Original Article

Role of M.R.I. in Evaluation of Traumatic Knee Joint Injuries

Ambareen Muhammad, Zeenat Adil, Abdul Majid, Aziz Zia and Rida Saleem

ABSTRACT

Objective: To describe the MRI characteristics of traumatic lesions and to identify common knee joint lesions.
Study Design: Cross sectional study
Place and Duration of Study: This study was conducted at the Radiology Department of Kuwait Teaching Hospital between 1 July 2023 - 30st June 2024.
Methods: The study was performed on 160 consecutively registered patients. It is a cross sectional descriptive study. Patients 16 yrs. and above with traumatic knee injury were included in this study. Non cooperative patients, those who have undergone prior surgical procedures, periarticular tumors or infections and contraindications to MRI were excluded from the study.
Results: We analyzed MRI scans of total of 160 patients with knee joint injuries. The age of patient was grouped in clusters of 10 years. Majority of the patients (35%) were found in 26-35 years' age group. Out of total 160 patients; majority of them were male comprising 126 patients and 34 were female. They underwent MR imaging within 6 months of their injury. Right knee was involved in 55% and left knee in 45% cases. Among cruciate ligaments partial tear of ACL was most commonly seen. In one-third of our cases bone contusions were present.
Conclusion: Based on the current study's data, it can be said that MRI is the most effective method for evaluating internal knee joint derangement after injury. The most common findings were anterior cruciate ligament tears, medial meniscal tears, and joint effusions.

Key Words: Knee joint, MRI, ACL, PCL, MM, LM.

Citation of article: Muhammad A, Adil Z, Majid A, Zia A, Saleem R. Role of M.R.I. in Evaluation of Traumatic Knee Joint Injuries. Med Forum 2025;36(6):4-8. doi:10.60110/medforum.360601.

INTRODUCTION

The knee joint is a hinge. It has a broad range of movement and is vulnerable to both acute and non-traumatic ligament damage[1]. Knee joint discomfort always affects the mobility of patient therefore early diagnosis of knee joint pathologies/injuries is very important. Osteoarthritis and meniscal tears are two common pathologies. Trauma or degeneration causes knee pain and meniscal tears are common findings. Meniscal tears should be treated on time, if not it will lead to osteoarthritis and will then require surgical treatment[2]. ACL tears are one of the most common and catastrophic sports injury in knee joint. After ACL injury, femur and tibia bone bruises can be seen on MRI which reveals hypo intense and hyper intense signals on T1 and T2 WI respectively.

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Received: December, 2024
Reviewed: January-February, 2025
Accepted: March, 2025

Patterns of bone bruises provides a clue to the mechanism of ACL injury and also provides information when the injury has occurred[3]. ACL injuries mainly affects young people which causes joint instability leading to reduced activity[4].

Knee joint is an important and complex joint in human body characterized by presence of various ligaments and menisci. Human mobility is dependent upon stability of knee joint[5,6]. Knee pain can occur at any age. Knee discomfort can be caused by a number of things, including injuries and underlying conditions like arthritis. When determining the source of knee discomfort, radiology is crucial[5]. When it comes to identifying and evaluating both acute and chronic internal derangements of knee joint injuries, MRI is the preferred modality[7].

Imaging techniques for knee pain include scintigraphy, arthrography, CT, MRI, and X-rays. Due to their accessibility and affordability, X-rays were the first imaging modality to be employed; nevertheless, their use was limited because they were unable to detect soft tissue pathology and exposed the patient to radiation[8]. According to the American College of Radiology Appropriateness Criteria, MRI should be the first radiological test performed in suspected cases of non-osseous knee injury. The gold standard for high-resolution evaluation of the musculoskeletal system is MRI[9]. MRI plays a vital role in diagnosing meniscal tears, helps in preoperative planning and post op rehabilitation[10].

When evaluating traumatic knee injuries, MRI offers a considerable advantage over conventional imaging methods due to its multiplanarity and superior soft tissue contrast resolution. MRI should be performed often since it can reliably diagnose ligamentous injuries to the knee joint. Noninvasive MRI is capable of precisely assessing a variety of conditions, including fractures, arthritis, infections, trauma, torn tendons and ligaments, and damaged cartilage. Bony and soft tissue abnormalities can be accurately identified by MRI in terms of their nature and extent[11]. Multi ligament injuries are caused by high force and severe injury but are rare. Early detection is very important for prompt treatment of multi ligament injury. MRI is valuable in detection of isolated ligament injury however its role in assessment of multi ligament injury is not clear yet[12].

Although arthroscopy is the gold standard for diagnosing internal knee derangement, it is an intrusive treatment that has drawbacks, including surgical and anesthetic difficulties, hospital stays, and theater expenses, and it is user dependent[13]. When utilized properly, MRI has been shown to decrease the incidence of needless surgical arthroscopies and aid in pre-operative planning.

METHODS

The study was performed in the Radiology Department of Kuwait Teaching Hospital between 1 July 2023 - 30st June 2024 on 160 consecutively registered patients. It is a cross-sectional descriptive study. Patients of either sex, 16 years or above referred for MRI knee with history of injury were included in the study. Non cooperative individuals, those who have undergone prior surgical procedures, periarticular tumors or infections and contraindications to MRI were excluded from the study.

Ethical approval was obtained from the hospital ethics committee. According to the inclusion criteria, patients with knee injuries who were sent to KTH's Radiology Department for knee MRIs were selected. A proper history was taken. Written informed permission was obtained after they were briefed on the study's significance and goal. Toshiba Japan's 0.3 Tesla MR machine was used to perform the knee MRI scan. To maximize the signal to noise ratio and enable full imaging of the ACL on a sagittal image, patients were positioned in a supine posture with their knee extended and slightly externally rotated (10–15 degrees) in an extremity coil. The following sequences were included in MRI protocols: fat suppressed T2, axial, coronal, and sagittal weighted sequences for TI, T2, and PD.

Two expert radiologists who were blinded evaluated four structures: the ACL, PCL, MM, and LM. PCL and ACL were categorized as either partial or total tears. Grade I, II, and III tears were assigned to MM and LM. The degree of joint effusion was rated as moderate and mild. Lastly, the existence or lack of bone bruising was evaluated as well.

MR Image Evaluation: Two skilled radiologists who were blinded to the damage pattern separately examined MR images to check for meniscus, ACL, PCL, MM, and LM injuries. The MRI results of each other were hidden from the two radiologists. The damaged ligaments were categorized as either a partial tear (the ligament was disturbed but continuous, Grade 1 or 2) or a total tear (interruption of ligament integrity, Grade 3), depending on the integrity of the ligaments. Grade 1 meniscal tears were defined as intra-substance abnormalities, grade 2 tears as lateral non-articular surface tears, and grade 3 tears as superior or inferior articular surface tears. Any discrepancies in the radiologists' assessments were settled by dialogue and agreement.

SPSS version 23.0 was used to gather, tabulate, and statistically analyze all of the data. The information was displayed in tables. Absolute frequencies (numbers) and relative frequencies (percentages) were used to express various variables. Age, gender, laterality, kind of injury, injured ligaments, injured menisci, presence or absence of bone bruising and joint effusions were the variables included in the study.

RESULTS

We analyzed MRI scans of total of 160 patients with knee joint injuries. The age of patient was grouped in clusters of 10 years. Majority of the patients were found in 26-35 years' age group comprising 56 patients which make 35%. (Figure-1) Out of total 160 patients; majority of them were male comprising 126 patients and 34 were female. (Figure-2)

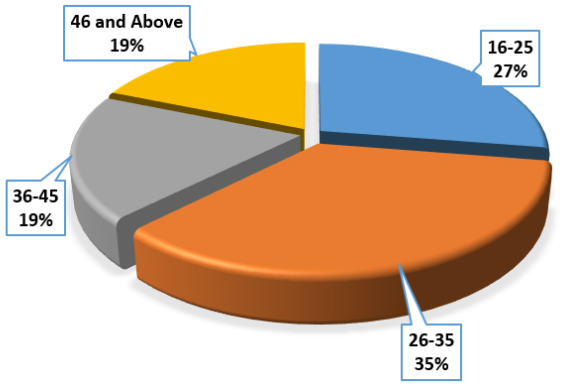

Figure No.1: Age Group Distribution

They underwent MR imaging within 6 months of their injury. When we analyzed the type of injury, it was found that majority of the patient had history of fall (30%), followed by sports trauma (18.8%) and road traffic accident (15%). 36.3% of patients had other type of trauma which did not fit in above categories. Right knee was affected in 55% cases and left knee in 45% cases.

Table No. 1: Frequency of MRI Findings in Knee Injuries (n = 160)

Parameter	Category	Number of Patients	%age
Affected Side	Right	88	55%
	Left	72	45%
Type of Injury	Sports	30	18.8%
	Fall	48	30%
	RTA	24	15%
	Other Trauma	68	36.3%
ACL	Intact	98	61.3%
	Partial Tear	42	26.3%
	Complete Tear	20	12.5%
PCL	Intact	158	98.8%
	Partial Tear	2	1.3%
	Complete Tear	0	0%
MM Anterior Horn	Intact	160	100%
	Grade 1	0	0%
	Grade 2	0	0%
	Grade 3	0	0%
MM Posterior Horn	Intact	40	25%
	Grade 1	20	12.5%
	Grade 2	28	17.5%
	Grade 3	72	45%
LM Anterior Horn	Intact	156	97.5%
	Grade 1	2	1.3%
	Grade 2	2	1.3%
	Grade 3	0	0%
LM Posterior Horn	Intact	118	73.8%
	Grade 1	20	12.5%
	Grade 2	10	6.3%
	Grade 3	12	7.5%
Joint Effusion	Normal	50	31.3%
	Mild/Small	90	65.3%
	Moderate	20	12.5%
Bone Contusion	Present	42	26.3%
	Absent	118	73.8%

When we assessed the injured structures after trauma to knee joint we found that ACL was intact in 98 cases, partial tear in 42 cases and complete tear in 20 cases. Similarly, PCL was intact in 158 cases, partial tear seen in 2 case and complete tear in 0 case. When we analyzed menisci, we noted that posterior horn of medial meniscus was most commonly injured. Grade 3 tears were most common comprising 72 patients which make 45%. Mild/small joint effusion was seen in 90 cases (65.3%) and moderate joint effusion was present in 20 cases (12.5%). Bone contusions were seen in 42 cases (26.3%). Table-1.

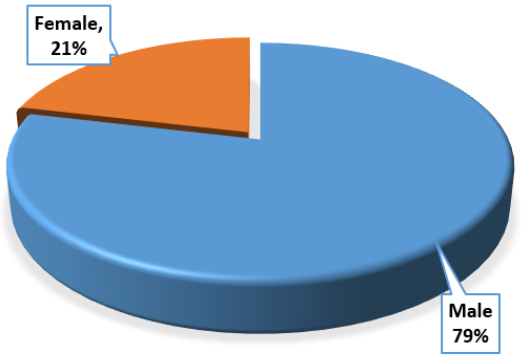

Figure No.2: Gender Distribution

DISCUSSION

One of the biggest and most intricate joints in the body is the knee joint. Pathologies or injuries to the knee joint can significantly impair movement and result in disability. The most effective non-invasive imaging method for evaluating the knee's anatomical features is magnetic resonance imaging (MRI), however arthroscopy is the gold standard in evaluation of meniscal and cruciate ligament pathology[14]. Knee and shoulder are the most frequently requested examination in sports injury. With conventional and CT arthrography; it is very difficult to completely evaluate capsule, collateral ligament, menisci and tendons, however MRI provides excellent details of internal structures, soft tissue and bone bruises.

Males predominated among the patients in this study, with the majority being in the 26–35 age range. Our findings are consistent with those of Rana et al[15], who showed that the majority of patients were male and in the 26–30 age range. Comparable to the Rana et al[15] study, in which the male population was 70.13% and the female population was 29.87%, our study had 78.8% males and 21.3% females. Men are more likely than women to be active and participate in outdoor activities, which puts their knees at higher risk of damage and injury. In our study we observed that right knee (55%) was affected more than the left knee (45%), these results are comparable with study of Wang et al[16] where right knee was involved in 58.44% and left knee in 41.56%[5].

After assessment of injured structures in knee joint following various types of trauma we found that ACL partial rupture was present in 26.3% of cases and complete tear in 12.5%. These results are slightly different from the findings of Kucha et al[17] where partial tear was seen in 22.2% and complete tear in 77.78% cases. In meniscal injury we noted that posterior horn of medial meniscus was most commonly injured comprising 75% cases and in majority of the cases (45%), it was grade-3 tears. This is in line with

the study performed by Van et al[18] where posterior horn of medial meniscus was most commonly injured (51.9%). In our study majority (65.3%) of the cases either mild or small joint effusion is seen while moderate effusion was present in only 12.5% cases. The result corresponds well with study of Mattoo et al[19] where small joint effusion was seen in majority of patients while moderate effusion was seen in only 11.69%. In this study bony contusions involving either femur or tibia was seen in 42 patients which comprises 26.3%. This result is in concordance with the study of Mohabey et al[20] where bony contusions were present in 22.07 % cases[5].

Many patients had normal MRI scans, which may be because patients with painful knees were included rather than those who had traumatic knee injuries. Joint effusion and meniscal damage were the most frequent soft tissue abnormalities found in our research. Most frequently observed was a grade 3 tear of the medial meniscus's posterior horn. Among cruciate ligaments partial tear of ACL was most commonly seen. In one-third of our cases bone contusions were present.

However, the study had its limitations as well. Patients with contraindications to MRI (e.g. cardiac pacemakers or cochlear implants or certain orthopedic prostheses) were excluded first to avoid selection bias. Second, although reclined and in the dark, having an MRI was still more difficult in claustrophobic or disoriented individuals, and these cases may have been excluded. Third, because the MRI was not closely accessible to non-ambulatory patients (for example, patients in wheelchairs or on hospital beds), these patients could not receive scans due to logistical limitations of the study. These factors potentially limited some cases of injury from being captured and may minimally impact the comprehensiveness of the study. Despite these limitations, this study sets a strong basis for future research and illustrates the important role of MRI in evaluating and managing knee injuries.

CONCLUSION

Magnetic Resonance imaging (MRI) would be the best choice in assessment of internal derangement of knee joint following injury and most frequent findings include joint effusion, medial meniscal and anterior cruciate ligament tear. MRI provides rapid, accurate and non- invasive examination of knee joint following injury. It is also cost effective and reduces unnecessary surgical and arthroscopic procedures.

Recommendations

Further randomized, multi-center studies with extended follow-up are recommended to validate and generalize these findings.

Acknowledgement

First of all, I want to express my gratitude to Allah the Almighty for allowing me to finish this study. I am appreciative of everyone who contributed their knowledge to assist me finish this project. I am also appreciative of my family's and parents' moral support during this research.

Author's Contribution:

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Drafting or Revising Critically:	Aziz Zia, Rida Saleem
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

Conflict of Interest: The study has no conflict of interest to declare by any author.

Source of Funding: None

Ethical Approval: No. 2023-929-1 Dated 27.06.2023

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