and accuracy

Tear	Sensitivity	Specificity	NPV	PPV	Accuracy
ACL	93.75%	73.08%	82.61%	89.55%	87.78%
Meniscus	93.85%	68.00%	80.95%	88.41%	86.67%

The ACL tear detection has a high sensitivity of 93.75% and a specificity of 73.08%. The Negative Predictive Value (NPV) and Positive Predictive Value (PPV) are 82.61% and 89.55%, respectively. The overall accuracy for ACL tear detection stands at 87.78%. Similarly, Meniscus tear detection has a comparable sensitivity of 93.85%, slightly lower specificity of 68.00%, NPV of 80.95%, PPV of 88.41%, and an accuracy of 86.67%.

DISCUSSION

Both in daily life and, to a greater extent, during athletic activity, the knee is strained. Apart from the surrounding muscles, the ligaments, menisci, and joint capsule are also passive stabilizers of the joint that are vital for maintaining joint stability.[6] A sports injury that damages the knee's secondary stabilizers may cause an overuse of other internal knee components.[7] Research revealed that the knee is involved in 32.6% of all sports injuries and that playing sports is the reason for 20–25% of all knee injuries. Sports-related injuries are comparable in severity to those sustained in auto accidents.[8] A prior study found that sports injuries happen twice as frequently as car accidents. This can be attributed to two factors: the large number of athletes or the high rate of injuries sustained while playing sports. Sports injuries are common in soccer and skiing, and during the past 20 years, skiing-related injuries have increased.[9,10]

We found that the most commonly torn ligament was the anterior cruciate ligament (ACL), affecting 67 (74.4%) of patients. Medial meniscus tears were also frequent, affecting 46 (51.1%) of patients, followed by lateral meniscus tears at 23 (25.6%). Other ligaments were less commonly injured, affecting only 10 (11.1%) of patients.Among the 90 patients, 31.1% (28) had ACL tears. Medial Meniscus tears were more frequent than Lateral Meniscus tears, affecting 16.7% (15) and 4.4% (4) of patients, respectively. Combinations of tears were also observed, with the most common being a combined medial meniscus and ACL tear, affecting 23 (25.6%) of patients. Combined tears involving both MM and LM were found in 4 (4.4%) of cases, while LM combined with ACL tears were noted in 11 (12.2%) of cases. The least frequent pattern was the involvement of all three structures (MM, LM, and ACL), seen in 5 (5.6%) of cases. Douglas et al[11] studied a college football teamat the University of Arizona in a prospective case-control study to determine the efficacy of knee braces as a

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preventive measure. They discovered that the number of knee injuries was comparable in both the groups that used splints and those that did not.

Out of the total 90 patients, 67 were diagnosed with ACL tears clinically, out of which 60 were confirmed through MRI. Additionally, 4 patients clinically assessed as normal showed ACL tears on MRI. On the other hand, 23 patients were clinically diagnosed as normal, out of which 19 were also found to be normal through MRI, while 7 were identified with ACL tears.Out of the total 90 patients, 69 were identified with meniscus tears clinically, with 61 of them confirmed through MRI. However, 4 patients who were clinically diagnosed as normal were found to have meniscus tears on MRI. On the other hand, 21 patients clinically assessed as normal had 17 confirmed as normal through MRI, while 4 were identified with meniscus tears.The ACL tear detection has a high sensitivity of 93.75% and a specificity of 73.08%. The Negative Predictive Value (NPV) and Positive Predictive Value (PPV) are 82.61% and 89.55%, respectively. The overall accuracy for ACL tear detection stands at 87.78%. Similarly, Meniscus tear detection has a comparable sensitivity of 93.85%, slightly lower specificity of 68.00%, NPV of 80.95%, PPV of 88.41%, and an accuracy of 86.67%.According to a comparative diagnostic accuracy study by Palmet al[12], MRI's sensitivity and specificity range from 61.0% to 100.0% and 82.0% to 97.0%, respectively, in post-double bundle ACL reconstruction cases. For complete tears, the MRI's sensitivity was 82.3%. ACL tears may be accurately identified by MRI with a 93% to 97% accuracy rate. The ACL tears in our study had a positive predictive value of 89.55% and a negative predictive value of 82.61%, respectively. From 70% to 76% and 70% to 100%, respectively, are the ranges for the PPV and NPV.

The shortcoming of the study is small sample size.

CONCLUSION

Authors found that MRI is a reliable method for identifying, localizing, and characterizing different types of ligament rips in the knee joint by thoroughly comparing MRI knee results with clinical evaluation. As a result, it non-invasively directs the patient's further care for their knee ailment. To avoid unnecessary arthroscopies, every patient with a suspected ligamentous injury should have an MRI before being scheduled for one.

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