

Role of MR Imaging in Evaluation of Traumatic Knee Lesions

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Abstract:

Background: MRI is an accurate, noninvasive imaging modality for evaluation of knee injuries, and determines the patient management, saving them from unnecessary arthroscopy, **Aim and objectives:** to emphasize the role of Magnetic Resonance imaging in the assessment of traumatic lesions of the knee joint. **Subjects and methods:** a cross sectional study including thirty patients with history of knee trauma, referred to perform knee MRI. The duration of the study ranged from 6-12 months (Dec. 2018 to Dec. 2019). **Results:** The current study showed regarding MRI findings of the studied group, that joint effusion was the commonest finding in between our study group (80%). This was followed by ACL injury (63.3%) and PHMM injury (56.7%). LCL was the least structure to be injured (3.3%). **Conclusion:** MRI is an extremely useful imaging modality for evaluation of knee injuries. It gives valuable information to the referring orthopaedician for planning the line of treatment in terms of conservative management or surgery. MRI is not only a diagnostic tool but also helps in correlation of injury with biomechanical forces involved in trauma and follow up post-operative patients.

Keywords: MRI, Diagnostic, Conservative, Knee Joint, Biomechanical forces

Abbreviation:

MRI: Magnetic resonance imaging

ACL: anterior cruciate ligament

PHMM: posterior horn of medial meniscus

LCL: lateral collateral ligament

Introduction

The knee is a major weight bearing joint that provides mobility and stability during physical activity as well as balance while standing. Traumatic knee injuries are frequently encountered both in general practice and in the hospital setting. These injuries are often caused by sports activities and may lead to severe pain and disability. Magnetic resonance imaging (MRI), with its multi-planar capabilities and excellent soft tissue contrast, has established itself as the leading modality for noninvasive evaluation of the sports related knee injuries. (1).

Magnetic resonance imaging is a well-accepted imaging modality in the diagnostic workup of patients with knee complaints and has largely replaced diagnostic arthroscopy for this purpose. It is regarded as the top imaging and diagnostic tool for the knee joint as a result of its ability to evaluate a wide range of anatomy and pathology varying from ligamentous injuries to articular cartilage lesions (2).

Imaging of the knee requires excellent contrast, high resolution and the ability to visualize very small structures, all of which can be provided by MR imaging. The development of advanced diagnostic MR imaging tools for the joints is of increased clinical importance as it has been recently

shown that musculoskeletal imaging is a rapidly growing field in MR imaging applications (3).

Magnetic resonance imaging (MRI) is used more commonly in the knee trauma comparing with other joints and is an excellent diagnostic tool that may help clinicians in the evaluation of injuries to menisci and ligaments, osseous structures, articular surfaces and tendon. It plays an important role in clinical decision making (4).

Most knee injuries seen in the emergency department are soft tissue rather than osseous. MRI is an excellent test for diagnosing ligamentous and meniscal injuries and for determining whether surgery is required or if conservative management will suffice. MRI has supplanted diagnostic arthroscopy as the study of choice for diagnosing internal derangement of the knee and has proven to be cost effective (5).

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 (6).

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 (7).

This work aimed to emphasize the role of magnetic resonance imaging in the assessment of traumatic lesions of the knee joint.

Patients and methods

This was a cross sectional study including thirty patients with history of knee trauma, referred to perform knee MRI, at the Radiology Department, Benha University Hospital, after orthopedic consultation. During the period from December 2018 to December 2019.

Patients had MR imaging of the affected knee joints on high field strength scanner (1.5 T) MRI unit (Siemens Magnetom Aera). MRI was performed using knee coil in all cases.

Inclusion criteria:

Any patient with knee pain following traumatic insult, was included.

(History of trauma, Pain /Swelling, Deformity &/or Limitation of movement).

Exclusion criteria:

History of infection, surgery or neoplasm of knee joint, patients having any prosthetic heart valve implant, any pacemaker implant, aortic stent graft, cochlear implant or any metallic orthopedic implants (Any electrically, magnetically or mechanically activated implants), any joint replacement surgery and claustrophobic patients.

All patients had been subjected to clinical assessment: including complete history taking and clinical examination

- Patient preparation: No specific preparation unless the patient will be injected with contrast material (whenever indicated), or will receive anesthesia (sedation in uncooperative patients), then the patient is instructed to fast for 4-6 hours. All metallic objects should be removed from the patient's body.
- Protocol:
 - Axial T2
 - Sagittal T1, PD and T₂ WIs
 - Coronal STIR, gradient or both.
 - Sagittal STIR , gradient or T₂* [optional]

An informed verbal consent from all participants was taken and confidentiality of information was assured. An official written administrative permission letter was obtained from dean of faculty of medicine, Benha university hospital. The title and objectives of the study were explained to the patients to ensure their cooperation. Permission from the faculty of medicine ethical committee was also obtained and approval from institutional review board was taken.

Statistical Analysis

Data entry, processing and statistical analysis was carried out using MedCalc ver. 18.2.1 (MedCalc, Ostend, Belgium). Tests of significance (Kruskal-Wallis, Wilcoxon's, Chi square, logistic regression analysis, and Spearman's correlation) were used. Data were presented and suitable analysis was done according to the type of data (parametric and non-parametric) obtained for each variable. P-values less than 0.05 (5%) was considered to be statistically significant. *Descriptive statistics:* Mean, Standard deviation (\pm SD) and range for parametric numerical data, while Median and Inter-quartile range (IQR) for non-parametric numerical data. Frequency and percentage of non-numerical data.

Analytical statistics: Kruskal-Wallis test was used to assess the statistical significance of the difference of a non-parametric variable between more than two study groups.

Results

This study included thirty patients with history of knee trauma, 17 (56.7%) male and 13 (43.3%) female. Their ages range between 24-65 years (mean value 39.77 ± 11.913 years).

Table 1

Comorbidity of the studied group show that 9(30%) had hypertension (HTN), 11(36.7%) had diabetes mellitus (DM) and 2(6.7%) had cardiovascular. Figure 1. Distribution of studied sample according to patient's Symptoms and mode of injury, shown in table 2

Regarding MRI findings of the studied group: The joint effusion was the commonest finding in between our study group occurred (in 24 patients representing 80 % of cases). This was followed by anterior cruciate ligament (ACL) injury and posterior horn of medial meniscus (PHMM) injury occurred in 19 patients (63%) and 17 patients (56%) respectively. Lateral collateral ligament (LCL) was the least structure to be injured noticed only in 1 patient representing 3% of cases. Table 3

CASE No.1; A 31 year old female patient presented with left knee pain of 8 hours duration after accident. Figure 2. **CASE No.2;** A 37 year old male patient presented with left knee pain after accident. (Figure 3).

Table (1): Distribution of studied sample according to patient's demographic data

	Number	Percent
Age (years)		
≤30	9	30
30-40	8	26.7
40-50	7	23.3
50-60	5	16.7
>60	1	3.3
	Range	24-65
	Mean±SD	39.77±11.913
Sex		
Male	17	56.7
Female	13	43.3

Table (2): Distribution of studied sample according to patient's Symptoms and mode of injury.

	Symptoms	Number	Percent
Symptoms	Pain	26	86.7
	Swelling	10	33.3
	Deformity	2	6.7
	Limitation of movement	4	13.3
	Accident	16	53.3
Mode of injury	Fall from high	3	10
	Sport injury	11	36.7

Table (3): Distribution of studied sample according to patient's overall MRI finding.

Overall MRI finding	Number	Percent
Anterior cruciate ligament sprain (ACL)	19	63.3
Posterior Medial meniscus (PHMM)	17	56.7
Medial collateral ligament sprain (MCL)	13	43.3
Posterior cruciate ligament sprain (PCL)	3	10
Joint effusion	24	80
Bone Marrow	16	53.3
Muscle Injury	1	3.3
Tendon Injury	2	6.7
PHLM	2	6.7
LCL	1	3.3

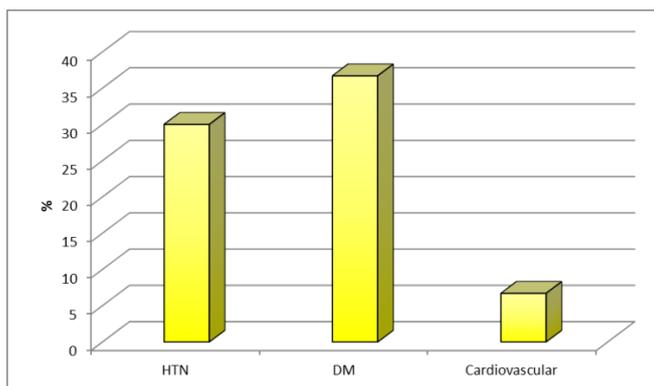


Figure (1): Distribution of studied sample according to patient's Comorbidity



Figure (2): A: Sagittal PDW knee MR image demonstrating horizontal tear of PHMM (arrow). B: Axial T2W knee MR image demonstrating hazy ACL that diagnosed as ACL sprain and minimal joint effusion (arrow). C: Coronal (STIR) knee MR image demonstrating MCL sprain (arrow). D: Coronal (STIR) knee MR image demonstrating Femoral condyle and opposite medial tibia contusion (arrows).

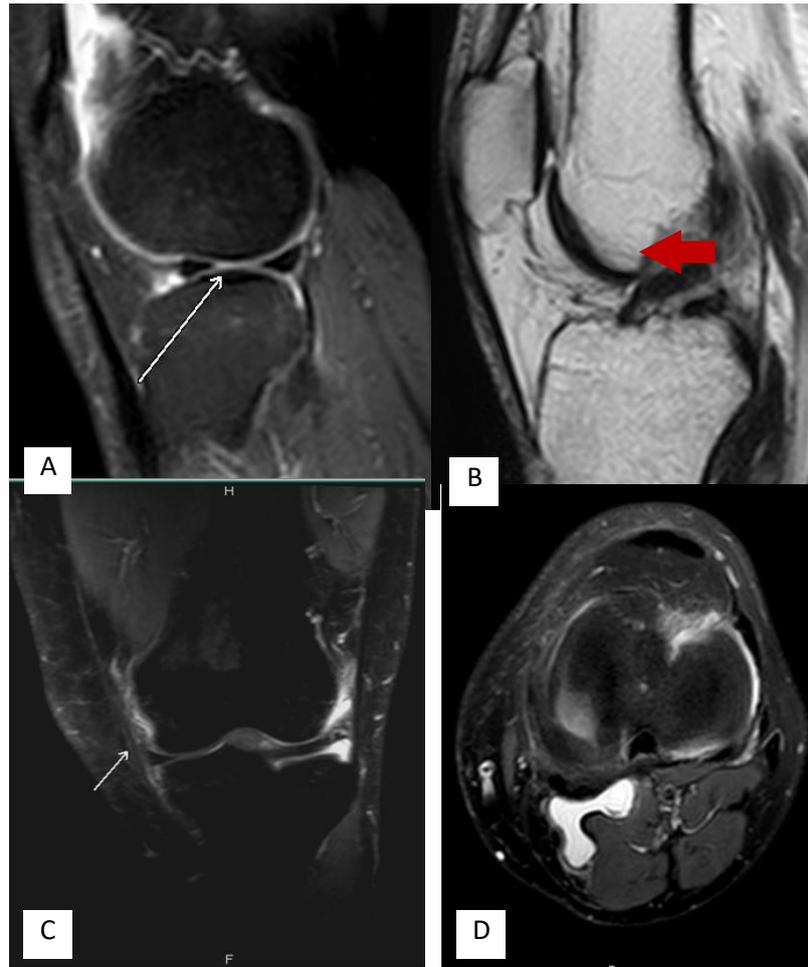


Figure (3): A: Sagittal PDW knee MR image demonstrating radial tear of PHMM (arrow). B: Sagittal T2W knee MR image demonstrating partial tear of ACL (arrow). C: Coronal (STIR) knee MR image demonstrating MCL grade II tear (arrow). D: Axial (STIR) knee MR image demonstrating Mild joint effusion with posterior popliteal cyst.

Discussion

Magnetic Resonance Imaging has gained popularity as a diagnostic tool of the musculoskeletal disorders especially the knee joint which is the most frequent examined joint with MRI. The diagnostic power of MRI in knee injuries was substantially more than physical examinations and studies on patients with knee injuries concluded that the MRI is very sensitive in diagnosing meniscus and ligamentous injuries (7).

Regarding demographic data of our study: The age of the study group ranged from 24-65 years with mean value 39.77 ± 11.913 years. Male cases were 17(56.7%) while female cases were 13(43.3%). 17(56.7%) from urban and 13(43.3%) from rural. As regard socioeconomic class of the studied group it was found to be 9(30%) of low class, 10(33.3%) of medium class and 11(36.7%) were high class.

Our results are in agreement with study of *Saeed* and co-workers, in 2018, (8) as they reported that the age group of (26-46) years was the more affected group with frequency of 33 (38.8%), followed by age group (15-25) years with frequency of 25 (29.4%), then a frequency of 24 (28.2%) for age group of (47-67).

The age groups of (<15) and (>67) were the least with frequency of 2 (2.4%) and one (1.2%) respectively. This result reflects that the activity is increased at these range of age (26-46) and (15-25) years, causing many problems related to knee joint compared to the rest of the ages that recorded a lower rate. They reported that the number of male patients 59 (69.4%) injured in the knee joint was higher than the number of female patients 26(30.6%).

The role of MRI has steadily increased and now it has become the investigation of choice for most of the lesions of knee. It is also being used for pre-and post-operative evaluation. It is a noninvasive technique that does not require contrast administration and is not operator dependent (8).

The current study showed that joint effusion was the commonest (80%). The nearest result have been shown by *Mehta and colleagues*, (9) in which joint effusion detected in 74% of cases, but disagreed with

Nasir (10), which demonstrated that joint effusion form 20% of cases.

Our study showed that the meniscus injury represented (PHMM) (56.7%), and posterior horn lateral meniscus (PHLM) (6.7%) which mean that, injuries of PHMM more than the injuries of PHLM in traumatic knee injury. This almost agreed with *Nasir* (10).

Tears involved PHMM more commonly. These results were also in concordance with the previously reported literature (11). Grade-2 was the commonest meniscal tear in the current study which contrasts with the results by *Arumugam* and coworkers, (12), who reported grade-3 as the commonest grade of meniscal tear. Vertical tears were found to be the commonest type of meniscal tear.

In this study of ACL tears, were diagnosed in (63.3%) of cases and this finding was similar to that of *Hetta and Niazi* (1), in which (60%) of cases showed different ACL injuries, but not in accordance with *Swenson et al.*, (13), study which showed that ACL forms only (25.4%) of knee injuries.

Our study was also in accordance with other studies (14), which stated that the commonest finding on MRI scanning was ACL tear (partial and complete) and was present in 67% of the patients .

In the study done in 2017, (15), showed a difference between complete and partial ACL

tear. Non-visualization and discontinuity of ACL fibers were considered indicator of a complete ACL tear. Thus, a complete ACL tear was seen on MRI in 10 patients (50%) and partial tear identified also in 10 patients (50%) but in arthroscopy, a complete tear was in 14 patients (70%) and partial tear was in 6 patients (30%). This means that 4 cases with complete ACL tear was diagnosed as partial tear by MRI.

Posterior cruciate ligament (PCL) injury represented in (10%) of the total cases in our study, partial PCL tear was the commonest PCL pathology and this result agreed with *Hetta and Niazi* (1), in which (8%) of cases presented with PCL injury.

Bone injuries formed about (53.3%) of acute traumatic knee pain in our study and this was in agreement with a study of *Mehta et al.* (9) which demonstrated that the bone injury form (62%), but disagreed with that of *Hetta and Niazi* (1) in which the bone injury represented (20%).

Tibia was more commonly involved than femur by contusions and lateral femoral condyle was involved more frequently than its medial counterpart. Their results are in agreement with the existing literature (16).

Bone marrow abnormalities are best evaluated with fat-suppression techniques such as short time inversion recovery (STIR) or selective

partial inversion recovery (SPIR), and these imaging protocols should be used in all cases of suspected stress-related injury (17).

Patellar tendon/ligament injury formed about (6.7%) of acute traumatic knee pain in our study and this was in agreement with a study of *Futch et al.* (18), but disagreed with that of *Sillanpaa et al.* (19).

Popliteal cysts were associated with joint effusion, medial meniscal tear and ACL tear. MRI detects an associated disorder in 94% cases of popliteal cysts. An association of popliteal cyst with joint effusion, meniscal tear and ACL tear has been previously reported (20). The finding of meniscal cyst involving the posterior horn of medial meniscus and its association with horizontal tear compares favourably with the reported literature (21).

Conclusion

MRI affects the diagnosis and management of the knee injuries by decreasing the number of arthroscopic procedures, improving clinician diagnostic certainty, and assisting in management decision. We conclude that MR imaging is the best imaging modality for diagnosis of acute traumatic knee pain as it provides the potential for rapid and definitive diagnosis and can be considered as replacing of other invasive modalities in patients of different acute traumatic knee injuries.

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