

ROLE OF MRI IN EVALUATION OF KNEE JOINT TRAUMA - AN OBSERVATIONAL CROSS-SECTIONAL STUDY

Kuldeep Yadav¹, Ashwin Patidar², Reshu Sharma³, Pranav K Dave⁴

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Corresponding Author:

Dr. Reshu Sharma

Email: reshunho@gmail.com

ORCID: 0000-0002-2149-7816

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¹Post Graduate Resident, Department of Radiodiagnosis, LN Medical College and JK Hospital, Bhopal, Madhya Pradesh, India.

²Senior Resident, Department of Radiodiagnosis, LN Medical College and JK Hospital, Bhopal, Madhya Pradesh, India

³Associate Professor, Department of Radiodiagnosis, LN Medical College and JK Hospital, Bhopal, Madhya Pradesh, India

⁴Professor, Department of Radiodiagnosis, LN Medical College and JK Hospital, Bhopal, Madhya Pradesh, India

Abstract

Background: Knee injuries are common injuries associated with significant morbidity. Stress examinations are not always accurate in the acute phase of the injury. MRI is a non-invasive, painless and radiation-free technique that provides excellent information about type and severity of injury and can help in guiding treatment. The objective of our study is to determine the efficacy of MRI in diagnosing various lesions in a traumatic knee joint. **Materials and Methods:** An observational cross-sectional study was conducted in the Department of Radiodiagnosis and Imaging at LN Medical College and J.K. Hospital Kolar Road, Bhopal, on patients having recent clinical history of knee injury. Total 100 patients were included and MRI knee joint was performed using standard MR protocol on 1.5 Tesla Philips Achieva machine. **Result:** Out of total 100 patients, 78% were males (78%) and 21-30 years was the most common age group (33 %). 58% patients were having right knee joint trauma. ACL injury was the most common injury (64 %), followed by meniscal injury (47 %) and collateral ligaments injury (38%). PCL injury is less common and seen in 9% of the cases. **Conclusion:** MRI is safe, non-invasive, radiation free diagnostic imaging modality with excellent soft tissue contrast resolution and high efficacy, to evaluate and accurately delineate soft tissue injury associated with knee joint trauma.

INTRODUCTION

Knee joint is a biggest joint of the human body.^[1] It is a complex modified hinge joint formed by lower end of the femur, upper end of the tibia and the patella.^[2,3] It has greatest range of movement in flexion and extension about the sagittal plane, varus and valgus rotation about the frontal plane and it facilitates the medial rotation at the end of the flexion and the lateral rotation in full extension of the knee.^[2] Joint capsule encloses the articular surfaces, menisci and cruciate ligaments. Collateral ligaments and the tendons are extra-articular, except popliteus tendon, which has an intraarticular portion. These articulating structures sustain high mechanical stresses in day-to-day life, so the frequency and severity of the ligament and meniscus injuries is high in young adults and sportsmen, which is associated with significant morbidity.^[1]

Because of painful knee joint, stress examinations are not always accurate in the acute phase of the injury. X-rays can only show the bone injuries and therefore are not helpful in diagnosing soft tissue injury in the early stage.^[4] In the last few years, MRI has revolutionized the diagnostic imaging of the knee due to its excellent soft tissue contrast resolution and multiplanar imaging technique.^[5,6,7,8,9,10] It provides significant advantages over other imaging techniques in the evaluation of traumatic injuries of knee joint. It represents a non-invasive, painless and radiation-free technique that provides excellent soft tissue contrast and information about type and severity of injury. MRI plays a crucial role in the evaluation of the internal architecture of the knee and in the diagnosis, monitoring and follow up examination of traumatic knee injuries. It can help in guiding treatment and save an unnecessary arthroscopy for

the patient. Magnetic Resonance Imaging (MRI) is now accepted as the best non-invasive, radiation free imaging modality for evaluation of knee joint trauma.^[1] It can clearly delineate injury of menisci, tendons, ligaments cartilage and bone marrow. Our current research is aimed at determining the efficacy of MRI in diagnosing various bony and soft tissue lesions in a traumatic knee joint.

MATERIALS AND METHODS

An observational cross-sectional study was conducted in the Department of Radiodiagnosis and Imaging at LN Medical College and J.K. Hospital Kolar Road, Bhopal (MP) from November 2020 to April 2022 (one and half year duration) after obtaining permission from the ethical and scientific committee. The study was conducted on patients having recent clinical history of knee injury and coming for MRI knee joint from OPD or IPD. Total 100 number of patients were included in this study who were willing to take part in the study, fulfilling inclusion criteria. MRI knee joint was performed on all patient using standard MR protocol on 1.5 Tesla Philips Achieva machine using knee coil.

Patients of all age group, either male or female, referred from OPD or IPD with recent history of traumatic knee joint injury within 7 days duration, were included in the study. The patients who did not give their consent for the study and those who had past history of knee joint operation or any procedure related to knee joint were excluded. Those patients who had any chronic knee joint pathology, history of claustrophobia or any contraindication to MRI were also excluded from the study.

Statistical Analysis

Imaging findings of all patients were recorded on day-to-day basis in master chart using Microsoft excel worksheet software version 16.0. The data of master chart was interpreted by using tables, columns, bar charts, pie charts and line diagram on Microsoft word. Patients are distributed according to the frequency observed and percentage involvement.

RESULTS

In this study, 100 patients were included and MRI was performed to evaluate the knee joint injuries. Out of these 100 patients, 78% were males and 22%

were females with male to female ratio being 3.6:1; age-wise distribution of study subjects is given in [Table 1].

Among these 100 patients, 58 patients had right knee joint trauma and 42 patients had left knee joint trauma.

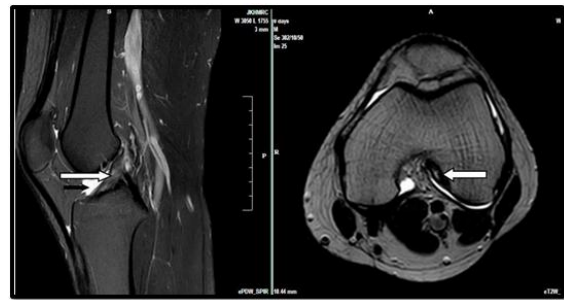


Figure 1: sagittal PDW and axial T2 weighted image showing grade-I ACL tear (thick arrow), with joint effusion (black arrow)

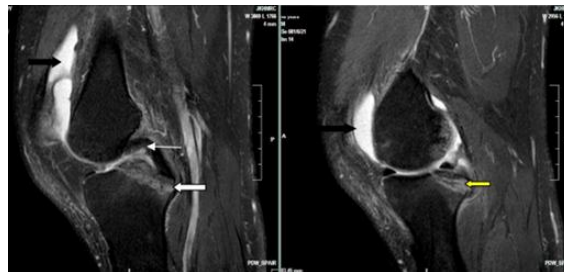


Figure 2: Sagittal PDW image showing PCL avulsion fracture (thick arrow), lateral tibial condylar fracture with bone contusion (yellow arrow), PCL grade-I tear (thin arrow) with joint effusion (black arrow).

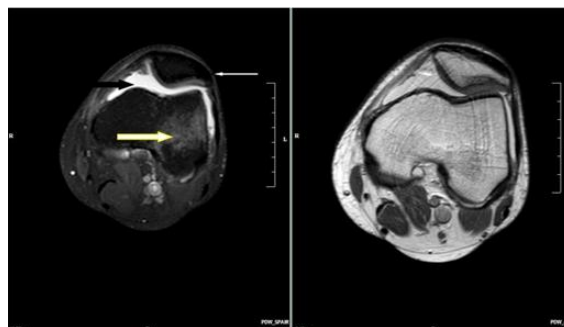


Figure 3: Axial SPAIR and T2 weighted image showing lateral patellar subluxation (thin white arrow), bone contusion (thick white arrow) and joint effusion (black arrow)

Table 1: Distribution of patients according to gender and age

Age	Male	Female	Total
10 or <10	0	0	0
11-20	11	1	12
21-30	24	9	33
31-40	23	5	28
41-50	12	7	19
51-60	5	0	5
>60	3	0	3
Total	78	22	100

It was observed that amongst the soft tissue injuries including ligaments, cartilage tendon and meniscus, injury of ACL was most common which was found in 64 % of the patients. Second most common soft tissue injury observed was meniscal injury,^[12] which was seen in 47 % of the patients.

Table 2: Distribution of patients according to structural injury on MRI

ACL	64	
PCL	9	
MCL	25	38
LCL	13	
MM	32	47
LM	15	
MPR and medial PFL	20	
LPR and lateral PFL	5	
Bone fracture with contusion	28	64
Bone contusion only	22	
Patellar injury	14	
Joint effusion only	77	89
Joint effusion with lipohaemarthrosis	12	

It was observed that among the patients with ACL Tear (64%), complete or grade 3 ACL tear was found in majority (43%) of the patients followed by partial or grade 2 ACL tear and avulsion fracture -tibial attachment was present in 9% of them as shown in [Table 3].

Table 3: Distribution of MRI finding of ACL involvement.

Complete or grade III ACL tear	43
-Near femoral attachment	17
-Mid fiber tear	26
Near tibial attachment	0
Partial or grade II ACL tear -surface fiber	9
Grade I ACL tear -interstitial fiber	3
Avulsion fracture -tibial attachment	9

In the patients with PCL tear, PCL avulsion fracture was found in majority (55%) amongst them as shown in [Table 4]. Although overall PCL tear was not so common compared to ACL tear.

Table 4: Distribution of MRI finding of PCL involvement.

Interstitial tear/sprain or Grade-I PCL injury		2
Partial surface tear or Grade-II PCL injury		2
Complete PCL tear or Grade-III PCL injury	Proximal fiber	1
	Middle fiber	0
	Distal fiber	0
Grade-IV PCL injury		0
PCL avulsion fracture	Tibial attachment	5
	Femoral attachment	0
Total		9

It was observed that the meniscus is second most common soft tissue injured in knee joint trauma. Overall meniscal injury was seen in 47% of the patients. In meniscal injury, medial meniscus was injured the most, which was found in 32% of the patients. Lateral meniscus tear was found to be far less common than medial meniscal tear and was found in only 15% of the cases.

Table 5: Distribution of various grades of Meniscal tear – observed frequency

Grading	MM	LM	Total
Grade I	8	0	8
Grade II	4	2	6
Grade III	20	13	33
Total	32	15	47

In our study, patella related injury was seen in 12% of the cases which included patellar subluxation or dislocation in 4% of the patients [Figure 3 & Table 6] and patellar articular cartilage injury which is classified according to modified Outerbridge grading of chondromalacia patellae.

Table 6: Patellar injury

Lateral subluxation	4	
Patellar cartilage tear / Chondromalacia patella41	Grade I	5
	Grade II	2
	Grade III	0
	Grade IV	1
Total	12	

Amongst bone fracture, fracture of lateral tibial condyle is most common and accounts for overall 16% cases, followed by fracture of lateral femoral condyle. Bone fracture distribution of involved bones in decreasing order as; lateral tibial condyle fracture (16%), lateral femoral condyle fracture (7%), medial tibial condyle fracture (4%), head of fibula fracture (4%), intercondylar tibial notch fracture (1%), comminuted tibial condyle fracture (1%).

Bony contusional edema was seen as discrete or confluent patches of T2/FS high signal intensity bony lesions. Involvement varies from patient to patient depending upon site of injury.

Table 7: Bone fracture distributions according to bony involvement

	Lateral condyle	Medical condyle	Other	Total
Tibia	16	4	Notch-1 Comu. #1	22
Femur	7	0		7
Fibular head	4			

DISCUSSION

Magnetic Resonance Imaging has gained popularity as a diagnostic tool of the musculoskeletal disorders, especially for the knee joint which is the most frequently examined joint and vulnerable to trauma in cases of accidents, sports related injury, fall on ground, twisting injury etc.^[1] Various types of soft tissue injuries like ligaments, meniscus, articular cartilage and tendon injuries, can be seen in cases of knee joint trauma. MRI is a non-invasive procedure and could affect the treatment of knee injuries, saving unnecessary arthroscopy and thus preventing all the potential complications of a surgical procedure. However, Arthroscopy is considered as "the gold standard" for diagnosis of intraarticular trauma in the knee.

In this study, total 100 patients were included, with history of the recent knee joint trauma. Majority of our study participants were males (78%), with male to female ratio 3.6: 1. 21 to 30 years age group was found to be the most common age group of patients having knee joint trauma, for both males and females, with frequency of injuries to be about 33 % in this age group. Similar findings were also noted in a study on MRI of internal derangements of knee conducted by Arjun Radhakrishnan et al,^[13] at Shri Sathya Sai Medical College and Research Institute, Chennai, Tamil Nadu in 2019. In this study, the author observed that majority of participants were males (70%) and majority of patients belonged to age group of 31-40 years. Similar findings were also noted by Ashok Srikar et al,^[14] in a study on MRI evaluation of internal derangement of knee in 2018, and by Chaudhari NH S et al,^[1] in a study on MR imaging of ACL injuries in 2017. In this study, it was found that out of 100 patients, 58 patients were having right knee joint trauma and 42 patients were having left right knee joint trauma. Similar findings were seen in the study conducted in 2018 by Ashok Srikar et al.^[14]

The third most commonly involved soft tissue is collateral ligaments, which is seen in 38% patients. The frequency of all other soft tissue injuries was as follows: ACL tear (64%), medial meniscus (32%), medial collateral ligament (25%), medial patellofemoral or medial patellar retinaculum

(20%), lateral meniscus (15%), lateral collateral ligament (13%), PCL (9%), and lateral patellofemoral ligament (5%) (Table -3, chart -3). Similar findings were noted by Umap, et al,^[15] in his study, in which the author noted that ACL (76%) injury is most common injury in cases of knee joint trauma, followed by medial meniscal injury (38%). Gupta, et al,^[1] in his study on clinicoradiological correlation in the diagnosis of ligament and meniscus injuries of knee joint in 2019, also noted that ACL tear is most common injury amongst ligaments and menisci, and is seen in 72% cases, followed by medial meniscus tears which are seen in 36% cases. Similar findings were also noted by Ashok Srikar et al,^[14] in a study in 2018, in which it was found that ACL injury was the commonest, followed by medial and lateral meniscus injuries, followed by collateral ligament tears which is 83.3%, 53.6% and 28.7% respectively. Similar findings were also noted by Arjun Radhakrishnan et al,^[13] he noted that ACL tear is most common and seen in 62% cases.

PCL injury is less common and seen in 9% of the cases. Common type of PCL injury seen is PCL avulsion with chip fracture from tibial attachment site and its proximal migration, which is found in 5% of the patients [Table 5, Figure 5]. Umap et al,^[15] in his study noted that out of total 100 patients, PCL injuries were detected in 15% of the cases. And in complete PCL tears, mid substance and avulsion tear are commonest (33.33%). Ikhlas O. Saeed,^[16] reported 5.9%, Arjun Radhakrishnan et al,^[13] reported 2%, and Ashok Srikar et al,^[14] reported 14.8% cases having PCL tear in his study.

CONCLUSION

Knee joint injury is common in patients presenting with history of road traffic accident, outdoor sports players, twisting of knee and fall on ground. For the diagnosis of soft tissue injury in patients of traumatic knee trauma, clinical examination along with radiographs, CT scan and ultrasound is not enough to diagnose soft tissue injury. Arthroscopy is considered as the gold standard for diagnosis of traumatic intra-articular knee lesions, but it also has limitations due to invasiveness and complications associated with surgical procedure.

From this study, it can be concluded that MRI is safe, non-invasive, radiation free diagnostic imaging modality to evaluate soft tissue injury associated with the knee joint trauma. It can clearly and accurately delineate injury of the soft tissues like ligaments, cartilage, tendon, and menisci, associated with knee joint trauma. It reduces unnecessary surgical, aesthetic and arthroscopic interventions as well as expenditure. Magnetic Resonance Imaging is a multiplanar imaging technique with excellent soft tissue contrast resolution and high efficacy and can be considered as best way to rapidly evaluate traumatic knee joint injuries.

REFERENCES

- Gupta K, Guleria M, Sandhu P, Galhotra R, Goyal A. Clinico-radiological correlation in the diagnosis of ligament and meniscus injuries at knee joint: A prospective study. *Saudi J Sports Med.* 2013;13(1):22-26.
- Singh N. International Epidemiology of Anterior Cruciate Ligament Injuries. *Orthop Res Online J.* 2017;1(5):1-3.
- Hazra M, Shaw R. Role of MRI in post-traumatic internal derangement of knee joint with arthroscopic correlation. *J Evolution Med Dent Sci.* 2019;8(21):1741-1746.
- Potter HG, Linklater JM, Allen AA, Hannafin JA, Haas SB. Magnetic resonance imaging of articular cartilage in the knee. An evaluation with use of fast-spin-echo imaging. *J Bone Joint Surg Am.* 1998;80(9):1276-84. doi: 10.2106/00004623-199809000-00005.
- MacMahon PJ, Palmer WE. A biomechanical approach to MRI of acute knee injuries. *AJR Am J Roentgenol.* 2011;197(3):568-77. doi: 10.2214/AJR.11.7026.
- Englund M, Guermazi A, Gale D, Hunter DJ, Aliabadi P, Clancy M, et al. Incidental meniscal findings on knee MRI in middle-aged and elderly persons. *N Engl J Med.* 2008;359(11):1108-15. doi: 10.1056/NEJMoa0800777.
- Graber MA, Dachs R, Darby-Stewart A. Clinical significance of meniscal damage on knee MRI. *Am Fam Physician.* 2011;83(10):1160-2.
- Kijowski R, Roemer F, Englund M, Tiderius CJ, Swärd P, Frobell RB. Imaging following acute knee trauma. *Osteoarthritis Cartilage.* 2014;22(10):1429-43. doi: 10.1016/j.joca.2014.06.024.
- Sikka RS, Dharmi R, Dunlay R, Boyd JL. Isolated fibular collateral ligament injuries in athletes. *Sports Med Arthrosc Rev.* 2015;23(1):17-21. doi: 10.1097/JSA.0000000000000044.
- Dodson CC, Slenker N, Cohen SB, Ciccotti MG, DeLuca P. Ulnar collateral ligament injuries of the elbow in professional football quarterbacks. *J Shoulder Elbow Surg.* 2010;19(8):1276-80. doi: 10.1016/j.jse.2010.05.028.
- De Smet AA. How I diagnose meniscal tears on knee MRI. *AJR Am J Roentgenol.* 2012;199(3):481-99. doi: 10.2214/AJR.12.8663.
- Bansal N, Kaur N, Sandhu KS. Role of MRI in the Evaluation of Painful Knee Joint. *International Journal of Anatomy. Radiol Surg.* 2018;7(3):27-30.
- Sharma UK, Shrestha BK, Rijal S, Bijukachhe B, Barakoti R, Banskota B, et al. Clinical, MRI and arthroscopic correlation in internal derangement of knee. *Kathmandu Univ Med J (KUMJ).* 2011;9(35):174-8. doi: 10.3126/kumj.v9i3.6300.
- Matsui N, Kobayashi M. Application of MR imaging for internal derangement of the knee (orthopedic surgeon' view). *Semin Musculoskelet Radiol.* 2001;5(2):139-41. doi: 10.1055/s-2001-15669.
- Khanal UP, Das D, Shrestha BR. Imaging Anatomy of Normal Knee Joint using 3.0 T MRI- A pictorial review. *Nepal Med J.* 2019;01(02):109-18
- Saeed IO. MRI Evaluation for Post-Traumatic Knee Joint Injuries. *J Nurs Health Sci.* 2018;7(2):48-51.