

Role of MRI to Determine Impact on Contralateral ACL/Meniscal Damage Secondary to Unilateral Traumatic Knee Injury in Adults

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ABSTRACT

Background: Knee injuries are one of the most common sports injuries and may cause chronic functional impairment. During a study in emergency department approximately 50% of injuries are caused by sports activities, with majority of the cases comprising of knee soft tissue injuries. The most common modality to diagnose musculoskeletal injury is magnetic resonance imaging nowadays. Knee injuries are one of the most frequently overlooked injuries and cause long term functional impairment. MRI provides the most effective and comprehensive imaging assessment of the knee joint and adjacent structures. **Objective:** To determine the significance of Magnetic resonance imaging (MRI) of contralateral uninjured knee in suspected meniscal/ACL injury of traumatic patients. **Study Design:** Prospective study. **Settings:** Radiology Department of Jinnah Postgraduate Medical Center (JPMC), Karachi Pakistan. **Duration:** January 2018 to December 2021. **Methods:** Patients aged 18 years or older who presented with a unilateral traumatic knee injury requiring medical evaluation and treatment and who underwent MRI evaluations for both the injured knee (ipsilateral) and the contralateral knee (opposite side) as part of their medical assessment were included. After taking informed consent, all patients underwent magnetic resonance imaging (MRI) examinations of both their affected (ipsilateral) and non-affected (contralateral) knee joints. These MRI findings were subjected to rigorous statistical analysis, which included comparisons between the affected and non-affected knees. Self-made proforma was used for the data collection. **Results:** According to our inclusion criteria, we identified 45 patients to participate in the study. Amongst these 82% of the patients were male and 17% were females, ratio between the male and female is 4.6:1. Mean age of the participants was found to be 38.64±14.4 years. Upon analysis, 62.2% of the patients had meniscal injury associated with ACL/PCL damage. While MRI findings were compared with contralateral normal side and found meniscal injury in 17(37.8%) cases, followed ACL/PCL injury 7(15.6%) and ACL/PCL injury associated meniscal injury ± effusion 7(15.6%) was (p = 0.004). **Conclusion:** MRI has proven to be a valuable imaging modality for identifying ligament tears and meniscal injuries of the knee joint in patients suspected of having meniscal/ACL injuries due to trauma. It not only assists in diagnosis but also provides valuable insights into the complexity of knee trauma.

Keywords: Magnetic resonance imaging, Contralateral side, Traumatic injuries.

INTRODUCTION

Knee injuries are one of the most common sports injuries and may cause chronic functional impairment. During a study in emergency department the most of the injuries are caused by sports activities, with majority of the cases comprising of knee soft tissue

injuries and these in these 50% occurred in individuals aged 20 to 29 years.¹ Knee injuries are most frequently overlooked and hence cause long term functional impairment. The most common modality to diagnose musculoskeletal injury is magnetic resonance imaging nowadays. X-rays are used to diagnose fractures and

sometimes large soft tissue injuries. CT scan are used in major trauma cases to assess complex fractures and it also provides information about adjacent tissue injuries. Indications for surgery in knee injuries are meniscal and ligament tears of the knee. The MR imaging's ability to detect meniscal tears shows a sensitivity of 93% for the medial meniscus and 88% for the lateral meniscus, while its specificity is 79% for the medial meniscus and 95% for the lateral meniscus.² Therefore, MRI provides the most effective and comprehensive imaging assessment of the knee joint and adjacent structures.³ Sports related knee injuries are a known cause of early osteoarthritis. Previous cohort study showed that knee injuries are consistent with future osteoarthritis after duration of 3-10 years. The outcome after injury differs according to sex and duration since injury.⁴ Meniscal tears can be classified according to its complexity and direction of tears. Horizontal tears are the most common tear with around 30% of the tears occurring during arthroscopy. Horizontal tears are also morphologically most commonly found in persons over 40 years of age without any prior history of trauma. In contrast vertical tears occur due to any traumatic episode. Along with flap tears, medial meniscus is involved in 87% of cases altering the anatomy of posterior horn or its body.⁵ Despite a large body of literature describing MRI studies of injured knee causing its instability, the geometric morphological alterations of the contralateral intact knee are surprisingly ill-defined, especially in adults. The aim of this study is to assess the efficacy of MRI of the affected as well as of the intact knee in a first-time traumatic adult population so as to provide early diagnosis and hence its corresponding treatment. Studies have shown that MRI imaging of knee required to make diagnosis of ligamentous tears is performed with 1.5 or 3T systems. MRI scans are required in three orthogonal planes with T2 weighted with or without fat suppression. Scans are required in multiple planes to do complete assessment of ligamentous injuries. Scans are obtained in coronal, oblique and axial planes to diagnose injuries of popliteofibular ligament.⁶ There are specific criteria for the diagnosis of meniscal injuries. The criteria include abnormal intra-meniscal signal intensity extending to at least two articular sections, alteration of meniscal morphology, or identification of displaced meniscal fragments. This study has been done to observe the significance of Magnetic resonance imaging (MRI) of contralateral uninjured knee in suspected meniscal/ACL injury of traumatic patients.

METHODS

This prospective study was conducted at radiology department of Jinnah Postgraduate Medical Center (JPMC), Karachi from January 2018 to December 2021. Participants 18 years of age or older presented with unilateral traumatic knee injury that required medical

evaluation and treatment, undergoing MRI evaluation for both the injured knee (ipsilateral) and the contralateral knee (opposite side) as part of their medical assessment were included. Participants with a history of pre-existing knee injuries, chronic knee conditions (e.g., osteoarthritis, rheumatoid arthritis), or previous knee surgeries, individuals who have sustained bilateral traumatic knee injuries and patients presenting with any infective, degenerative or neoplastic etiology of the knee were excluded from the study. After taking informed and written consent from eligible participants, all patients underwent magnetic resonance imaging (MRI) examinations of both their affected (ipsilateral) and non-affected (contralateral) knee joints. These MRI scans were conducted using standardized imaging protocols and equipment as per the established practices at JPMC Karachi. Subsequently, the obtained MRI findings of the knee joints were meticulously assessed by experienced radiologists who were blinded to the study's objectives. The radiological evaluation encompassed the integrity of the Anterior Cruciate Ligament (ACL), including the identification of ACL tears, as well as the examination of meniscal status. Subsequently, these MRI findings were subjected to rigorous statistical analysis, which included comparisons between the affected and non-affected knees. Self-made proforma was used for the data collection and data analysis was done by using SPSS version 26.

RESULTS

According to our inclusion criteria, we identified 45 patients to participate in the study. Amongst these 82% of the patients were male (n=37) and 17% were females (n=8). Mean age of the participants was found to be 38.64±14.4 years. Table. 1

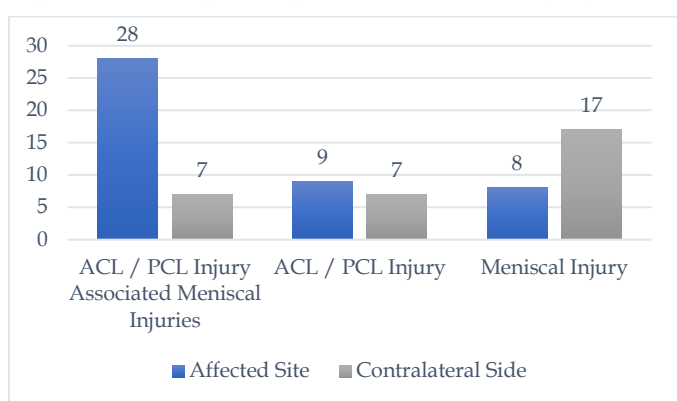
The ratio of knee injury found in male to female was 4.6:1. Our analysis revealed a significant association between meniscal injury and Anterior Cruciate Ligament/Posterior Cruciate Ligament (ACL/PCL) damage in traumatic knee injuries. Among the patients studied, a substantial proportion, approximately 62.2%, exhibited concomitant meniscal injury in conjunction with ACL/PCL damage. Importantly, when comparing MRI findings in the affected knee with those of the contralateral normal knee, we found that meniscal injury was identified in 37.8% of cases, while isolated ACL/PCL injuries were observed in 15.6% of cases. Remarkably, a considerable number of patients, also at 15.6%, displayed the co-occurrence of ACL/PCL injury along with meniscal injury and effusion. This observation underscores the clinical significance of MRI in the assessment of traumatic knee injuries, as it not only aids in the diagnosis of these injuries but also provides valuable insights into the multifaceted nature of knee trauma. The statistical significance of these findings, as

indicated by a p-value of 0.004, further highlights the importance of utilizing MRI as a diagnostic tool in the evaluation of suspected meniscal and ACL/PCL injuries in traumatic knee cases.

Table 1: Descriptive statistics of age and gender of the patients (n=45)

Variables		Statistics
Age (mean ± SD)		38.64 ± 14.4 years
Gender	Males	37 (82.2%)
	Females	08 (17.8%)
	Total	45 (100.0%)

Figure 1: Finding of magnetic resonance imaging (n=45)



DISCUSSION

Sudden knee injuries represent a frequently encountered condition in both surgical and orthopedic emergency departments. it is most commonly injured joint due to trauma and frequent cause of musculoskeletal pain. Due to its complex anatomy and various structures, its injury results in various symptoms like instability and restriction of movement.⁷ Among knee joint issues, meniscal injuries rank as the second most prevalent, occurring in approximately 12-14% of cases and having a prevalence rate of 61 instances per 100,000 individuals.^{8,9} For appropriate management, effective clinical skills as well as imaging is required. As MRI has now become the gold standard for the diagnosis of knee soft tissue injury.¹⁰ Present study has been done to evaluate the significance of Magnetic resonance imaging (MRI) of contralateral uninjured knee in suspected meniscal/ACL injury of traumatic patients and observed a valuable significance of MRI as upon analysis, it was determined that 62.2% of the patients had concurrent meniscal injuries along with ACL/PCL damage. When comparing MRI findings to the contralateral normal side, meniscal injuries were found in 17 cases (37.8%), followed by ACL/PCL injuries in 7 cases (15.6%), and ACL/PCL

injuries combined with meniscal injury and effusion in 7 cases (15.6%) (p = 0.004). In the study by Abd Razak HR et al¹¹ reported that the positive predictive value (PPV) of MRI for detecting meniscal injuries was around 60%. MRI exhibited nearly 100% sensitivity and specificity in the diagnosis of ACL injuries, and it showed 82% sensitivity and 100% specificity in detecting PCL injuries. MRI shows highest sensitivity for medial meniscus tear followed by lateral meniscus. The posterior horn of the lateral meniscus has the lowest MRI sensitivity.¹² Small meniscal tears occupying one third of the lateral meniscus are often missed on MRI examination. ACL tears occurring in association with lateral meniscal tears also decreases meniscal tear detection by MRI.¹³ However, in order to make the diagnosis of ligament injury, there are mixed reviews about diagnostic modalities. In a previous study arthroscopy was considered as the definitive diagnostic modality for knee injury. Findings of arthroscopy was compared with findings of MRI and physical examination. Results showed that MRI and clinical examination together show same sensitivity as arthroscopy. Clinical examination had better sensitivity and specificity as compared to MRI in diagnosing traumatic ACL injuries.¹⁴ it has been observed that the injuries to the ACL can coincide with damage to other knee support structures, including the menisci, collateral ligaments, the anterolateral ligament, and components of the posterolateral corner. The detection of these concurrent injuries through imaging is crucial as it can impact the treatment approach and, as such, holds significant diagnostic importance.¹⁵ Furthermore Alford JW et al¹⁶ stated that, it is necessary to assess the injured knee in comparison to the unaffected knee on the opposite side. Additionally, in the initial stage, it is important to assess any potential accompanying injuries. According to this study majority of injuries occurred in males (82%), while females accounted for 17% of the cases. The overall average age of these patients was 38.64±14.4 years. In the study by Moatshe G et al¹⁷ reported that the among the 303 patients of their study, males were 65% and females were 35%, and their overall mean age was 37.8 ± 15.3 years. According another traumatic knee injury study demonstrated that there were 75 males, constituting 85% of the total, and 13 females with an overall average age of 35 years. Assessing the injured knee in comparison to the unaffected knee on the opposite side is a fundamental and medically justified practice for several compelling reasons. Firstly, it provides a crucial baseline for evaluation. Every individual's anatomy and biomechanics can vary to some degree, so comparing the injured knee to its healthy counterpart allows medical professionals to discern anomalies more accurately. This baseline is essential for diagnosing injuries or conditions, particularly in cases involving the complex structures of the knee, such as ligaments, tendons, and menisci. Without this reference

point, identifying subtle changes indicative of injury or pathology becomes significantly more challenging. Our findings cannot be considered definitive due to the limitations of our study, which had a small sample size and a scarcity of relevant reports in the literature. Therefore, it is advisable to conduct a more extensive and longitudinal investigation on this subject before implementing any conclusions.

CONCLUSION

As per the study conclusion, MRI has been observed to be a valuable imaging modality for identifying ligament tears and meniscal injuries in the knee joint of patients suspected to have meniscal or ACL injuries resulting from trauma. Meniscal injuries were identified in 37.8% of cases, while 15.6% isolated ACL/PCL injuries. Additionally, a significant proportion exhibited the simultaneous occurrence of ACL/PCL injuries along with meniscal injury and effusion. This underscores the clinical significance of MRI in assessing traumatic knee injuries, as it not only aids in diagnosis but also offers valuable insights into the complexity of knee trauma.

LIMITATIONS

The study may not fully understand knee injuries and their long-term effects because it likely used a cross-sectional design with a small sample and limited reports.

SUGGESTIONS / RECOMMENDATIONS

Future large studies are recommended for more comprehensive investigations that encompass a broader range of variables, including patient demographics, injury mechanisms, and treatment modalities.

CONFLICT OF INTEREST / DISCLOSURE

None.

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