Research Article

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Magnetic Resonance Imaging in diagnosing anterior and posterior cruciate ligament injury of knee joint with arthroscopic correlation

Abstract

Anterior and posterior cruciate ligaments are the most injured of the major knee ligaments. Magnetic Resonance Imaging (MRI) knee is routinely used to diagnose or support clinical diagnosis for cruciate ligament tear before arthroscopic treatment. MRI of the knee has been regarded as the non-invasive alternative to diagnostic arthroscopy, which is regarded as the gold standard for the diagnosis of traumatic intra-articular knee injuries. A cross-sectional study was carried out in the Department of Radiology in collaboration with Orthopedics among 55 patients with clinically suspected anterior and posterior cruciate ligament injury using the purposive sampling method. MRI diagnosis of anterior and posterior cruciate ligaments tear correlated significantly well with arthroscopic diagnosis as shown by the higher validity test results with 90.91% sensitivity, 97.73% specificity, 96.36% accuracy, 90.91% positive predictive value, and 97.73% negative predictive value. The study also revealed that there is no statistically significant difference (p =0.62) between MRI and arthroscopy in the evaluation of cruciate ligament tears. Therefore, MRI is a reliable tool and non-invasive diagnostic modality in the evaluation of anterior and posterior cruciate ligament tears before surgical management of these cases.

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Manmohan Bir Shrestha,[1] Mahesh Chaudhary,[1] Jayanti Limbu,[2] Biva Chaudhary,[3] Abishek Pokhrel,[1] Leela Chaudhary,[4] Amit Limbu[5]

[1]Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[2]B & C Medical College Teaching Hospital, Jhapa, Nepal
[3]East West Medical College and Hospital, Dhaka, Bangladesh
[4]University of Texas Health Science Center at Houston, Texas, United States
[5]B. P. Koirala Institute of Health Science, Dharan, Nepal

Correspondence: Manmohan Bir Shrestha, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, Email macbirshresth@gmail.com

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Introduction

Cruciate ligaments are the most injured of the major knee ligaments. The anterior cruciate ligament (ACL) is a vital stabilizer against anterior tibial translation and resists internal tibial rotation. The posterior cruciate ligament (PCL) is a central stabilizer against posterior tibial translation and internal tibial rotation.[1] Cruciate ligaments are commonly injured due to trauma, repetitive activities, sudden falls, and sports activities. So, cruciate ligament injuries plague both athletes and non-athletes.[2] Patients with ACL & PCL injuries have variable knee instability which may limit daily activities. The torn cruciate ligaments undergo limited healing. Untreated patients suffer from long-term morbidity with sequelae including osteoarthritis and secondary meniscal tears. Clinical tests for the diagnosis of cruciate ligament injury are painful are not always accurate and may cause a delay in the diagnosis. In cases of multiple intra-articular knee lesions, it is difficult to identify objective signs and injuries by clinical tests.[3] The primary signs of ACL tear include non-visualization, discontinuity, abnormal signal intensity, and focal or diffuse thickening. The axis of ACL is abnormal if it is more horizontal than the Blumensaat line and is a reliable predictor of ACL tear. The value of an ACL angle less than 45 degrees is also a specific and sensitive quantitative parameter for ACL tears.[4] Ancillary findings apart from abnormalities of ACL proper are termed secondary signs. Secondary signs of ACL tear are buckling of PCL, anterior tibial translation, bone bruise, posterior displacement of the posterior horn of lateral meniscus, meniscal tear, deep lateral femoral notch sign, and Segond fracture. The sensitivity of these signs is limited; therefore, their absence doesn't exclude ACL injury.[4-7] Certain signs, however, have greater than 80% specificity for ACL injury. When the cutoff value for anterior tibial translation is 7 mm, the sensitivity is 41% and the specificity is 91% for ACL tears.[5] Sagittal MRI may show a "deep lateral femoral notch sign" that manifests as an exaggerated (>1.5 mm deep) condylopatellar notch of the lateral femoral condyle.[4] When the cutoff value for the PCL angle is 107 degrees, the sensitivity is 52% and the specificity is 94% for ACL tears.[5] The primary signs of PCL tear in Magnetic Resonance (MR) imaging include non-visualization, discontinuity, abnormal signal intensity, and focal or diffuse thickening. PCL injury can be classified as partial tear with abnormal signal intensity within their substance, complete tear, and avulsion injuries of the tibial insertion site. Secondary signs of PCL tear are medial collateral ligament injuries, meniscal tear, bone marrow contusion, ACL tear, and joint effusion.[8] While diagnosing cruciate ligament injuries clinically, sometimes clinical tests become painful and are not always accurate. Sometimes, these tests are confusing when there are multiple injuries and may cause a delay in the diagnosis. Therefore, diagnostic tools like MRI become necessary in the evaluation of cruciate ligament injuries.[2] MR imaging of the knee has been regarded as the non-invasive alternative to diagnostic arthroscopy, which is regarded as the gold standard for the diagnosis of traumatic intra-articular knee lesions.[9]

The reported sensitivity, specificity, and accuracy of knee MRI (for ACL tear: 91.3%, 88.2%, 90% and for PCL tear: 92.8%, 96.1%, 95%) indicates MRI should serve well in this role.[10] The primary role of MRI in the management of the patient with cruciate ligament injury lies in allowing confident diagnosis or exclusion of tears in patients with equivocal physical examination. This study is intended to evaluate the efficacy of MRI in the evaluation of anterior and posterior cruciate ligament injury in comparison to arthroscopy. The evaluation and treatment of cruciate ligament injuries present a formidable challenge for both radiologists and orthopedic surgeons. Clinical tests for the diagnosis of cruciate ligament injury are painful are not always accurate and may cause a delay in the diagnosis. In cases of multiple intra-articular knee lesions, it is difficult to identify objective signs and injuries by clinical tests. MRI of the knee has become an ideal and reliable modality in the detection of intra-articular knee injuries as it has a better soft tissue contrast and multiplanar slice capability. It helps in the accurate assessment of cruciate ligament injuries before surgical exploration. Before the introduction of MRI in clinical use, arthroscopy was used both as a diagnostic and therapeutic modality in cruciate ligament injuries. So, after the establishment of the role of MRI in the diagnosis of cruciate ligament injuries, arthroscopy is used only for surgical repair of cruciate ligament injuries and not for diagnostic purposes.

Literature review

Studies have been conducted in the past to study the role of MRI knee in the characterization of cruciate ligament injuries. MRI knee is routinely used to diagnose or support clinical diagnosis for cruciate ligament tear before arthroscopic treatment.

Bin Abd Razak et al.[11] conducted a retrospective study to assess the accuracy of MRI comparison with arthroscopic findings in ligamentous injuries of the knee. The study included 320 patients with ACL injury. Patients belonged to a single surgeon from a high-volume tertiary healthcare institution. All patients underwent therapeutic arthroscopic ACL reconstruction. The study revealed MRI as 100% sensitive and specific in diagnosing ACL injuries and 82% sensitive and 100% specific in diagnosing PCL injuries. The study concluded MRI was the most accurate in the diagnosis of anterior cruciate ligament injury with a positive predictive value (PPV) approaching 100%. Gupta et al.,[10] in their cross-sectional study of 40 patients for 1 year conducted in B.P. Koirala Institute of Health Sciences, Dharan, Nepal, sensitivity, specificity, and accuracy of MRI in detecting cruciate ligament injuries were as follows: for anterior cruciate ligament: 91.3%, 88.2%, 90%; and for posterior cruciate ligament: 92.8%, 96.1%, 95% respectively. Bari et al.[12] studied 230 patients, to correlate MRI findings with arthroscopy by calculating sensitivity, specificity, positive and negative predictive values (PPV & NPV) keeping arthroscopy as a gold standard in ACL injuries. The sensitivity, specificity, PPV, and NPV for ACL injury were as follows: 87.87%, 81.57%, 80.55%, and 88.57%. Arthroscopic correlation of MRI findings in a study with 173 patients by Singh et al.,[13] revealed the sensitivity, specificity, and accuracy of MRI in detecting cruciate ligament injuries as follows: for anterior cruciate ligament: 98.72%, 98.94%, 98.84%; and for posterior cruciate ligament: 98.72%, 98.94%, 98.84%.[13] Behairy et al.[14] performed a study to detect the accuracy of routine magnetic resonance imaging done in different centers and its correlation with arthroscopy in ligamentous injuries of the knee. The study was designed prospectively with an examination of 70 patients ranging in age between 22 and 59 years. Sensitivity, specificity, and accuracy of 77.8%, 100%, and 94% were noted for anterior cruciate ligament injury. Esmaili et al.,[15] conducted a prospective, single-blind study to assess the accuracy of MRI comparison with arthroscopic findings in ligamentous injuries of the knee. Patients studied were involved in acute knee trauma. The mean age was 27.9 years. All the included patients underwent MRI and arthroscopy. The sensitivity, specificity, and accuracy of MRI in detecting cruciate ligament injuries in the study are as follows: for anterior cruciate ligament: 78.3%, 95.7%, 88.5%; and for posterior cruciate ligament: 81.8%, 100%, 94.6% respectively. Mellado et al.[4] used both quantitative and non-quantitative imaging parameters in the evaluation of the diagnostic utility of magnetic resonance imaging for predicting anterior cruciate ligament tears. The quantitative parameters included are ACL angle, Blumensaat angle, and PCL angle. MRI examinations of the knee were retrospectively evaluated in a group of patients with arthroscopically confirmed complete ACL tear and a control group with arthroscopically confirmed intact ACL. Keeping 45 degrees as a threshold value of ACL angle, the sensitivity and specificity reached 100% for detecting ACL tears. With a threshold value of 0 degrees, the Blumensaat angle had a sensitivity of 90% and a specificity of 98%. Similarly, with a threshold value of 115 degrees for PCL angle, the sensitivity and specificity of ACL tears reached 70% and 82% respectively. The study also revealed that discontinuity of ACL is the most useful abnormality in detecting ACL tear. Among the ancillary findings of ACL injury in MRI, anterior tibial translation was the best indicator. Rubin et al.[16] interpreted MR images focused on two cruciate ligaments, two collateral ligaments, a patellar tendon, and two menisci. The interpretations were correlated with arthroscopy findings, which remained as gold standard. The study concluded that sensitivity and specificity for diagnosing cruciate ligament tears were 94% and 99% respectively, when no or one supporting structure was torn. And sensitivity and specificity of 88% and 84% respectively, when two or more supporting structures were torn. The difference in specificity in the study was statistically significant.

Detection of anterior cruciate ligament tear is primarily based on the appearance of the ligament on MRI. However, other MR findings called secondary or ancillary signs may be useful to establish the diagnosis of ACL tear. Ancillary MR findings are those that are observed elsewhere in the ACL in the knee. McCauley et al.[7] carried out a retrospective study of 68 patients with the correlation between MR images and arthroscopic findings. MR images were reviewed by two radiologists who did not know the arthroscopic findings. The reviewers noted the presence and location of bone bruises, and posterior displacement of the posterior horn of lateral meniscus and measured the posterior cruciate ligament angle as secondary signs. The presence of bone bruising in the posterolateral tibial plateau had sensitivities of 50% and 46%, and specificities of 97% and 97% in the detection of ACL tears for the two reviewers. Posterior displacement of the posterior horn of the lateral meniscus had a sensitivity of 56% for both reviewers and specificities of 100% and 97% respectively. With a threshold value of less than 105 degrees for the PCL angle, sensitivities were 72% and 74% and specificities were 79% and 86% correspondingly for the two reviewers. Therefore, ancillary MR imaging findings may be helpful in the diagnosis of ACL tears when diagnosis based on the MR appearance of the ligament is equivocal. Diagnosis of ACL tears must be considered strongly whenever there is the presence of bone bruising in the posterolateral tibial plateau and the presence of posterior displacement of the posterior horn of the lateral meniscus.

Materials and methods

It was a cross-sectional type of study**.** The study was carried out in the Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University (BSMMU) in collaboration with departments of Orthopedics. This study is undertaken to develop a systematic method for the evaluation of injuries of cruciate ligaments and help the people of Bangladesh by guiding them in proper diagnostic procedures in the 1.5 Tesla MR machine.

Study population

Patients with knee injury referred to the Radiology department of BSMMU for MRI knee and found positive for ACL & PCL tear & clinically suspected of ACL & PCL tear; and who underwent arthroscopic procedures; who fulfill inclusion & exclusion criteria and are willing to participate in the study were taken as the study population. Purposive samples were used to select the patients for one year from October 2018 to September 2019.

Inclusion criteria

- Patients with knee injuries who had experienced at least 1-8 weeks of symptoms that included pain, swelling, instability, and locking of the knee and referred to the Radiology department of BSMMU for an MRI knee.

- Above mentioned patients were found positive for ACL & PCL tear & also clinically suspected of ACL & PCL tear; followed by arthroscopic procedures in the Orthopedics department of BSMMU.

Exclusion criteria

- Previous knee surgery.
- Contraindication to MR (claustrophobia, presence of ferromagnetic implants).
- Knee joint neoplasm.
- Infections and inflammatory conditions of the knee joint.
- Presence of radiographically confirmed fracture around knee.
- Severe osteoarthritis of the knee.

Data collection procedure

Ethical clearance from the Institutional Review Board (IRB) was obtained first. Patients with knee injuries referred to the Radiology department, BSMMU for an MRI knee & found positive for cruciate ligament injury were included in the study. The patients who were also clinically suspected of cruciate ligament injury as revealed by an appropriate history and a positive anterior drawer test or Lachman test for ACL and positive posterior drawer test for PCL were included in the study. All the clinical information was obtained by performing a structured questionnaire.

All the MR imaging studies were performed using a standard knee protocol on a 1.5 Tesla MR scanner with a phased array knee coil magnet. The normal slice thickness was 5 mm, PD sagittal, coronal image, T2 weighted axial & sagittal, T1 weighted axial, STIR coronal and sagittal images obtained. Knee MRI protocols were designed to yield diagnostic images of the anterior cruciate ligament (ACL) and of the menisci, bones, articular cartilage, and other ligamentous structures of the knee.

Arthroscopic examinations were carried out using two inferolateral portals and super-lateral drainage under general/or spinal anesthesia. The routine sequence included an evaluation of the patellofemoral joint and an examination of the intercondylar notch. The medial and lateral compartments were evaluated for osseous, cruciate, and meniscal abnormalities. The arthroscopic findings were considered as the reference diagnostic data.

MRI diagnosis was placed into one of the four categories after arthroscopic evaluation.

1. True positive: When MRI diagnosis of tear was confirmed on arthroscopic evaluation.
2. True negative: If the diagnosis of no tear was confirmed on arthroscopy.
3. False positive: If MRI will show a tear but arthroscopy was negative.
4. False negative: If MRI images are negative but arthroscopy will show a tear.

Data management and analysis

All the continuous data was represented by mean with standard deviation. Categorical data was presented by frequency with percentage. Sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were calculated for MRI in the evaluation of ACL & PCL tears compared to arthroscopy. The results were presented in tables and figures. P value calculated using McNemar's test for 2x2 contingency table to find out the efficacy of MRI in the role of diagnosis of ACL & PCL tear compared to arthroscopy. Data were analyzed by using Statistical Package for Social Sciences (SPSS) software version 22.0 for Windows (SPSS Inc., Chicago, Illinois, USA).

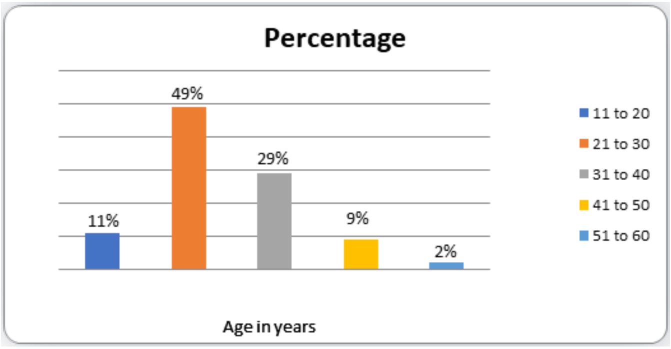

Figure 1 The bar diagram shows the age distribution of the patients in percentage.

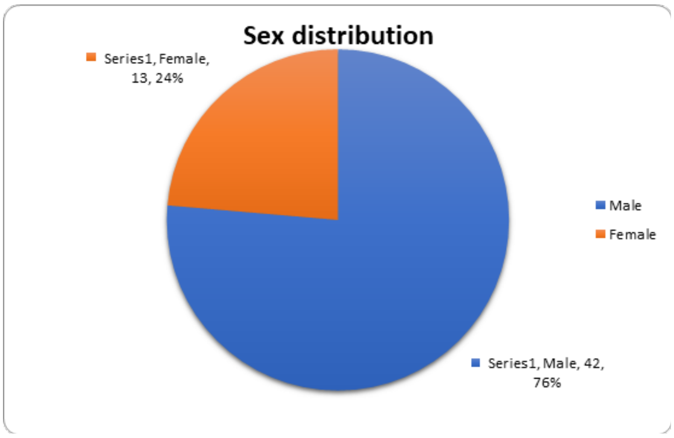

Figure 2 The pie chart shows the sex distribution of the patients.

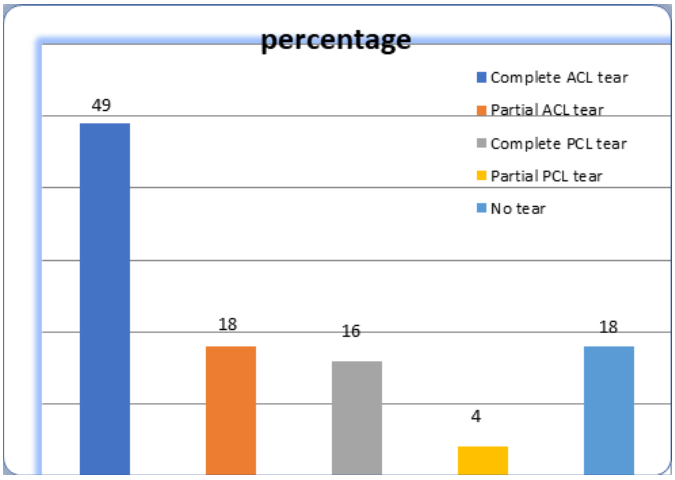

Figure 3 The bar diagram shows the MRI diagnosis of the patients.

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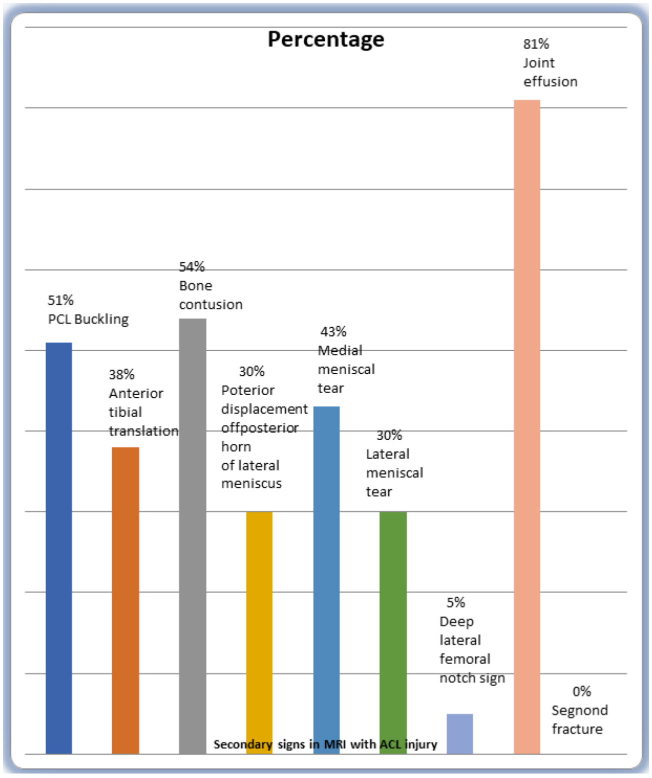

Figure 4 The bar diagram shows secondary signs of ACL injury in MRI.

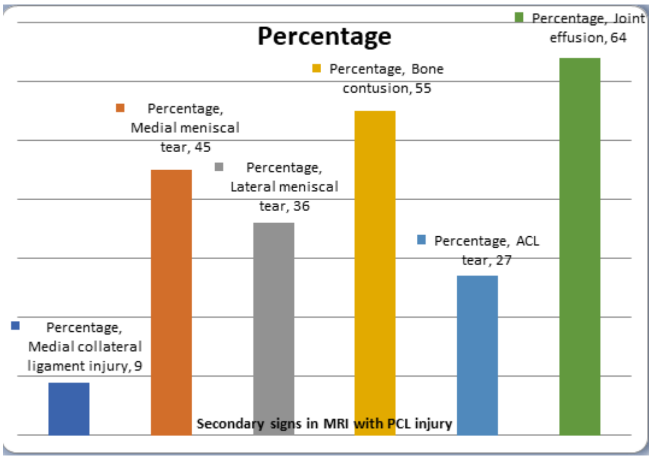

Figure 5 Bar diagram shows secondary signs of PCL injury in MRI.

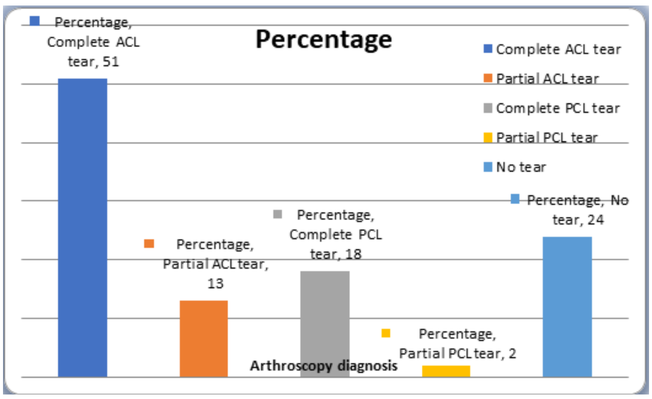

Figure 6 Bar diagram showing arthroscopy diagnosis of patients.

Results and observation

A total of 55 patients with knee injuries clinically suspected of anterior and posterior cruciate ligament injury referred for MRI knee in the Department of Radiology & Imaging, BSMMU, and who fulfilled inclusion and exclusion criteria, were included in this study. Then all patients underwent arthroscopic procedure in the Department of Orthopedics, BSMMU. The results of the study were as follows:

Table 1 shows particular of the patients. It was observed that nearly half (49.0%) of the patients belong to the age group 21-30 years. The mean age was found 29.8±8.3 years with a range from 17 to 52 years.

Table 1 Distribution of the study by demography of the patients (n=55)

Particular of the patients	Number of patients	Percentage (%)
Age (in year)		
11-20	6	11.0
21 – 30	27	49.0
31 – 40	16	29.0
41 – 50	5	9.0
51 – 60	1	2.0
Mean±SD	29.8	±8.3
Range (minimum-maximum)	17	-52
Sex		
Male	42	76.0
Female	13	24.0
Occupation		
Service	10	18.0
Athlete	10	18.0
Student	17	31.0
Housewife	4	7.0
Business	11	20.0
Unemployed	3	5.0

Regarding sex distribution, it was observed that male was 42 (76.0%) and female were 13 (24.0%). Male to female ratio was 3.2:1.

The majority of 17 (31.0%) patients were students followed by 11 (20.0%) who were businessmen, 10 (18.0%) each were service holders & athletes respectively, 4 (7.0%) were housewives and 3 (5.0%) were unemployed.

Table 2 shows duration of suffering and clinical symptoms of patients. It was observed that majority 19 (35.0%) suffering in duration of 1-2 weeks. Most of the patients, 93% suffering from pain and about half had difficulty in walking.

Table 2 Distribution of the study patients by duration of suffering & clinical presentation (n=55)

	Number of patients	Percentage (%)
Duration of suffering (weeks)		
1-2	19	35.0
3-4	15	27.0
5-6	10	18.0
7-8	11	20.0
Clinical presentation		
Pain in knee joint	51	93.0
Difficulty in walking	28	51.0
Swelling in knee joint	21	38.0
Restricted range of motion	17	31.0

Multiple responses were considered.

Table 3 shows the mode of injury & clinical tests for anterior and posterior cruciate ligament injury. It was observed that the majority (45%) of patients sustained knee injury due to trauma followed by sports (33%) and then falls (22%).

Table 3 Distribution of the study patients by mode of injury & clinical tests (n=55)

	Number of patients	Percentage (%)
Mode of injury		
Trauma	25	45.0
Sports injury	18	33.0
Fall	12	22.0
Clinical test		
Anterior drawer test	30	55.0
Lachman test	16	29.0
Posterior drawer test	7	15.0

Anterior drawer test and Lachman tests, which are performed for ACL injury were positive in 30 (55.0%) and 16 (29.0%) patients respectively.

The posterior drawer test performed for PCL injury was positive in 7 (15.0%) patients respectively.

Table 4 shows the MRI findings of the patients. It was observed that complete and partial ACL tears were present in 27 (49.0%) and 10 (18.0%) patients respectively.

Table 4 Distribution of the study patients by MRI findings (n=55)

MRI findings	Number of patients	Percentage (%)
ACL complete tear	27	49
ACL partial tear	10	18
PCL complete tear	9	16
PCL partial tear	2	4
No tear	10	18

Complete and partial PCL tears were present in 9 (16.0%) and 2 (4.0%) patients respectively. ACL & PCL were normal in 10 (18.0%) patients.

Table 5 shows secondary signs of ACL injury in MRI. It was observed that majority had joint effusion (81.0%). Around half of the patients with ACL injury had buckling of PCL (51.0%), bone contusion (54.0%) and medial meniscal tear (43.0%).14 (38.0%) patients had anterior tibial translation, 11 (30.0%) patients had posterior displacement of posterior horn of lateral meniscus and lateral meniscal tear. Only 2 (5.0%) patients had deep lateral femoral notch signs. And no patient had Segond fracture.

Table 5 Distribution of the study patients with secondary findings in MRI with ACL injury (n=37)

Secondary findings	Number of patients	Percentage (%)
Buckling of PCL	19	51
Anterior tibial translation	14	38
Bone contusion	20	54
Posterior displacement of posterior horn of lateral meniscus	11	30
Medial meniscal tear	16	43
Lateral meniscal tear	11	30
Deep lateral femoral notch sign	2	5
Joint effusion	30	81
Segond fracture	0	0

Multiple responses were considered.

Table 6 shows secondary signs of PCL injury in MRI. It was observed that most of them had joint effusion (64.0%). 6 (55.0%) patients had bone contusion. 5 (45.0%) and 4 (36.0%) patients had medial and lateral meniscal tear respectively. Only 1 patient had medial collateral ligament injury. And 3 (27.0%) patients with PCL injury were combined with ACL injury as well.

Table 6 Distribution of the study patients with secondary finding in MRI with PCL injury (n=11)

Secondary findings	Number of patients	Percentage (%)
Medial collateral ligament injury	1	9
Medial meniscal tear	5	45
Lateral meniscal tear	4	36
Bone contusion	6	55
ACL tear	3	27
Joint effusion	7	64

Multiple responses were considered.

Table 7 shows the arthroscopy diagnosis of the patients. It was observed that complete and partial tears of ACL were present in 28 (51.0%) & 7 (13.0%) patients respectively. Complete and partial tears of PCL were present in 10 (18.0%) & 1 (2.0%) patients respectively.13 (24.0%) patients had normal ACL and PCL.

Table 7 Distribution of the study patients by Arthroscopy diagnosis (n=55)

Arthroscopy diagnosis	Number of patients	Percentage (%)
Complete ACL tear	28	51
Partial ACL tear	7	13
Complete PCL tear	10	18
Partial PCL tear	1	2
No tear	13	24

Table 8 shows MRI diagnosis of anterior cruciate ligament tear evaluated by arthroscopy diagnosis: 34 cases are true positive, 3 cases are false positive, 1 case is false negative and 17 cases are true negative.

Table 8 Association between arthroscopy diagnosis with MRI diagnosis in ACL injury (n=55)

MRI diagnosis	Arthroscopy diagnosis		Total	P value
	Tear (n=35)	No tear (n=20)		
ACL tear (n=37)	34 (True positive)	3 (False positive)	37	0.62^{ns}
No tear (n=18)	1 (False negative)	17 (True negative)	18	
Total	35	20	55	

McNemar's chi-square test for 2x2 contingency table was done to analyze the data**.**

ns = not significant

In our study, "p value">0.05. Hence, it concludes there is no significant difference between MRI and Arthroscopy in the evaluation of ACL tear. (Table 9)

Table 9 Sensitivity, specificity, accuracy, positive and negative predictive values of the MRI diagnosis evaluation for prediction of anterior cruciate ligament tear

Validity test	
Sensitivity	97.0%
Specificity	85.0%
Accuracy	92.7%
Positive predictive value (PPV)	91.9%
Negative predictive value (NPV)	94.4%

The validity of MRI diagnosis evaluation for anterior cruciate ligament tear was correlated by calculating sensitivity, specificity, accuracy, and positive and negative predictive values.

Table 10 shows MRI diagnosis of posterior cruciate ligament tear evaluated by arthroscopy diagnosis: 10 cases are true positive, 1 case is false positive, 1 case is false negative and 43 cases are true negative.

Table 10 Association between arthroscopy diagnosis with MRI diagnosis in PCL injury (n=55)

MRI diagnosis	Arthroscopy diagnosis		Total	P value
	Tear (n=11)	No tear (n=44)		
PCL tear (n=11)	10 (True positive)	1 (False positive)	11	0.48^{ns}
No tear (n=44)	1 (False negative)	43 (True negative)	44	
Total	11	44	55	

McNemar's chi-square test for 2x2 contingency table was done to analyze the data.

ns = not significant

Table 11 Sensitivity, specificity, accuracy, positive and negative predictive values of the MRI diagnosis evaluation for prediction of posterior cruciate ligament tear

Validity test	
Sensitivity	90.91%
Specificity	97.73%
Accuracy	96.36%
Positive predictive value (PPV)	90.91%
Negative predictive value (NPV)	97.73%

In our study, "p value">0.05. Hence, it concludes there is no significant difference between MRI and Arthroscopy in the evaluation of PCL tear.

The validity of MRI diagnosis evaluation for anterior cruciate ligament tear was correlated by calculating sensitivity, specificity, accuracy, positive and negative predictive values.

Discussion

This cross-sectional type of study was carried out to evaluate the role of MRI in diagnosing anterior and posterior cruciate ligament injury with arthroscopic correlation to determine the accuracy, sensitivity, and predictivity of MRI in diagnosing ACL and PCL injury in the knee joint. All patients with knee injuries who had experienced at least 8 weeks of symptoms and were clinically suspected of ACL and PCL injury, who underwent both MR imaging and arthroscopy of the knee for one year, and who willingly gave informed written consent, were included in this study. Patients with previous knee surgery, knee joint neoplasm, infections, fracture around the knee and severe osteoarthritis were excluded. All their MR imaging studies were performed using a standard knee protocol on a 1.5-Tesla MR scanner with a phased array knee coil magnet. The present study findings were discussed and compared with previously published relevant studies. In this present study, it was observed that nearly half (49.0%) of the patients with a cruciate ligament injury in the knee joint were in the 3rd decade and the mean age was found 29.8±8.3 years with a range from 17 to 52 years. Similarly, Bin Abd Razak et al.[11] found the mean age was 32.3 years with a range from 18.0 to 43.0 years. Bari et al.[12] study included 230 patients clinically suspected of having some form of internal derangement of the knee. Maximum (32.0%) were young subjects in the age 3rd decade. In another study, Behairy et al.[14] examined 70 patients ranging in age between 22 and 59 years. Vincken et al.[17] found the patients had a mean age of 30.6 years, which closely resembled with the present study.[14] Regarding sex distribution, it was observed that injuries occurred with a male predominance, where 76.0% and 24.0% were male and female, therefore the male-to-female ratio was 3.2:1. Bin Abd Razak et al.[11] found male was 83.0% and female was 17.0%. Similar observations regarding male predominance were also observed by Bari et al.,[12] Behairy et al.,[14] and Rubin et al.[16] In this present study, it was observed that 31.0% of patients were students, 20.0% were businessmen, followed by service holders & athletes 10.0% each, 7.0% were students and 5.0% were unemployed. Rubin et al.[16] proposed several reasons for the decreased accuracy of MR imaging in knees with multiple ligament injuries. Patients with these severe injuries may be less likely to remain motionless during MR imaging because of pain, resulting in fewer diagnostic images. The large hemarthrosis that accompanies severe trauma may mask normal structures. Finding a serious injury may distract the radiologist from observing other more subtle although equally important, injuries. Finally, subluxations that result from combined ligament tears can result in abnormal or unexpected anatomic relationships for the structures that are not torn, making their recognition more difficult. In this current study, it was observed that most (35.0%) of patients were suffering in 1-2 weeks. Also, it was observed that, the cause of cruciate ligament injury in the majority (45.0%) patients was trauma, followed by sports injury (33.0%) and fall (22.0%). Anterior drawer test was positive in 55.0%, the Lachman test positive in 29.0% and the Posterior drawer test was positive in 15.0% of patients.

In our study, it was observed that ACL tear was present in 67.0% of patients, PCL tear in 20.0% of patients, and normal cruciate ligament in 18.0%. In a similar study by Singh et al.[13] among 178 patients, 45.08% showed ACL tears and 10.0% showed PCL tears. In a cross-sectional study performed by Gupta et al.[10] among 40 patients, 67.0% showed ACL tears and 35.0% showed PCL tears. The authors concluded ACL tears to be more common than other ligamentous injuries, which is consistent with our study. Among the 37 (67.0%) cases with ACL tears, 27 were complete tears and 10 (18.0%) were partial tears. Among the 11 patients with PCL tears, 9 cases were complete tears and 2 were partial tears. Regarding the secondary findings in MRI associated with ACL injury, it was observed that the majority (81.0%) of patients had joint effusion. Around half of the patients had PCL buckling (51.0%), bone contusion (54.0%), and medial meniscal tear (43.0%). 14 (38.0%) patients had an anterior tibial translation, and 11 (30.0%) patients each had a posterior displacement of the posterior horn of the lateral meniscus and lateral meniscal tear. The presence of a medial meniscal tear than a lateral meniscal tear is more common with ACL injury, which is similar as observed by similar studies by Bari et al.[12] and Singh et al.[13] Regarding the secondary findings in MRI associated with PCL injury, it was observed that the majority 64.0% of patients had joint effusion, 55.0% had a bone contusion, 45.0% had a medial meniscal tear, 36.0% had a lateral meniscal tear and 9.0% had medial collateral ligament injury. Out of the 55 patients in the study group, 3 patients had combined ACL and PCL injuries. It was observed that MRI diagnosis of anterior cruciate ligament tear evaluated by arthroscopy diagnosis: 34 cases are true positive, 3 cases are false positive, 1 case false negative and 17 cases are true negative. The validity of MRI in the present study in the evaluation for anterior cruciate ligament tear was 97% sensitivity, 85.0% specificity, 92.7% accuracy, 91.9% positive predictive value, and 94.4% negative predictive value. Singh et al.[13] reported that MRI was most accurate in diagnosing anterior cruciate ligament injuries with a sensitivity of 98.72%, specificity of 98.94%, and accuracy of 98.84%. MRI diagnosis of posterior cruciate ligament tear evaluated by arthroscopy diagnosis: 10 cases are true positive, 1 case false positive, 1 case false negative and 43 cases are true negative. The validity of MRI in the present study in the evaluation for posterior cruciate ligament tear was 90.91% sensitivity, 97.73% specificity, 96.36% accuracy, 90.91% positive predictive value, and 97.73% negative predictive value. Gupta et al.[10] reported that MRI was most accurate in diagnosing posterior cruciate ligament injuries with a sensitivity of 92.8%, specificity of 96.1%, and accuracy of 95%. P-value >0.05 between MRI and Arthroscopy in the evaluation of ACL and PCL tear also revealed that there is no statistically significant difference between MRI and Arthroscopy.

Conclusion

This study was undertaken to correlate MRI findings with the arthroscopic findings in the evaluation of anterior and posterior cruciate ligament injury in the knee joint. In this study, the MRI diagnosis of ACL & PCL tear correlated significantly well with arthroscopic diagnosis as shown by the higher validity test results. The study also revealed that there is no statistically significant difference (p>0.05) between MRI and Arthroscopy in the evaluation of ACL and PCL tears. Hence, it can be concluded that the MRI is a useful & non-invasive diagnostic modality in the evaluation of anterior and posterior cruciate ligament tear. It should be worth noting here that MRI can be used as a reliable tool with which we can assess anterior and posterior cruciate ligament tears and plan the subsequent appropriate management of these cases.

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None

Conflicts of interest

All authors declare that there is no conflicts of interest.

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