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Role Of USG And MRI In Knee Pathology

Author

Abstract
Background:
Magnetic resonance imaging (MRI) has been accepted as the best non-invasive imaging modality for the evaluation of knee joint pathology but the advantages of ultrasound (US) over magnetic resonance imaging (MRI) are that the ultrasound is readily available, cheap and offers real-time imaging.
Aim:
To assess the accuracy of ultrasound and MRI in diagnosing knee joint pathologies.
Materials And Methods:
30 patients were evaluated prospectively over a period of 2 years by USG followed by MRI of the affected knee.
Results*:*
In our study, the majority of patients were in age group 30-39 years. Perfect agreement was noted between ultrasound and MRI for detecting Baker's cyst. Near perfect agreement was noted between ultrasound and MRI for detecting joint effusion and soft tissue edema. Ligaments and tendon injuries were better diagnosed in MRI as compare to USG. However, USG provided better opportunity in bone and soft tissue mass for guided biopsy
Conclusion*:*
Knee USG has high accuracy in diagnosing pathologies like knee joint effusion, synovitis, popliteal/baker's cysts, soft tissue edema/cellulitis, arthritic changes, collateral ligament and meniscal tears.

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I. Introduction:

The stability and biomechanical function of the knee joint are governed by an intricate interplay between deep and superficial anatomical structures. High-resolution magnetic resonance imaging (MRI) and musculoskeletal ultrasound are integral imaging modalities in the radiologic evaluation of these components, offering complementary insights into both normal anatomy and a wide spectrum of pathologic conditions.

This study provides a focused review of key osseous, ligamentous, tendinous, and synovial structures, along with common joint abnormalities, emphasizing the respective merits, limitations, and diagnostic pitfalls of Ultrasound and MRI. For radiologists, a nuanced understanding of each modality's technical parameters and diagnostic yield is essential to optimizing image interpretation, improving diagnostic accuracy, and guiding appropriate clinical management of knee joint pathology. [1]

Magnetic resonance imaging (MRI) is the primary advanced technique for assessing knee joint issues due to its excellent soft tissue contrast and ability to detect intra-articular abnormalities. However, MRI can be expensive, and some patients may not be eligible for the procedure due to the presence of implanted devices [2].

In such cases, ultrasound (US) offers a more affordable alternative that can be used in point-of-care settings to examine many of the knee's superficial and some deeper structures. Additionally, US is often preferred for guiding therapeutic procedures and capturing dynamic images of the knee. Despite its accessibility, US is highly dependent on the skill of the operator and is less effective for evaluating deeper tissues or specific cartilage regions [3].

II. Materials And Methods:

The study comprised of 30 patients referred to the department of Radio-diagnosis at a tertiary care hospital with a clinical suspicion of knee pathology referred from orthopaedic department. First Ultrasonography and then Magnetic Resonance Imaging of the knee was performed on GE P7 Ultrasound machine and 1.5T SIEMENS MRI machine respectively at GCS Hospital, Ahmedabad over a period of 24 months from January 2023 to December 2024.

Inclusion criteria: - Patients referred for imaging due to signs and symptoms consistent with the clinical suspicion of Knee pathology.
-All age group.
-Both males and females.

Exclusion criteria: - Implanted electric and electronic devices, in particular - heart pacemakers (especially older types), insulin pumps, implanted hearing aids, neurostimulators, intracranial metal clips, metallic bodies in the eye, Metallic hip replacements, sutures or foreign bodies in other sites.

III. Results:

1) SOCIODEMOGRAPHICS:

A total of 30 cases were included in the study in which the predominant age group involved was between 30-39 year with a male to female ratio of 1.5:1.

Table 1: Sociodemographics.

Variable	Distribution	Number	Percentage
Age distribution	0-19	2	7
	20-29	6	20
	30-39	**10**	**33**
	40-49	6	20
	50-59	2	7
	>60	4	13
Sex distribution	Males	18	
	Females	12	
	M:F	**1.5:1**	

2) HISTORY OF TRAUMA:

Out of 30 cases, 21 patients had prior history of acute trauma preceded the symptomatology. A criterion for acute trauma was taken as any significant trauma to knee within six weeks of imaging.

Present	Absent
21	9

3) IMAGING FEATURE:

Out of 30 cases, there were 24 cases with tear and 6 cases without tear.

Pathology with Tear	Pathology without tear
24	6

Tears of various ligaments around the knee were identified involving either a single ligament or combination of ligaments.

ACL	PCL	MCL	LCL
12	2	6	7

Out of 12 ACL Tear, 9 patients had complete tear.

COMPLETE ACL TEAR	PARTIAL ACL TEAR
9	3

Out of 6 cases with final diagnosis other than tear majority were infective etiology.

PATHOLOGY	NUMBER
INFECTIVE ETIOLOGY	3
BONE AND SOFT TISSUE MASS	2
POPLITEAL CYST	1

4) COMPARISON OF USG AND MRI:

Ligaments and tendon injuries were better diagnosed in MRI as compare to USG.

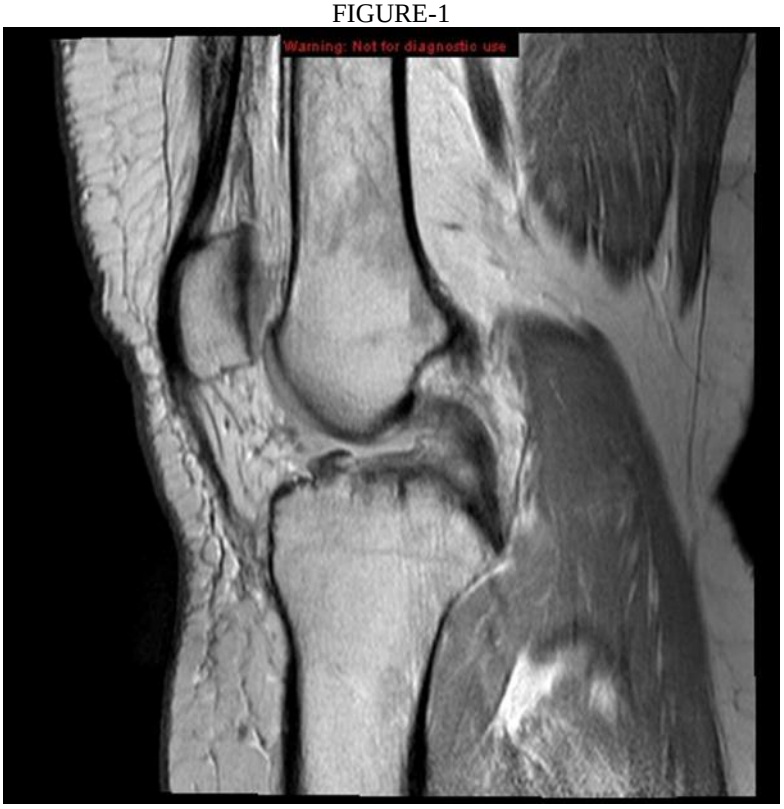
However, USG provided better opportunity in bone and soft tissue mass for guided biopsy and in popliteal cyst / Joint effusion for percutaneous drainage.

Table 2 : Sensitivity and specificity of USG and MRI.

Findings	USG		MRI	
	Sensitivity	Specificity	Sensitivity	Specificity
ACL Tear	55	80	90	95
PCL Tear	50	90	92	96
MCL Tear	83	95	95	95

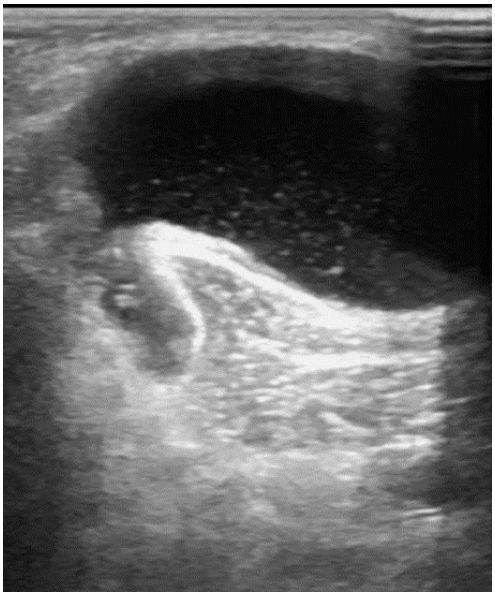
LCL Tear	75	94	90	97
MM Tear	70	90	95	92
LM Tear	75	94	91	96
Joint effusion	93	100	95	100
Soft tissue edema	86	100	88	100
Popliteal cyst	100	100	100	100
Osteoarthritis	70	94	92	98

FIGURE-1



Sagital section of PDFS sequence of knee joint shows hyperintensity replacing ACL ligament – suggest ACL Tear.

FIGURE-2



USG shows cystic lesion involving popliteal region – suggest Baker's cyst.

IV. Discussion:

Disruption of various ligaments and cartilage around the knee joint leads to significant morbidity, especially in young adults. Therefore imaging of this complex synovial joint becomes crucial to promptly identify the pathology affecting it.

In study done by Majewski et al,[4] acute traumatic injuries of knee were common in age group of 20-39 years. In our study acute traumatic injury to knee was found in 70% of cases out of which approx. 70% were from the age group 30-39 years.

In this study done 40% patient had ACL injury, out of 12 ACL tears, 75% was complete tear and 80% of them involved the mid substance. In study done by Mink et al [5] mid substance tear was demonstrated in 90% of ACL tears. The indirect signs of ACL tears were analysed.

Associated posterolateral corner injury was seen in majority cases of ACL tears. It is important to identify posterolateral corner injuries as unrecognized posterolateral injuries have been suggested as a cause of chronic instability of the knee after trauma and post-surgical failure of the cruciate ligaments.

Helms et al [6] reported that 10% of tears of medial meniscus were of bucket handle type. Our study also found similar occurrence of bucket handle tear (16%). The case of bucket handle tear of medial meniscus shows double PCL sign, where the displaced fragment was seen as a hypointense structure parallel to PCL on all sequences.

Features of osteomyelitis and septic arthritis was seen in 3 patients with evidence of synovial thickening , articular destruction with a possibility of Koch's in 2 patients.

V. Conclusion:

Ultrasonography (USG) and Magnetic resonance imaging (MRI) examination is a non invasive and precise diagnostic technique to evaluate ligamentous and other soft tissue structures around the knee. Appropriate sequences and analysis of images in all 3 planes increases the diagnostic yield. Most of the injuries to ligaments and menisci can be diagnosed with increased level of confidence.

Although arthroscopy has revolutionized the diagnosis and treatment of knee disorders, most orthopaedic acknowledge the invasiveness of the procedure: limitation in evaluation of extra-articular pathology; cost and uncommon but potential complication associated with the procedure. They acknowledge the accurate diagnostic imaging complementing their clinical evaluation and providing a global intra-articular and extra-articular assessment of the knee.

Clinicians utilize USG and MR imaging to support non-surgical management or to confirm injuries that benefit from arthroscopic or open surgical treatment. Technical improvements in arthroscopic instrumentation have paralleled the technical advances in MR imaging and have expanded the surgical procedures now performed by arthroscopy.

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