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Original Research Article

Association of Meniscal and Cruciate Ligament Tears Using Magnetic Resonance Imaging of Knee

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Conflict of interest: Nil

Abstract:

Introduction: The menisci are crescent-shaped fibrocartilage located on the medial and lateral surfaces of the tibial plateau. Each meniscus is divided into three parts: an anterior horn, a body, and a posterior horn. The Anterior Cruciate ligament originates along the medial aspect of the posterior lateral femoral condyle within the intercondylar notch and inserts onto the tibial eminence, with fibres oriented parallel to the roof of the intercondylar notch when the knee is extended. It consists of two separate bundles: the anteromedial bundle and the posterolateral bundle. The posterior cruciate ligament originates from the lateral aspect of the medial femoral condyle within the anterior intercondylar notch and inserts distally on to the posterior tibial intercondylar fossa adjacent the root of the medial meniscus Advancement in MRI have improved the accuracy of detecting cruciate and meniscal tears which have helped in classification of injury and treatment accordingly. This study aims to present association between meniscal and cruciate ligament tears using MRI.

Materials and Methods: In a retrospective observational study conducted in a tertiary care hospital at department of radio diagnosis, All MRI knee scans conducted between January 2024 to June 2024 were analysed. After exclusion of digitally inaccessible, ill eligible and unclear records, total of 50 cases were selected.

Results: All the data collected was analysed using RevMan(R) Version 5.3 and P value <0.05 was considered statistically significant. The most common injured ligament was anterior cruciate ligament. (48%). Highest number of tears was found in the age group 20-29 years followed by 30-40 years and other subsequent age groups. Ligament injuries were more common in males (68%) compared to female (32%). Among the meniscal tear, Most commonly found tears were of medial meniscus (64.7%) and among the ACL tears partial thickness ACL tears were commoner (62%). There was evidence of significant association of lateral meniscal tears and ACL tears (P value < 0.05). No statistically significant association found between medial meniscus and ACL tears, medial meniscus and PCL tears and lateral meniscus and PCL tears.

Conclusion: The study emphasizes that tears of the menisci should be carefully looked for the presence of ACL tear, since they are commonly associated (especially lateral meniscal tears). This helps in repairing both the ACL and meniscal injuries in the same sitting, thereby reducing patient discomfort and improving patient care.

Keywords: NISCI, Cruciate Ligaments, Association Of Injury.

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Introduction

Normal anatomy and physiology of Menisci and Cruciate Ligaments: The menisci are crescent-shaped fibrocartilage located on the medial and lateral surfaces of the tibial plateau. Each meniscus is divided into three parts: an anterior horn, a body, and a posterior horn. Medial meniscus is broader than the lateral meniscus in antero-posterior dimension; therefore the weight nearing load in the medial compartment is distributed better. The lateral meniscus covers approximately 80% of the lateral tibial plateau surface. Their main function is to increase the stability of the knee joint, distribute axial load, and provide lubrication and nutrition to the joint. [1][2]

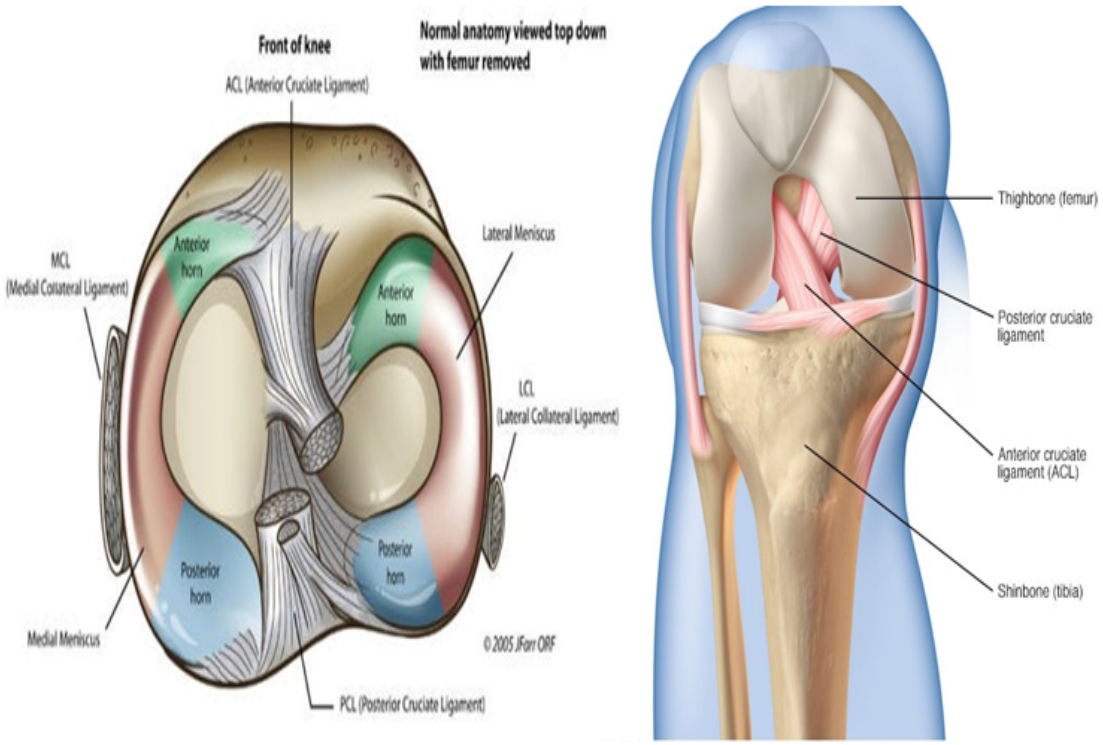

Figure 1: Illustrated images of Normal anatomy of menisci and cruciate ligament. (Image Courtesy: Mayo Clinic)

The Anterior Cruciate ligament originates along the medial aspect of the posterior lateral femoral condyle within the intercondylar notch and inserts onto the tibial eminence, with fibres oriented parallel to the roof of the intercondylar notch when the knee is extended. It consists of two separate bundles: the anteromedial bundle and the postero-lateral bundle. The postero-lateral bundle originates more distally and is more obliquely oriented than the anteromedial bundle [3] The anteromedial bundle prevent anterior tibial translation during flexion and postero-lateral bundle prevents anterior tibial translation during extension.

The Posterior cruciate ligament originates from the lateral aspect of the medial femoral condyle within the anterior intercondylar notch and inserts distally onto the posterior tibial intercondylar fossa adjacent the root of the medial meniscus. Function of posterior cruciate ligament is to limit posterior translation of the tibia as well as external rotation of the tibia.[4]

Role of MRI in Knee Imaging: MRI has become very useful tool over the years in evaluation of knee pathologies. Multiplaner imaging capability, excellent inherited soft tissue contrast, lack of beam hardening artefact, direct depiction of ligaments, tendons, bone marrow, cartilage are certain advantage offered by MRI compared to other imaging modalities. Advancement in MRI has improved the accuracy of detecting cruciate and meniscal tears which have helped in classification of injury and treatment accordingly. This study aims to present association between meniscal and cruciate ligament tears using MRI.

Materials and Methods

Patient selection: In a retrospective observational study conducted in a tertiary care hospital at department of radio diagnosis, All MRI knee scans conducted between January 2024 and June 2024 were analysed. After exclusion of digitally inaccessible, ill eligible and unclear records, total of 50 cases were selected.

MRI Knee Protocol: MRI knee was performed adhering to guidelines provided by American College of Radiology for standard MRI knee examinations. [5] MRI protocols of the knee consisted of three orthogonal imaging planes of section (axial, coronal, and sagittal) with a combination of fluid-sensitive sequences, either T2-weighted (T2W) fat-saturated (FS) or proton density-weighted (PDW) FS sequences, or T1-weighted (T1W) non-fat-saturated (NFS) imaging. Coronal and sagittal PDW sequences were performed for detecting meniscal tears. Dedicated cartilage sensitive sequence was also obtained. Routine non contrast enhanced 3T knee MRI protocol was followed as shown in the following table.

Table 1: Routine non contrast enhanced 3T knee MRI protocol

Sequence	TR (ms)	TE (ms)	Slice thickness (mm)	FOV (mm)
Sagittal PD FS	3000	37	3.0	140
Sagittal T1 FS	600	17	3.0	140
Coronal PD FS	2990	37	3.0	140
Axial PD FS	5480	37	3.0	150

FOV – field of view, FS – fat-suppressed, PDW – proton density-weighted, TE – echo time, TR – repetition time

Discussion

Imaging Findings of MRI knee in Menisci and Cruciate ligament tears: Meniscal tears are commonly divided into horizontal, longitudinal (vertical) and radial tears. Additional tears are oblique, parrot beak, vertical flap, horizontal flap, meniscal root, and bucket handle tears, which are usually displaced fragment variations of the horizontal, longitudinal and radial tears. When there is more than one component present, it is termed as complex tears. The horizontal tear runs parallel to the articular surface and contacts either the superior or inferior articulating surface of the meniscus or its inner free edge [6] these tears are often age related. Flap tears are displaced horizontal tears. Longitudinal tear are usually traumatic and runs perpendicular to the articular surface. They tend to involve the peripheral zone and occur in the posterior horn. Displacement of a vertical tear of the meniscus is known as a bucket handle tear, which more commonly occurs in the medial meniscus.

A radially oriented tear also runs perpendicular to the articular surfaces of the menisci. However, these tears run along the meniscal short axis, perpendicular to the longitudinally oriented fibres of the meniscus. A radially oriented tear involving the posterior meniscal root is often referred to as a meniscal root tear or meniscal root avulsion [6]

A type of vertical tear that progresses obliquely from a radially oriented tear at the inner free edge of the meniscus to a longitudinally oriented tear closer to the periphery is often termed a “parrot beak” tear.

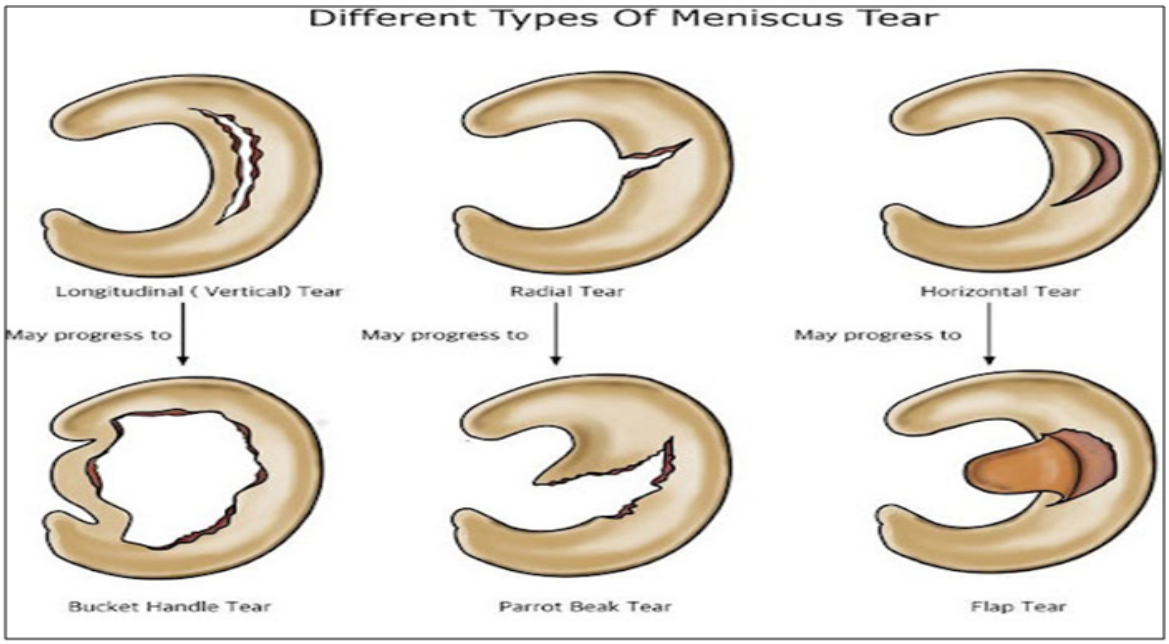

Figure 2: Illustrated image of types of different meniscal tears

Anterior cruciate ligament tears can be partial tear or complete tear. ACL is the most commonly injured knee ligaments. With a sensitivity of 90-100% and specificity of 82-100% for the diagnosis of ACL tears; Knee MRI has quickly become the best explorative technique of ACL currently. Increased signal on T2 or fat-saturated images, Discontinuity of fibres, empty notch sign and Abnormal ACL orientation relative to blumensaat line constitutes primary sign of ACL tear, which are pertaining to ligament itself. While secondary signs includes bone contusion in lateral femoral condyle and poster lateral tibial plateau, >7 mm of anterior tibial translation (also known as anterior drawer sign), uncovered posterior horn of the lateral meniscus, Bowing of PCL (reduced PCL angle <107^{o} or bowing ratio > 0.39) and lateral femoral sulcus deeper than 1.5 mm.

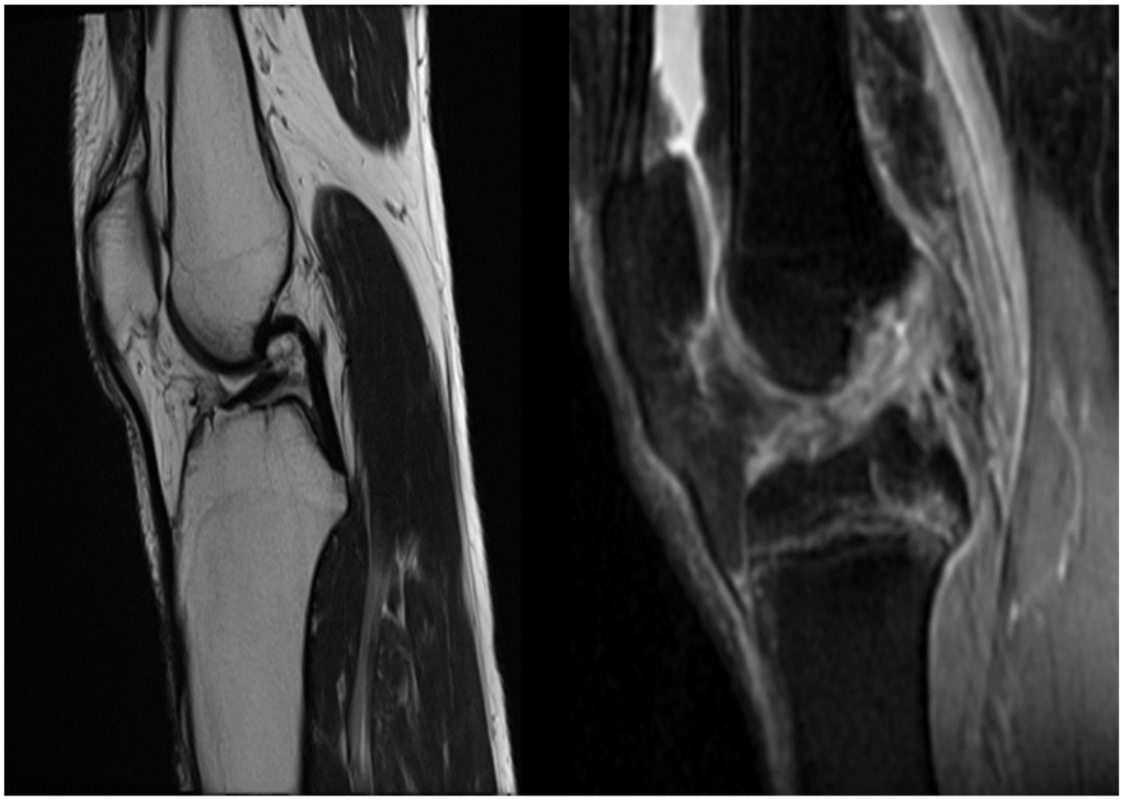

Figure 3: Sagittal T2 Weighted and PD images of 35 year old and 40 year old study participants demonstrating ACL tear. (High grade partial and Complete)

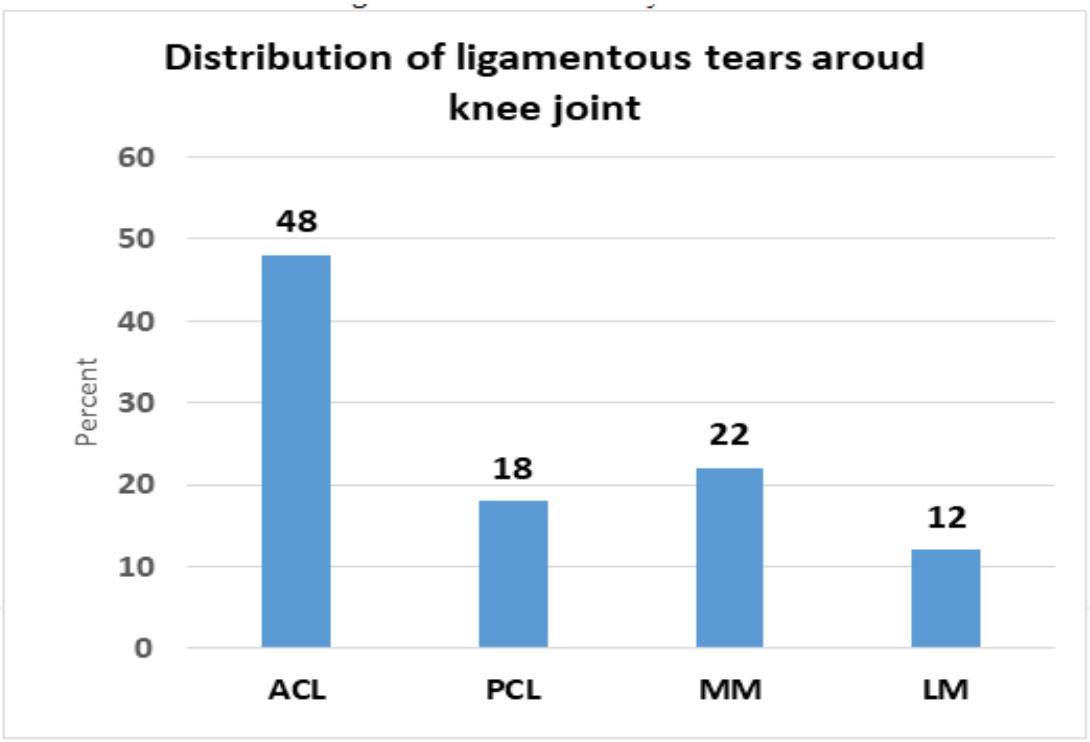

Figure 4: demonstrating Distribution of ligamentous tears around knee joint

Highest numbers of tears were found in the age group of 20-29 years followed by 30-40 years and other subsequent age groups. Ligament injuries were more common in males (68%) compared to female (32%).

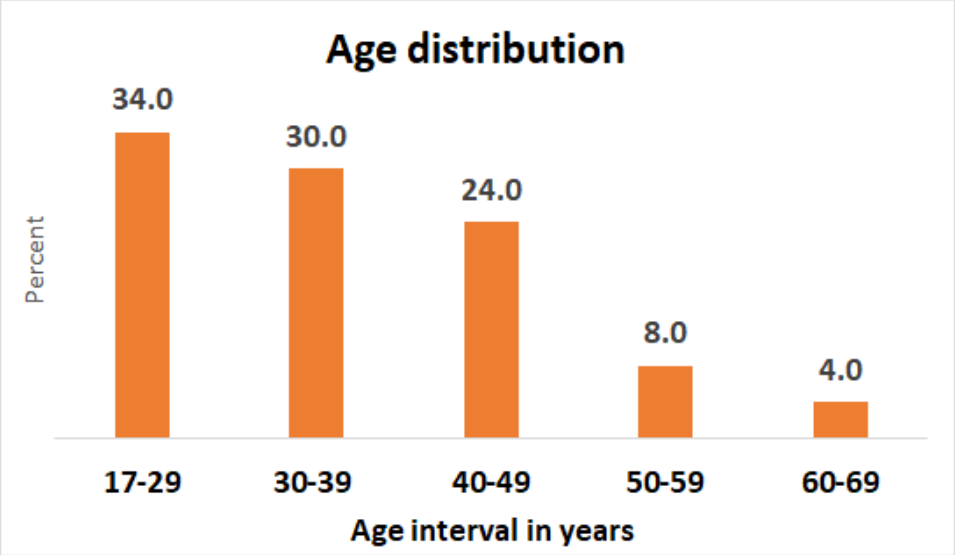

Figure 5: Demonstrating Age distributions of ligamentous tears around knee joint

Among the meniscal tear**,** Most commonly found tears were of medial meniscus (64.7%) and among the ACL tears, partial thickness ACL tears were commoner (62%).

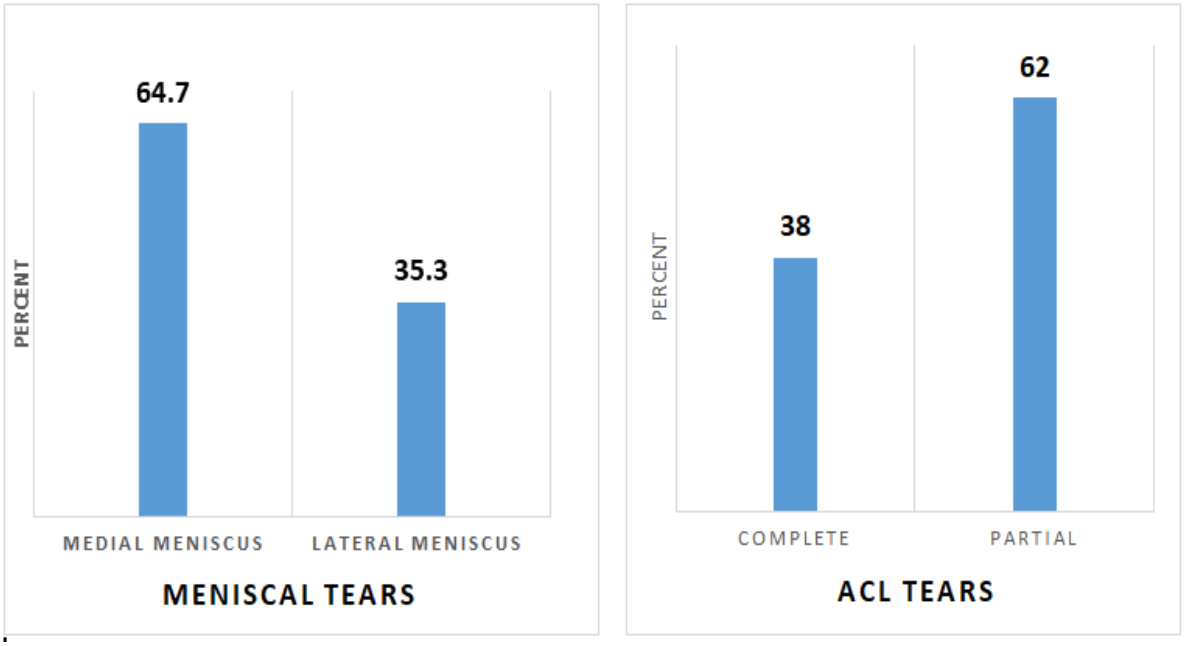

Figure 6: demonstrating distribution of meniscal tears and ACL tears

There was evidence of significant association between lateral meniscal tears and ACL tear (P value < 0.05). No statistically significant association was found between medial meniscus and ACL tears, medial meniscus and PCL tears and lateral meniscus and PCL tears**.**

Conclusion

The advancement in magnetic resonance imaging have made it possible to achieve greater detail in the diagnosis of knee joint pathologies. Commonly injured ligaments, their epidemiological distribution and their association described in the article emphasizes that tears of the menisci should be carefully looked for in the presence of ACL tear, since they are commonly associated (especially lateral meniscal tears). This helps in reparing both the ACL and meniscal injuries in the same sitting, thereby reducing patient discomfort and improves the patient care.

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