



Pattern of Bone Marrow Edema in Traumatic Knee and Its Association with Ligamentous Knee Injuries on Magnetic Resonance Imaging

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How to citation this article Dr Mohit E, Dr Sarath Yadav R, Dr Adithiya Krishnakumar, “Pattern of Bone Marrow Edema in Traumatic Knee and Its Association with Ligamentous Knee Injuries on Magnetic Resonance Imaging”, IJMACR- November - 2024, Volume – 7, Issue - 6, P. No. 108 – 111.

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Type of Publication: Original Research Article

Conflicts of Interest: Nil

Introduction

- Knee joint is most commonly affected by trauma. Post-traumatic knee results in a substantially lowered quality of life in predominantly young and physically active patients.
- Magnetic resonance (MR) imaging is an excellent means of evaluating knee for the presence of soft-tissue and bone abnormalities after trauma.
- Radiographically occult osseous injuries are frequently identified at MR imaging as poorly marginated altered signal areas in the cancellous bone and marrow. This appearance is thought to represent areas of hemorrhage, edema, or hyperemia secondary to trabecular injury.

- By studying the distribution of the edema, one can understand the mechanism of injury that occurred and thereby predict with accuracy the associated soft-tissue abnormalities that may be present.

Aims and Objectives

- To study the spectrum of bone marrow edema patterns in traumatic knee.
- To study the association of various ligamentous injuries with different bone marrow edema pattern.

Materials and Methods

- Cross-sectional, observational study
- Over a period of 12 months from September 2022 to October 2023

- Conducted in the Department Of Radiodiagnosis, A.J Institute Of Medical Sciences And Research Centre, Mangalore
- Imaging was performed Using Siemens Magnetom Symphony 1.5 Tesla Helium Cooled Superconducting MR Scanner

Inclusion Criteria

- Patients with recent history (<6 weeks) of trauma to knee and suspected ligamentous injury were included in the study.

Exclusion Criteria

- History of any co-existing infection, surgery or neoplasm of knee joint.
- Absolute contraindications for MR imaging that is patients having any prosthetic heart valve implant, any pacemaker implant, aortic stent graft, cochlear implant and claustrophobic patients.

Results

- A total of 160 post-traumatic MR knee examinations were done in 155 patients with bilateral knee studies in 13 patients.
- Marrow signal alterations were seen in 109 knee studies (64.8%).
 - The age of the patients ranged from 14-73 years.
 - Age group between 25-40 years had the maximum frequency of patients {51 cases (46.7%)}
 - 25 (22.9%) positive MR knee examinations were in females while 84 (77.0%) cases were in males.
 - Right knee injury was seen in 74 (68%) cases while left knee injury was seen in 35 (32%) cases.

Five patterns of marrow edema were observed:

Table 1:

Marrow Edema Pattern	Cases And Percentage	Most Common Ligamentous Injury
Pivot Shift Injury	56 (51.3%)	Acl Sprain Or Tear {48 Of 56 Cases (85.17%)}
Clip Injury	19 (17.4%)	MCL Sprain Or Tear {15 Of 19 Cases (78.9%)}
Dashboard Injury	13 (11.3%)	PCL Sprain Or Tear {10 Of 13 Cases (76.9%)}
Lateral Patellar Dislocation Injury	10 (9.1%)	MPLR Sprain Or Tear {9 Of 10 Cases (90%)}
Hyperextension Injury	4 (3.6%)	Acl Sprain Or Tear {2 Of 4 Cases (50%)}
Unclassified Pattern	5 (5.5%)	

Graph 1:

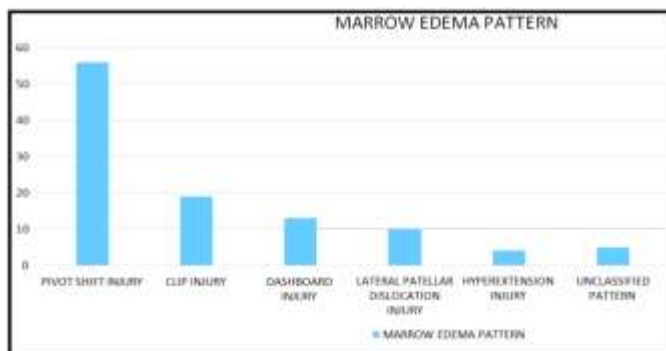


Figure 1: Pivot Shift Injury



Bone marrow edema in the postero-lateral aspect of tibia (arrow in middle image) and the lateral femoral condyle (arrow in right lateral image) with avulsion fracture of the anterior cruciate ligament (arrow in left lateral image).

Figure 2: CLIP Injury



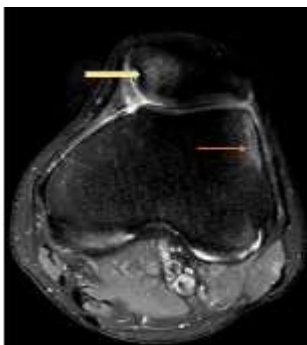
Marrow edema (thin arrow) seen at the lateral femoral condyle with sprain of the medial collateral ligament (thick arrow).

Figure 3: Dashboard Injury



Sequential PDFS Sag images showing complete mid-substance tear of the PCL (asterisk) with medially flipped medial meniscus body (curved arrow) and marrow edema of the anterior tibia (arrow).

Figure 4: Lateral Patellar Dislocation Injury



Marrow edema seen along the lateral femoral condyle (thin arrow) and the medial facet of patella (thick arrow) s/o patellar dislocation-relocation injury.

Figure 5: Hyperextension Injury



Marrow edema seen involving the medial femoral condyle (thin arrow) and the tibial plateau (thick arrow)

suggestive of kissing contusions in hyperextension injury.

Conclusion

- Pivot shift injury results from application of valgus load to the knee in various degree of flexion combined with external rotation of the tibia or internal rotation of the femur with resultant avulsion of Anterior Cruciate Ligament (ACL).
- Clip injury occurs after a pure valgus stress is applied to the knee while the knee is in a state of mild flexion.
- Dashboard injury occurs when force is applied to the anterior aspect of the proximal tibia while the knee is in a flexed position.
- Hyperextension injury of the knee results when direct force is applied to the anterior tibia while the foot is planted or from an indirect force, such as a forceful kicking.
- Patellar dislocation injury occurs when femur rotates internally on a fixed tibia on the flexed knee, contraction of the quadriceps occurs, leading to lateral dislocation of the patella out of the trochlear groove

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