

Research Article

MRI Evaluation of Common Peroneal and Posterior Tibial Nerve Injuries and Their Association with Ligamentous Injuries in Traumatic Knee Using Conventional MRI Sequences

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Abstract: **Introduction:** Traumatic knee injuries frequently involve complex damage to ligaments, meniscal, and osseous structures. Peripheral nerve injuries, particularly involving the common peroneal nerve (CPN) and posterior tibial nerve (PTN), are often under-recognized on routine knee MRI despite their significant clinical implications. **Purpose:** To determine the prevalence of CPN and PTN injuries in traumatic knee cases and to evaluate their association with ligamentous and meniscal injuries using conventional MRI sequences. **Methods:** This retrospective observational study included 200 patients who underwent MRI for acute or subacute traumatic knee injuries. MRI examinations were performed on a 3-Tesla scanner using standard knee protocols without dedicated MR neurography. The CPN and PTN were assessed for signal alteration, enlargement, fascicular disruption and associated muscle denervation changes. Ligamentous injuries (ACL, PCL, MCL, LCL, and posterolateral corner) and meniscal injuries were systematically evaluated and graded. Associations between nerve injuries and ligamentous or meniscal pathology were analyzed using appropriate statistical tests. **Results:** The study population showed male predominance (61%) with a mean age of 36.74 ± 13.36 years, most commonly affecting the 21–30-year age group. ACL injuries were the most frequent ligamentous injuries (85%), followed by MCL (43%), LCL (30.5%), and PCL (25%). Medial and lateral meniscal injuries predominantly involved the posterior horn, with Grade II tears being most common. CPN injury was more prevalent than PTN injury, with mild, moderate, and severe CPN injuries identified in 29.5%, 18.0%, and 2.0% of patients, respectively. PTN injuries were less frequent and predominantly mild. CPN injuries showed a strong association with lateral compartment and posterolateral corner injuries. **Conclusions:** Conventional knee MRI sequences are effective in detecting clinically significant CPN and PTN injuries when a systematic nerve evaluation is performed. Routine assessment of peripheral nerves, particularly the CPN, should be emphasized in traumatic knee MRI to facilitate early diagnosis and optimize patient management.

Keywords: Cholelithiasis; Gallstone disease; Laparoscopic cholecystectomy; Postoperative complications; Surgical outcome; Ultrasonography findings

INTRODUCTION

Traumatic injuries of the knee are common and frequently involve complex damage to ligamentous, meniscal, osseous, and soft-tissue structures. While ligamentous injuries such as anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), collateral ligaments, and posterolateral corner (PLC) injuries are routinely evaluated on magnetic resonance imaging (MRI), associated peripheral nerve injuries are often under-recognized in routine imaging practice. Among these, the common peroneal nerve (CPN) and posterior tibial nerve (PTN) are particularly vulnerable in knee trauma due to their close anatomical relationship with the fibular neck, posterolateral structures, and posterior compartment of the knee. Failure to identify nerve involvement may result in delayed diagnosis, inappropriate management, and poor functional

outcomes, including persistent motor deficits and sensory impairment.[1–3]

Peripheral nerve injuries following trauma are traditionally classified using the Seddon and Sunderland grading systems, which describe a spectrum ranging from transient conduction block (neurapraxia) to complete nerve transection (neurotmesis).[4,5] Although clinical examination and electrophysiological studies remain important, they have limitations in early injury detection and in differentiating the severity of nerve damage, particularly in the acute and subacute stages. MRI has emerged as a valuable non-invasive modality for evaluating peripheral nerve injuries by demonstrating nerve enlargement, altered signal intensity, fascicular disruption, perineural edema, and secondary muscle

denervation changes.[6,7] While magnetic resonance neurography (MRN) provides high-resolution nerve imaging, conventional MRI sequences, which are widely available in routine knee protocols, have been shown to reliably detect clinically significant nerve injuries.[8] The common peroneal nerve is especially susceptible to injury in knee trauma, particularly in association with posterolateral corner injuries, multiligamentous injuries, and fibular head fractures. Recent MRI-based studies have demonstrated a significant prevalence of CPN abnormalities in acute and subacute PLC injuries, emphasizing the need for systematic evaluation of the nerve during knee MRI interpretation.[9,10] MRI can also identify denervation changes in the anterior and lateral compartment muscles, which serve as indirect but sensitive indicators of nerve injury, often preceding definitive electrophysiological findings.[11] In contrast, injury to the posterior tibial nerve in knee trauma has been less frequently studied, despite its potential involvement in high-energy injuries and posterior knee compartment trauma.

Given the increasing reliance on MRI for comprehensive assessment of traumatic knee injuries, there is a growing need to emphasize routine evaluation of peripheral nerves using standard MRI sequences and to understand their association with ligamentous injuries. The present study aimed to evaluate MRI features of common peroneal and posterior tibial nerve injuries in patients with traumatic knee injuries and to analyze their association with concomitant ligamentous injuries using regular MRI sequences, thereby highlighting the importance of integrated nerve assessment in routine knee MRI reporting.

METHODOLOGY

This retrospective observational study was conducted by a 20 years experienced musculoskeletal radiologist on 200 patients who underwent MRI of the knee for evaluation of traumatic knee injuries during the study period. Patients with a history of acute or subacute knee

trauma and availability of complete MRI examinations were included in the study. Exclusion criteria comprised prior knee surgery, known peripheral neuropathy unrelated to trauma, space-occupying lesions around the knee, inflammatory arthropathy, or suboptimal MRI studies that precluded adequate evaluation. Demographic details including age and sex were recorded for all patients. The study was approved by the institutional ethics committee, and patient confidentiality was maintained throughout the study.

MRI examinations were performed using standard knee MRI protocols on a 3 Tesla MRI scanner and included conventional sequences such as axial, sagittal, and coronal T1-weighted, T2-weighted, and fat-suppressed or short tau inversion recovery (STIR) images. No dedicated magnetic resonance neurography sequences were used. The common peroneal nerve was evaluated along its course in the popliteal fossa, at the fibular neck, while the posterior tibial nerve was assessed in the posterior compartment of the knee and proximal leg. Nerve injury was identified based on abnormal nerve enlargement, altered signal intensity on fluid-sensitive sequences, loss of normal fascicular architecture, perineural edema, and indirect evidence of injury in the form of muscle denervation changes. Where applicable, nerve injuries were categorized according to imaging correlates of the Seddon and Sunderland classification systems into neurapraxia, axonotmesis, or neurotmesis. Associated ligamentous injuries—including anterior cruciate ligament, posterior cruciate ligament, medial collateral ligament, lateral collateral ligament, and posterolateral corner structures—were systematically evaluated and documented. Meniscal injuries involving the medial and lateral menisci were assessed for presence and grade. The prevalence of common peroneal and posterior tibial nerve injuries was calculated. Associations between nerve injuries and ligamentous or meniscal injuries were analyzed using appropriate statistical tests, including the Chi-square test or Fisher's exact test, with a p-value of <0.05 considered statistically significant. Statistical analysis was performed using standard statistical software.

RESULTS

A total of 200 patients with traumatic knee injuries were included in the study. The age–sex distribution is summarized in Table 1. The study population comprised 122 males (61.0%) and 78 females (39.0%), indicating male predominance. The most affected age group was 21–30 years, accounting for 115 patients (57.5%), followed by 31–40 years (33 patients; 16.5%) and 41–50 years (26 patients; 13.0%). Patients aged <20 years and 51–60 years constituted 7.5% and 5.5%, respectively. Descriptive statistics for age are presented in Table 2. The overall mean age was 36.74 ± 13.36 years. Males had a mean age of 35.03 ± 13.81 years, while females were slightly older with a mean age of 39.41 ± 12.25 years.

Table 1. Age-sex distribution:

Age (years)	Gender				Total	
	Male		Female		n	%
	n	%	n	%		
<20	12	6.0%	3	1.5%	15	7.5%

30	21-	74	37.0%	41	20.5%	115	57.5%
40	31-	15	7.5%	18	9.0%	33	16.5%
50	41-	14	7.0%	12	6.0%	26	13.0%
60	51-	7	3.5%	4	2.0%	11	5.5%
Total		122	61.0%	78	39.0%	200	100.0%

Table 2. Descriptive statistics for age (years):

Gender	N	Mean	SD
Male	122	35.03	13.81
Female	78	39.41	12.25
Total	200	36.74	13.36

MRI-based grading and frequency of ligament injuries are detailed in Table 3. ACL injuries were the most common, identified in 170 patients (85.0%), with Grade I tears being the predominant pattern (44.5%), followed by Grade III (20.0%) and Grade II (19.5%) injuries; avulsion was rare (1.0%). PCL injuries were observed in 50 patients (25.0%), most commonly Grade I (17.5%). MCL injuries were present in 86 patients (43.0%), with a notable proportion of avulsion injuries (21.5%). LCL injuries were detected in 61 patients (30.5%), predominantly Grade I (26.0%), with no Grade III tears or avulsions identified.

Table 3. MRI-Based Grading and Frequency of ACL, PCL, MCL, and LCL Injuries in Traumatic Knee:

		ACL Injury		PCL Injury		MCL Injury		LCL Injury	
		N	%	N	%	N	%	N	%
Grade I	Gra	9	85.0%	5	17.5%	3	11.0%	2	26.0%
Grade II	Gra	9	19.5%	3	1.0%	1	5.0%	9	4.0%
Grade III	Gra	0	0.0%	8	4.0%	1	5.0%	0	0.0%
Avulsion	Avu	2	1.0%	4	2.0%	4	21.5%	0	0.0%
Total	Tota	170	85.0%	50	25.0%	86	43.0%	61	30.5%

The grade and location distribution of medial meniscal injuries is shown in Table 4. Among 106 medial meniscal tears, Grade II injuries were most frequent (53.8%), followed by Grade III (23.6%) and Grade IV (15.1%). The posterior horn was the most commonly involved site (85 cases), whereas root involvement was less frequent (5 cases), predominantly with Grade IV tears.

Lateral meniscal injuries (Table 5) were identified in 51 cases. Grade II tears were most common (72.5%), followed by Grade III (15.7%) and Grade IV (7.8%). Similar to the medial meniscus, the posterior horn was the most frequently involved location.

Table 4. Grade × Location Distribution of Medial Meniscal Injuries (N = 106):

Grade	G	Posterior Horn		Anterior Horn		Body		Root		Total	
		N	%	N	%	N	%	N	%	N	%
Grade I	G	0	0.0%	1	1.1%	0	0.0%	0	0.0%	1	1.0%
Grade II	G	8	6.5%	4	4.4%	5	5.6%	0	0.0%	17	16.1%
Grade III	G	5	5.9%	1	1.1%	0	0.0%	0	0.0%	6	5.7%
Grade IV	G	5	5.9%	4	4.4%	5	5.6%	0	0.0%	14	13.2%
Total	Tota	106	100.0%	106	100.0%	106	100.0%	106	100.0%	106	100.0%

Grade III	0	3.5%	2	2.2%	2	2.2%	2	0.0%	5	3.6%	2	
Grade IV	2	4.1%	1	0.0%	0	0.0%	0	0.0%	8	6	5.1%	1
Total	5	00.0%	1	00.0%	1	00.0%	1	00.0%	1	06	00.0%	1

Table 5. Grade × Location Distribution of Lateral Meniscal Injuries (N = 106)

Grade	Gr	Posterior		Anterior		Body		Root		Total	
		Horn	%	Horn	%		%		%		%
Grade I	Gr		0.0%	7%	6.	0%	20.	0%	0.		3.9%
Grade II	Gr	3	79.3%	0	6.7%	0%	80.	0%	0.	7	5%
Grade III	Gr		20.7%		3.3%		0.0		0.		15.
Grade IV	Gr		0.0%		3.3%		0.0		1		7.8%
Total	To	9	100.	5	00.0%	0	100	0	1	1	0.0%

Selected MRI findings and peripheral nerve injuries are summarized in Table 6. Common peroneal nerve (CPN) injury was more frequent than posterior tibial nerve involvement, with mild CPN injury seen in 59 patients (29.5%), moderate in 36 (18.0%), and severe in 4 (2.0%). Posterior tibial nerve (PTN) injury was identified as mild in 18 patients (9.0%) and moderate in 2 patients (1.0%).

Associated findings included popliteal tendon (POP T) injuries (Grade I: 4.0%, Grade II: 1.5%), popliteofibular ligament injuries (Grade I: 6.0%, Grade II: 2.5%), and lateral compartment fluid (23.0%). Joint effusion was common, noted as mild in 44.0% and moderate in 24.5% of patients.

Table 6. Distribution of Selected MRI Findings and Peripheral Nerve Injuries in Traumatic

Knee:

		n	%
Popliteus Tendon	Grade I	8	0.04
	Grade II	3	0.015
Lateral Compartment Fluid	Mild	46	0.23
Popliteal fibular Ligament	Grade I	12	0.06
	Grade II	5	0.025
Nerve injury - PTN	Mild	18	0.09
	Moderate	2	0.01
Nerve injury - CPN	Mild	59	0.295
	Moderate	36	0.18
	Severe	4	0.02
Joint Effusion	Mild	88	0.44
	Moderate	49	0.245

The distribution of osseous injuries and associated MRI findings is presented in Table 7. Marrow contusions without fracture were observed in 30 patients (15.0%), with a predominance of lateral compartment–predominant contusions (13.0%), followed by medial compartment–predominant (7.0%) and bicompartamental contusions (5.0%). Among fractures, the most common sites were the tibia/tibial condyle/tibial plateau (6.0%), followed by the fibular head/fibula (4.0%), femoral condyle (3.0%), and patella (2.5%); combined tibia–fibula fractures accounted for 2.0%. Additional MRI findings included chondromalacia patella across all grades, most frequently Grade IV (3.0%), followed by Grade I (2.5%), Grade II (2.0%), and Grade III (1.0%). Other less frequent findings included medial retinacular injury, popliteus tendon injury, ganglion cyst of the popliteus tendon, posterior femoral exostosis, and mucoid degeneration of the ACL, each observed in 0.5% of cases.

Table 7. Distribution of Osseous Injuries and Associated MRI Findings in Traumatic Knee:

		n	%
Osseous Injury Category	Marrow contusion without fracture	30	15.0%
	Lateral compartment–predominant contusions (lateral femoral/tibial condyle)	26	13.0%
	Medial compartment–predominant contusions	14	7.0%
	Bicompartamental contusions	10	5.0%
Site	Tibia / Tibial condyle / Tibial plateau	12	6.0%
	Fibular head / fibula	8	4.0%
	Femoral condyle	6	3.0%
	Patella	5	2.5%
	Combined tibia–fibula fractures	4	2.0%
Additional findings	Chondromalacia patella Grade I	5	2.5%
	Chondromalacia patella Grade II	4	2.0%
	Chondromalacia patella Grade III	2	1.0%
	Chondromalacia patella Grade IV	6	3.0%
	Medial retinacular injury (Grade I)	1	0.5%
	Popliteus tendon injury (Grade I)	1	0.5%
	Ganglion cyst – popliteus tendon	1	0.5%
	Posterior femoral exostosis	1	0.5%
	Mucoid degeneration of ACL	1	0.5%

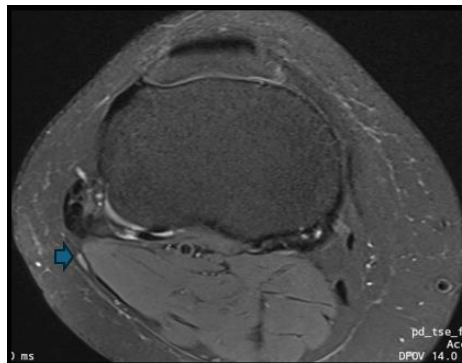


Figure 1a. Axial PDFS weighted MRI sequence with fat saturation, showing CPN neurapraxia . Note the increased signal intensity in the CPN (arrow).

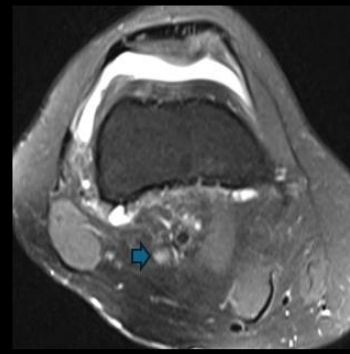


Figure 1b. Axial PDFS weighted MRI sequence with fat saturation, showing PTN neurapraxia . Note the increased signal intensity in the PTN (arrow).

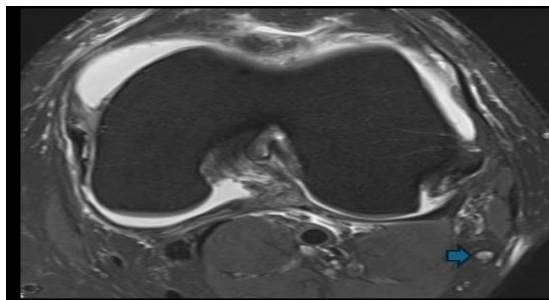


Figure 2a. Axial PDFS weighted MRI sequence with fat saturation, showing CPN axonotmesis. Note the increased signal intensity, clearly increased dimensions, and poorly defined fascicles in the CPN (arrow).

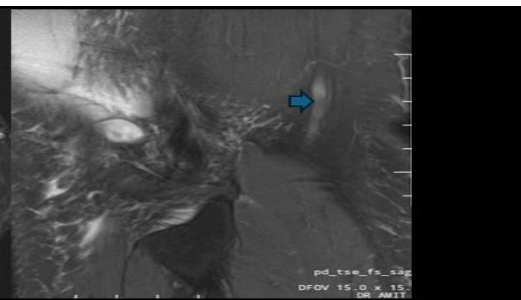
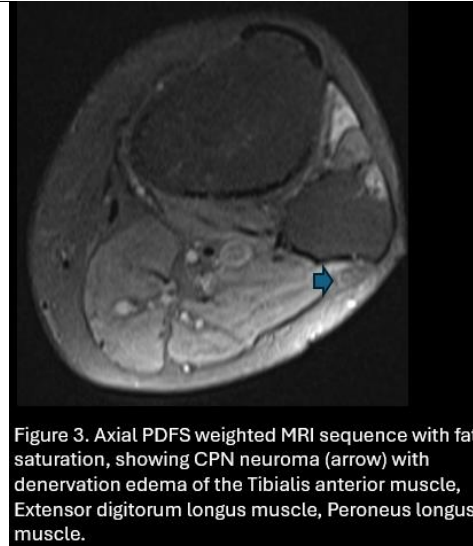


Figure 2b. Sagittal PDFS weighted MRI sequence with fat saturation, showing CPN axonotmesis. Note the increased signal intensity, clearly increased dimensions, and poorly defined fascicles in the CPN (arrow).



DISCUSSION

Traumatic injuries of the knee often result in complex involvement of ligamentous, meniscal, osseous, and neurovascular structures. In the present study, traumatic knee injuries were most frequently observed in young adults with a male predominance, reflecting exposure to high-energy mechanisms such as road traffic accidents and sports-related trauma. Ligamentous injuries, particularly involving the ACL, MCL, and posterolateral corner (PLC), were common. Previous biomechanical and anatomical studies have demonstrated that the PLC plays a critical role in resisting varus stress, external rotation, and posterior tibial translation, making it particularly vulnerable in high-energy trauma.[1–3] The frequent coexistence of ligamentous injuries in our cohort highlights the need for comprehensive MRI assessment beyond isolated ligament evaluation.

A key finding of this study is the higher prevalence of common peroneal nerve (CPN) injury compared to posterior tibial nerve (PTN) injury. This observation is anatomically and biomechanically well explained. The CPN is tethered around the fibular neck and lies in close proximity to the PLC structures, including the fibular collateral ligament and popliteus tendon, rendering it susceptible to traction and compression during PLC and multiligamentous injuries.[3,10] Previous MRI-based studies have similarly demonstrated a strong association between acute and subacute PLC injuries and CPN abnormalities, even in the absence of overt clinical neuropathy.[8,9] In contrast, PTN injuries were less frequent and generally milder, consistent with its deeper location and relative protection within the posterior compartment.

Peripheral nerve injury classification in this study was guided by MRI correlates of the Seddon and Sunderland grading systems, which describe a spectrum from neurapraxia to neurotmesis.[4,5] Advances in imaging have enabled MRI and MR neurography to bridge the gap between clinical examination and

electrophysiological testing by allowing direct visualization of nerve signal alteration, enlargement, fascicular disruption, and perineural edema.[6,7] Importantly, our study demonstrates that conventional knee MRI sequences, without dedicated MR neurography, were sufficient to identify clinically relevant nerve injuries. This finding is in agreement with prior literature emphasizing the applicability of routine MRI in early diagnosis of CPN injury, particularly in traumatic settings.[7–9]

Muscle signal alterations observed in this study were predominantly traumatic in nature, with only a small proportion suggestive of denervation-related edema. MRI features of muscle denervation, including diffuse T2 hyperintensity with preserved muscle architecture in the acute stage, have been well described and are valuable indirect markers of nerve injury.[11] The limited number of denervation-pattern changes in our cohort likely reflects early imaging in the acute or subacute phase of trauma. Recognition of such patterns is clinically important, as early identification of nerve injury can influence prognosis, guide surgical planning, and prevent delayed diagnosis leading to persistent functional deficits. Overall, the findings of this study underscore the importance of systematic evaluation of peripheral nerves, particularly the CPN, during routine knee MRI, especially in the presence of PLC or lateral compartment injuries.

CONCLUSION

Traumatic knee injuries are frequently associated with peripheral nerve involvement, particularly of the common peroneal nerve, which is often linked to posterolateral corner and lateral compartment injuries. Conventional knee MRI sequences are effective in detecting clinically relevant nerve injuries when a systematic evaluation of nerve anatomy and signal changes is performed. Early recognition of associated nerve, ligamentous, and meniscal injuries on routine

MRI is essential for appropriate management and improved functional outcomes.

Declarations:

●**abbreviations:** PTN(Posterior tibial nerve) , CPN(common peroneal nerve),ACL(Anterior cruciate ligament), PCL(posterior cruciate ligament),LCL(lateral collateral ligament), MCL(medial collateral ligament),

● **Intitutional ethics sub committee as provided the waiver letter which as been uploaded in the related file category. Institute name : Dr DY Patil Medical College and Research centre.** The study was done in compliance with the Helsinki Declaration. Informed Consent from everyone was taken at the time of starting the MRI procedure.

●**Consent for publication:** identifying images or other personal or clinical details of participants are not presented in the study and steps taken not to compromise anonymity

●**Availability of data and materials:** complete data collected to make this paper is provided in the form of excel sheet and is attached in additional supporting files

●**Competing Interests:** none

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