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A retrospective study on magnetic resonance imaging findings in knee injuries

E. Dosita[1]*, M. Ramesh[2]

[1]Department of Emergency, Sai Fertility Centre and Hospital (Multi-Speciality), Chengalpattu, Tamil Nadu, India
[2]Department of Radiodiagnosis, Chengalpattu Medical College and Hospital, Tamil Nadu, India

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***Correspondence:**
Dr. E. Dosita,
E-mail: lathaelavarasu2708@gmail.com

ABSTRACT

Background: Magnetic resonance imaging (MRI) is a noninvasive and accurate tool for diagnosing internal knee injuries after trauma. It reliably detects anterior cruciate ligament (ACL) tears, meniscal injuries, collateral ligament damage, and bone contusions, which often coexist in traumatic knee injury. This study aimed to evaluate the prevalence and types of MRI-detected knee injuries and their associations with patient age and gender.
Methods: This retrospective observational study included 132 patients who underwent knee MRI following trauma at a radiology department. Patients of all ages and genders were included unless their MRIs showed only degenerative changes or incomplete data. MRI reports were reviewed for ligamentous injuries [ACL, posterior cruciate ligament (PCL), medial collateral ligament (MCL), and lateral collateral ligament (LCL)], meniscal tears, and bone contusions. Data on age and gender were recorded and analysed.
Results: Among 132 patients, 70.45% were male and 29.55% were female, with the largest age groups being 21-30 years (30.3%) and 41-50 years (31.82%). ACL injuries were present in 78.78% of cases, meniscus injuries in 61.36%, PCL injuries in 39.39%, bone contusions in 14.39%, MCL injuries in 8.33%, and LCL injuries in 3.78%. Complete ACL tears accounted for 41.35% of all ACL injury cases. Significant associations were found between age and ACL injury (p=0.002), meniscus injury (p=0.001), bone contusion (p=0.046), and LCL injuries (p=0.044). No significant differences were observed between gender for any injury type.
Conclusions: Our study highlights MRI's effectiveness in detecting and classifying traumatic knee injuries. ACL tears, often accompanied by meniscal and PCL injuries, were the most common. Injury patterns varied with age but not gender, emphasising MRI's role in early diagnosis and age-specific management.

Keywords: MRI, Knee trauma, ACL injury, Meniscus tear, Bone contusion, Ligament injury

INTRODUCTION

Magnetic resonance imaging (MRI) is the preferred noninvasive modality for evaluating internal derangement of the knee after trauma. Numerous studies have confirmed its high diagnostic accuracy for ligament and meniscal injuries compared to arthroscopic findings, with a reported sensitivity of 87% for ACL tears and a specificity of approximately 93%.[1] ACL tears are among the most frequent soft-tissue injuries encountered in traumatic knee injuries. MRI not only reliably identifies ACL disruption but also reveals associated injuries, such as meniscal tears, collateral ligament damage, and bone contusions, which commonly co-occur in ACL-deficient knees.[2] Meniscal injuries frequently accompany ACL tears in traumatic knee injury cases. In a prospective study of patients suspected of meniscal tears, MRI revealed meniscal pathology in over 57% of symptomatic knees;

complex or displaced tears and collateral abnormalities were much more likely on the symptomatic side than the contralateral asymptomatic knee.[3,4]

Bone contusions or bruises are important concomitant findings on MRI in patients with acute knee trauma. A systematic review found bone marrow oedema in over 80% of patients with ACL rupture, typically located in the lateral femoral condyle and posterolateral tibial plateau patterns supporting valgus pivot injury mechanisms.[5] Complementary studies showed contusion prevalence as high as 92.9% in recent MRI scans of ACL-injured patients, often correlating with the severity or presence of associated meniscal and collateral ligament injuries.[2,3] Collateral ligament injuries (MCL, LCL and PCL) lesions are less common than ACL or meniscal tears but remain clinically relevant in multi-structure trauma. MRI studies report MCL injury in a significant subset of ACL-deficient knees, whereas LCL injuries are relatively rare but still important when present.[6,7]

Research highlights associations between injury prevalence and clinical characteristics but focuses on a relatively narrow age range, emphasising the need for broader epidemiologic evaluations across wider age groups and diverse trauma populations.[8] Similarly, a study noted differences by demographics, such as gender and trauma history, but indicated a lack of extensive retrospective cohort data across more general knee trauma populations, underscoring the importance of systematic evaluations in diverse clinical settings.[9] This gap underscores the need for systematic evaluation in wider clinical settings.

Considering the high accuracy and detailed visualisation MRI offers for ACL, meniscus, collateral ligament, and bone contusions, our retrospective analysis investigated these injuries in a more representative trauma study. It also aims to explore whether prevalence and patterns differ by age or gender. This study aimed to determine the prevalence and classification of MRI-detected knee injuries, including ACL, PCL, MCL, LCL, meniscus, and bone contusions, in patients presenting with knee trauma and to assess their associations with patient age and gender.

METHODS

Study design and setting

This retrospective observational study was conducted at Chengalpattu medical college and hospital from June 2022 to June 2025. It included 132 patients who underwent knee MRI at the department of radiology during the defined study period, focusing on patients who presented with knee trauma.

The study utilized previously collected and anonymized data, which did not include any personally identifiable information.

Inclusion criteria

The study included all patients who underwent MRI of the knee following trauma within the selected time frame, regardless of age or gender.

Exclusion criteria

Patients were excluded if their MRI records were incomplete or if the MRI showed only degenerative changes unrelated to acute trauma.

Methods used

Demographic details, such as age and gender, were also recorded. Data were collected retrospectively from hospital electronic radiology archives. MRI reports of patients who met the inclusion criteria were reviewed in detail by the authors. Findings related to ligamentous injuries (ACL, PCL, MCL, and LCL), meniscal tears, and bone contusions were reviewed, and the findings were manually extracted and recorded on a structured observation sheet.

Statistical methods

All collected data were entered into Microsoft excel and analysed using IBM SPSS Statistics software version 24. Categorical variables, such as gender and type of injury, were summarised as frequencies and percentages. Continuous variables, such as age, are presented as means and standard deviations. The association between variables was assessed using the chi-square test. Statistical significance was set at $p<0.05$.

RESULTS

The majority of patients were aged 41-50 years (31.82%) and were male (70.45%). ACL injury was the most common (78.78%), followed by meniscus (61.36%) and PCL injuries (39.39%). Other findings were observed in 64.39% of the cases (Table 1).

Among 104 ACL injuries, 41.35% were complete tears, 20.19% grade I, 17.31% partial tears, 10.58% other types, 5.77% graft intact, 1.92% sprain/strain, 1.92% not visualised, and 0.96% avulsion fractures. Of the 52 PCL injuries, 63.46% showed buckling, 21.15% were grade I, 11.54% were other types, and 1.92% each were complete tears and avulsion fractures. Among the 81 meniscus injuries, 19.75% were complex tears, 16.05% were horizontal tears, 14.81% were strain/sprain, 13.58% were other tears, 7.41% were vertical and longitudinal tears, 6.17% were radial tears, 4.94% were root tears, 3.70% were bucket handle tears and extrusion, and 2.47% were other types. Of the 11 MCL injuries, 63.64% were grade I, 18.18% were other tears, 9.09% were partial tears, and 9.09% were other. Of the five LCL injuries, 80% were grade I and 20% were partial tears. Among the ninteen bone contusions, 31.58% involved the femur and tibia,

26.32% the tibia, 21.05% the condyle, 10.53% the femur, and 5.26% each the patella as well as the other sites (Table 2).

ACL injury was most frequent in the 21-30 years age group (36.5%), followed by 41-50 years (26.9%) and 31-40 years (22.1%), with a significant association between age and ACL injury (p=0.002). Bone contusions were most common in the 21-30 (36.8%) and 31-40 (26.3%) age groups, showing a significant age association (p=0.046). LCL injuries occurred mostly in the <20 years group (40%), with a significant difference between age groups (p=0.044). MCL injuries were distributed mainly in the 21-30 and 31-40 years age groups (36.4% each); however, the association was not significant (p=0.353). Meniscus injuries were most prevalent in the 31-40 years group (32.1%), followed by the 41-50 years (28.4%) and 21-30 years (24.7%) groups, with a significant correlation with age (p=0.001). Other findings showed a trend towards a higher frequency in the 31-40 (35.3%) and 21-30 years (25.9%) age groups, with borderline significance (p=0.054). PCL injuries were most frequent in the 41-50 years age group (38.5%), but no significant association was observed with age (p=0.19) (Table 3).

Table 1: Demographic and injury type.

Category	Subgroup	N (%)
Age group (in years)	<20	5 (3.79)
	21-30	40 (30.30)
	31-40	31 (23.48)
	41-50	42 (31.82)
	51-60	9 (6.82)
	61-70	5 (3.79)
Gender	Male	93 (70.45)
	Female	39 (29.55)
Injury type	ACL injury	104 (78.78)
	Meniscus injury	81 (61.36)
	PCL injury	52 (39.39)
	Bone contusion	19 (14.39)
	MCL injury	11 (8.33)
	LCL injury	5 (3.78)
	Other findings	85 (64.39)

Table 3: Subtypes of various injury types.

Category	Subtype	N (%)
ACL injury, (n=104)	Complete tear	43 (41.35)
	Grade I	21 (20.19)
	Partial tear	18 (17.31)
	Graft intact	6 (5.77)
	Sprain/Strain	2 (1.92)
	Not visualized	2 (1.92)
	Avulsion fracture	1 (0.96)
	Other	11 (10.58)
PCL injury, (n=52)	Buckling	33 (63.46)
	Grade I	11 (21.15)
	Complete tear	1 (1.92)
	Avulsion fracture	1 (1.92)
	Other	6 (11.54)
Meniscus injury, (n=81)	Complex tear	16 (19.75)
	Horizontal tear	13 (16.05)
	Strain/Sprain	12 (14.81)
	Other tear	11 (13.58)
	Vertical tear	6 (7.41)
	Longitudinal tear	6 (7.41)
	Radial tear	5 (6.17)
	Root tear	4 (4.94)
	Bucket handle tear	3 (3.70)
	Extrusion	3 (3.70)
	Other	2 (2.47)

Continued.

Category	Subtype	N (%)
MCL injury, (n=11)	Grade I	7 (63.64)
	Other tear	2 (18.18)
	Partial tear	1 (9.09)
	Other	1 (9.09)
LCL injury, (n=5)	Grade I	4 (80.00)
	Partial tear	1 (20.00)
Bone contusion, (n=19)	Femur and tibia	6 (31.58)
	Tibia	5 (26.32)
	Condyle	4 (21.05)
	Femur	2 (10.53)
	Patella	1 (5.26)
	Other	1 (5.26)

Table 4: Comparison of injury types with age groups.

Injury type	Age group (in years), N (%)						P value
	<20	21-30	31-40	41-50	51-60	61-70	
ACL injury	5 (4.8)	38 (36.5)	23 (22.1)	28 (26.9)	9 (8.7)	1 (1.0)	0.002
Bone contusion	2 (10.5)	7 (36.8)	5 (26.3)	1 (5.3)	3 (15.8)	1 (5.3)	0.046
LCL injury	2 (40.0)	1 (20.0)	1 (20.0)	1 (20.0)	0 (0.0)	0 (0.0)	0.044
MCL injury	1 (9.1)	4 (36.4)	4 (36.4)	1 (9.1)	0 (0.0)	1 (9.1)	0.353
Meniscus injury	2 (2.5)	20 (24.7)	26 (32.1)	23 (28.4)	6 (7.4)	4 (4.9)	0.001
PCL injury	2 (3.8)	15 (28.8)	7 (13.5)	20 (38.5)	7 (13.5)	1 (1.9)	0.19
Other findings	2 (2.4)	22 (25.9)	30 (35.3)	21 (24.7)	5 (5.9)	5 (5.9)	0.054

Table 5: Comparison of injury types with gender.

Injury type	Gender, N (%)		P value
	Female	Male	
ACL injury	29 (27.9)	75 (72.1)	0.566
Bone contusion	8 (42.1)	11 (57.9)	0.957
LCL injury	2 (40.0)	3 (60.0)	0.867
MCL injury	6 (54.5)	5 (45.5)	0.12
Meniscus injury	23 (28.4)	58 (71.6)	0.981
PCL injury	16 (30.8)	36 (69.2)	0.353
Other findings	30 (35.3)	55 (64.7)	0.495

Among patients with ACL injury, 27.9% were female and 72.1% were male, with no significant difference by gender (p=0.566). Bone contusions occurred in 42.1% of females and 57.9% of males (p=0.957). LCL injuries were observed in 40% of females and 60% of males (p=0.867). MCL injuries affected 54.5% of females and 45.5% of males (p=0.12). Meniscus injuries were present in 28.4% of females and 71.6% of males (p=0.981). Other findings were noted in 35.3% of females and 64.7% of males (p=0.495). PCL injuries occurred in 30.8% of females and 69.2% of males (p=0.353) (Table 5).

DISCUSSION

In our study, middle-aged adults were the most commonly affected, with a predominance of male patients among them. Balkanlı and Arslan evaluated only male coal miners aged 18-45 years old. The majority were aged between 30-39 years (43 patients), followed by 20-29 years (16 patients), and 40-45 years (16 patients).[10] Choudhary et al demonstrated a similar trend, with 72% of the patients being male (male-to-female ratio of 2.6:1). The data indicate a peak incidence of knee injuries in the 21-30 year age group (32%), with a subsequent decline observed in the 31-40 (28%) and 41-50 (18%) cohorts, suggesting age-related susceptibility.[11] Moorthy et al findings reflected a comparable age distribution, with 37.33% of individuals falling within the 21-30 year range and 30.6% between 31 and 40 years. These figures suggest that the majority of affected patients were young adults.[12]

Similarly, Umap et al noted a strong male predominance (80%), with the most common age group being 21-30 years for both males and females. The mean age was 31.67 years for males and 35.1 years for females.[13] According to Zanetti et al the average age of patients with bilateral meniscal tears was 49 (±16) years, while those with unilateral tears had a mean age of 43 (±16) years. Individuals without meniscal tears had a lower mean age of 37 years (±3).[4] Findings from various studies

consistently demonstrate a marked predominance of male patients and a peak occurrence of knee injuries among young adults, especially within the 21-50 year age range.

Our data showed that ACL injury was the most common, followed by meniscus and PCL injuries, while other injuries were less frequent. A close concordance was observed between our results and those of Choudhary et al both identifying ACL tears as the most predominant injury, affecting 66% of the patients. Meniscal injuries were the second most common (48%), with medial meniscus tears (32%) being twice as prevalent as lateral (16%).[11] Moorthy et al further recognised ACL injuries as a major finding, reporting 25 complete ACL tears on MRI and 25 on arthroscopy. Meniscal injuries were also vastly encountered, with medial meniscus tears present in 34 (45.3%) and 33 (44%) cases on MRI and arthroscopy, respectively. Lateral meniscus injuries were slightly less frequent than medial meniscus injuries.

Likewise, Umap et al stated that ACL injuries were the most frequent (76%), followed by medial meniscus (38%) and lateral meniscus tears (26%). LCL, PCL, and MCL injuries were less common.[13] ACL injuries emerged as the most common ligamentous injury across all studies, followed by meniscal tears, particularly of the medial meniscus, whereas PCL, MCL, LCL, and bone contusions were observed less frequently.

Based on our observations, complete ACL tears accounted for the largest proportion, and buckling was the predominant PCL finding. Complex and horizontal tears were frequent in meniscus injuries, whereas grade I tears were most common in MCL and LCL injuries. Bone contusions mainly involve the tibia and the femur. Balkanlı and Arslan found that grade 2 ACL injuries were the most frequent subtype (56.3%) in their study. In meniscus injuries, horizontal tears were the predominant pattern in grade 3 lesions of the medial (67.9%) and lateral (50%) menisci. Most medial meniscal injuries involved the posterior horn and body.[10]

Choudhary et al documented complete (Grade III) ACL tears in 66.7% of affected patients, primarily in the mid-fibre region. Avulsion fractures and partial (Grade II) tears have also been reported. Grade III tears were widely observed (70.8%), affecting both the medial and lateral menisci.[11] The observation that 72.22% of ACL tears were complete is consistent with the findings reported by Bhingardeve.[14] Among meniscal injuries, grade III tears were the most common in the medial meniscus (51.73%), and grade II/III tears were typical findings in the lateral meniscus (40%).

Complete ACL tears were the most prevalent subtype across studies, whereas complex and horizontal meniscal tears, especially grade III tears, were commonly observed. MCL and LCL injuries were mostly low-grade, and bone contusions typically involved the tibia and femur.

Age was significantly associated with specific injury patterns in our study. The leading injuries among younger adults were ACL tears and bone contusions, LCL injuries in those aged <20 years, and meniscus injuries in the 31-40 age group. PCL and other injuries were not significantly correlated with the age of the patients. Gupta et al reported that the majority of patients (71.8%) were in the 21-30 year age group, with only 20.7% aged 31 years or older. Their study confirmed that ACL injuries were predominant in this younger age group.[15] An age-wise distribution of cases was reported, though no correlation between specific injury types and age groups was analysed in the study by Moorthy et al.[12] However, the high proportion of ACL and meniscal injuries in the 21-40 years age group aligns with our findings. ACL and bone contusion injuries were significantly more common in younger adults, especially those aged 21-30 years, whereas meniscal injuries peaked in the 31-40 years age group. These age-specific patterns were supported by similar trends in previous research.

Our study showed no significant association between gender and any specific knee injury, with similar distributions observed across both sexes. Bhingardeve et al. also observed a higher proportion of male patients (61.85%) but reported no significant difference in the mean age between genders.[14] An 80% male predominance was observed, corroborating the data presented in Umap et al study.[13] A similar outcome was described by Choudhary et al who reported that 72% of the patients were male, indicating a higher proportion of male involvement.[11] While males were more frequently affected by knee injuries, there was no significant association between gender and any specific type of injury, consistent with findings from other studies.

Limitations

This study was conducted at a single centre, which may limit the generalisability of the findings. The retrospective design restricted the analysis to existing data, preventing the assessment of long-term outcomes and prospective follow-up.

CONCLUSION

Our study underscores the value of MRI in the accurate detection and classification of traumatic knee injuries. ACL tears emerged as the most frequent injury, often accompanied by meniscal and PCL injuries, with complete ACL tears and complex meniscal tears being the predominant subtypes. Moreover, injury patterns varied significantly with age but remained consistent between genders. These results highlight MRI's role in early diagnosis and the importance of age-related trends in targeted clinical management.

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REFERENCES

1. Phelan N, Rowland P, Galvin R, O'Byrne JM. A systematic review and meta-analysis of the diagnostic accuracy of MRI for suspected ACL and meniscal tears of the knee. Knee Surg Sports Traumatol Arthrosc. 2016;24(5):1525-39.
2. Cristiani R, van de Bunt F, Kvist J, Stålman A. High prevalence of associated injuries in anterior cruciate ligament tears: A detailed magnetic resonance imaging analysis of 254 patients. Skeletal Radiol. 2024;53(11):2417-27.
3. Yoon KH, Yoo JH, Kim K-I. Bone contusion and associated meniscal and medial collateral ligament injury in patients with anterior cruciate ligament rupture. J Bone Joint Surg Am. 2011;93(16):1510-8.
4. Zanetti M, Pfirrmann CWA, Schmid MR, Romero J, Seifert B, Hodler J. Patients with suspected meniscal tears: prevalence of abnormalities seen on MRI of 100 symptomatic and 100 contralateral asymptomatic knees. AJR Am J Roentgenol. 2003;181(3):635-41.
5. Patel SA, Hageman J, Quatman CE, Wordeman SC, Hewett TE. Prevalence and location of bone bruises associated with anterior cruciate ligament injury and implications for mechanism of injury: a systematic review. Sports Med. 2014;44(2):281-93.
6. Cristiani R, van de Bunt F, Kvist J, Stålman A. High prevalence of superficial and deep medial collateral ligament injuries on magnetic resonance imaging in patients with anterior cruciate ligament tears. Arthroscopy. 2024;40(1):103-10.
7. Fortier LM, Stylli JA, Civilette M, Duran NS, Hanukaai S, Wilder H, et al. An evidence-based approach to multi-ligamentous knee injuries. Orthop Rev (Pavia). 2022;14(4):35825.
8. Van Oudenaarde K, Swart NM, Bloem JL, Bierma-Zeinstra SM, Algra PR, Koes B, et al. Post-traumatic knee MRI findings and associations with patient, trauma, and clinical characteristics: a subgroup analysis in primary care in the Netherlands. Br J Gen Pract. 2017;67(665):e851-8.
9. Shetty ND, Dhande RP, Parihar P, Bora N, Shelar SS. The role of magnetic resonance imaging in the evaluation of knee pain. Cureus. 2024;16(7):e65898.
10. Balkanlı B, Arslan A. Magnetic resonance imaging for acute musculoskeletal injuries of the knee joint in coal miners: A retrospective study. Indian J Orthop. 2023;57(1):102-9.
11. Choudhary N, Nagar A, Singh S, Guru BL. Role of MRI in diagnosis of knee injuries: An observational study. Int J Med Public Health. 2025;15(1):43-8.
12. Moorthy J, Radhan P, Kumar V, Thangam V, Gadiraju B. Clinical and MRI profile of patients with knee injuries and correlation of MRI with arthroscopic findings. Int J Res Orthop. 2023;9(2):352-6.
13. Umap R, Anurag B, Bagale S, Shattari N. Evaluation of traumatic knee joint injuries with MRI. Int J Contemp Med Surg Radiol. 2018;3(3):C77-81.
14. Bhingardeve CV, Bhingardeve VS, Desai S, Patil P. Radiological study of type and grade of the ligament injuries following knee trauma, with the help of appearances on MRI study. Int J Life Sci Biotechnol Pharma Res. 2024;13(3):22.
15. Gupta GK, Halder S, Murmu TK. An observational study correlating the diagnostic accuracy of clinical examination, MRI and arthroscopic findings in sports-related knee injuries in tribal population. Int J Life Sci Biotechnol Pharma Res. 2023;12(2):1000.

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