SONOLOGICAL EVALUATION OF MEDIAL KNEE INJURIES AND ITS COMPARISON WITH MAGNETIC RESONANCE IMAGING FINDINGS

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ABSTRACT:
OBJECTIVES:To assess the validity of ultrasound in the diagnosis of medial knee injuries in comparison with MRI findings.
MATERIALS AND METHODS: This study was a prospective study. Prospective patients with clinically suspected medial knee injuries scheduled for MRI of the knee wereevaluated by Ultrasound examination prior to the MRI. Sonographic findings were thencompared to MRI results.
STUDY DESIGN: Descriptive study with diagnostic test evaluation.
STUDY PERIOD: January 2020 to June 2021
STUDY SETTING: Department of Radiodiagnosis and Department of Orthopaedics, Govt. T D medical college Alappuzha - A tertiary care centre in Kerala.
STUDY POPULATION: Patients attending the department of Orthopaedics and referred to department of Radiodiagnosis of T.D. Medical College Alappuzha, who were clinically suspected to have medial knee injury, during the study period.
RESULTS AND DISCUSSION : 60 patients were enrolled in the study. 73.3% of the study population were males (44) and most of them belonged in their 2nd and 3rd decades. Most of the injuries were left sided [60%] and majority [65%] presented for radiological evaluation within 1 week to 1 month of history of injury.
Accuracy of ultrasound in the diagnosis of MCL and MM injuries were 86.7% and 85% respectively.US demonstrated 89.6% sensitivity and 75% specificity formedial collateral ligament (MCL) injuries and 85.3% sensitivity and 84.6% specificity formedial meniscus (MM)tears.The most frequent knee finding in this study was jointeffusion which was seen in 50(83.3%) patients.
CONCLUSION : USG gives high accuracy and specificity in the detection of MCL and MM injuries.Ultrasound may have a role as the initial rapid imaging modality in patients with suspected MCL or medial meniscus injuries and it may serve as an effectivelow-costscreening tool for patients with MM or MCL injuries and avoid performing the high cost MRI.

INTRODUCTION

The knee is one of the most active joints in humans and hence is very prone to injuries and knee pain is a pervasive difficulty that can affect all age groups. Internal derangement of the knee joint is a common cause of morbidity inthe young, active individuals like athletes. The ligaments constitute the major supporting framework of the knee joint. Due tolimited bony support, stability of the jointis highly dependent upon the ligaments, cartilages, tendons and menisci and the same are more prone to injuries. Early detection of cartilage and ligament injuries is crucial for early Intervention.

Direct trauma is one of the most common mechanisms for knee injury, and iscommonly seen in athletic injuries. When injury occurs, the superficial MCL is the mostcommonly damaged ligament of the knee, and is usually induced by valgus stress, and can be accompanied by a tear in the medial meniscus [1][2].

The most widely used investigations for assessing the knee internal derangement are arthroscopy and MRI [3]. Even though arthroscopy is considered as the gold standardfor diagnosis of traumatic intra-articular knee lesions, it has the disadvantage of being an invasive procedure requiring hospitalization and anaesthesia. Also, arthroscopy is associated with post procedure and anaesthetic complications.

Among the non-invasive investigations, MRI is the most accurate for detecting intra articular lesions of the knee. When compared with other diagnostic methods, MRI has the advantage of demonstrating the cartilages, bones, soft tissues and ligaments directly, in detail and in different planes. With the availability of the specialized extremity coil, the knee has become the most frequently studied articulation on MRI. However, MRI has the disadvantage of high cost, is not always available on demand, does not allow dynamic testing and is a rather lengthy imaging modality. Other limitations of using MRI, such as the presence of indwelling cardiac pacemakers, metal implants, patient intolerance due to claustrophobia and delay in treatment due to long wait periods.

Ultrasound on the other hand is an inexpensive, widely available and non-invasivetechnique which also allows dynamic imaging. Ultrasound has become anincreasingly utilized tool for the imaging of the musculoskeletal system, especially forimaging the components of the knee. The use of ultrasound has gained popularity given itsability for rapid diagnosis.

Ultrasonography offers several unique strengths over MR imaging, that make it a promising technique for the evaluation of certain disorders of the knee. First, USG has higher spatial resolution than MR imaging, which may be helpful in evaluating the superficial structures and popliteal fossa of the knee in detail. Second, USG allows for dynamic assessment, which can be particularly helpful in differentiating partial from complete tears involving the quadriceps and patellar tendons. Third, the ability to interact with patients during USG evaluation allows one to obtain a relevant history and guide the USG examination to identify the cause of specific patient complaints. USG also allows easy comparison with the contralateral knee, which can be very helpful for problem solving. Fourth, USG may be the modality of choice in evaluating patients with contraindications to MR imaging and claustrophobia. Finally, USG is lower cost than MR imaging and has the added advantage of portability. [4]

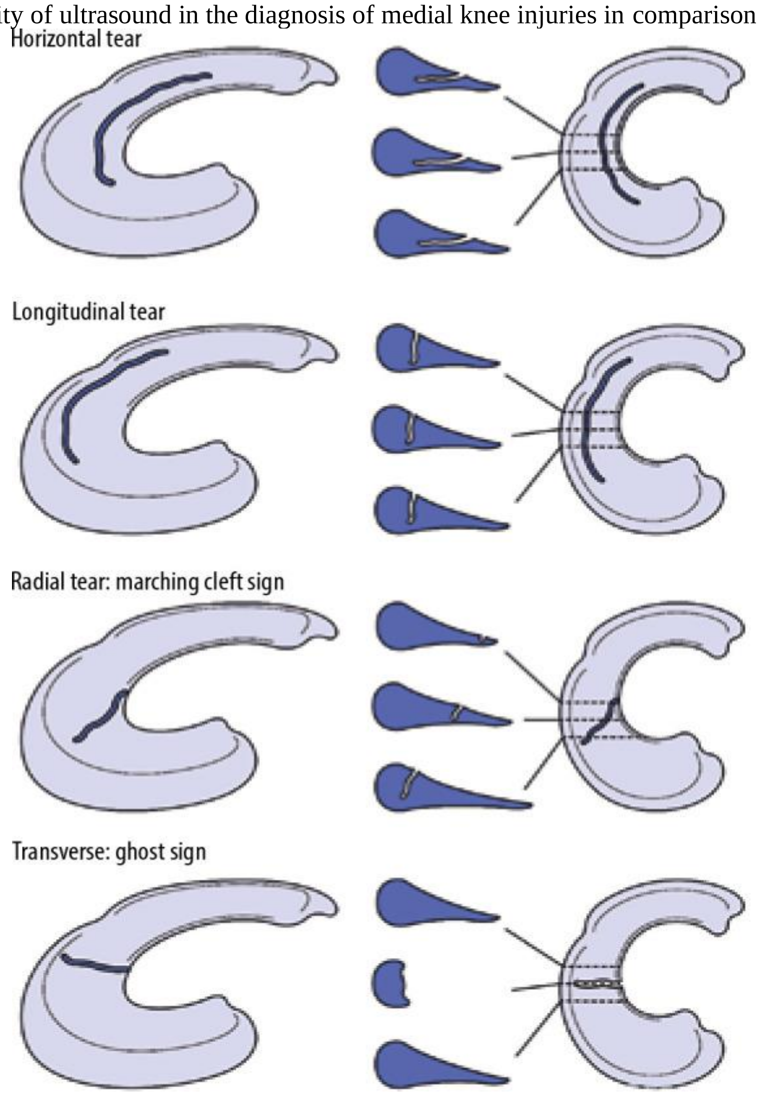
The primary limitation of USG of the knee is that it is operator dependent and requires proper training and experience for accurate image acquisition and interpretation. Further, limitations of USG include incomplete evaluation of the deep structures of the knee, particularly the cruciate ligaments, the menisci, and the majority of the articular cartilage. Especially for detection of abnormalities of cruciate ligaments, MR imaging remains the investigation of choice. USG, unlike MR imaging, cannot evaluate bone marrow oedema or intramedullary bone lesions. [4]

Medial collateral ligament is one of the most commonly injured ligaments of the knee and it mostly results from a valgus force in sport events, motor vehicle accidents or fall from height. MCL injury occurs either in isolation or together with other knee ligaments such as O'Donoghue unhappy triad or knee dislocations. Visualizing the MCL under ultrasound is relatively easy due to its superficial location, spanning from the medial femoral condyle to the medial tibial metaphysis. The MCL has two layers, a superficial and deep layer, with the deep layer being continuous with the medial meniscus. Because of this continuity of the deep layer of the MCL with the medial meniscus, they are often injured together. If not well diagnosed and treated, these injuries might end up with persistent instability, pain and loss of function [5,6]. Bucket handle meniscal tears causes profound pain and locking in patients and also is an indication of early surgery. Also,an early detection of these injuries is vital for early intervention to prevent further degeneration. An accurate and rapid diagnosis of injury to the MCL or medial meniscus is important so as to determine the treatment plan and whether immediate surgical intervention will be necessary

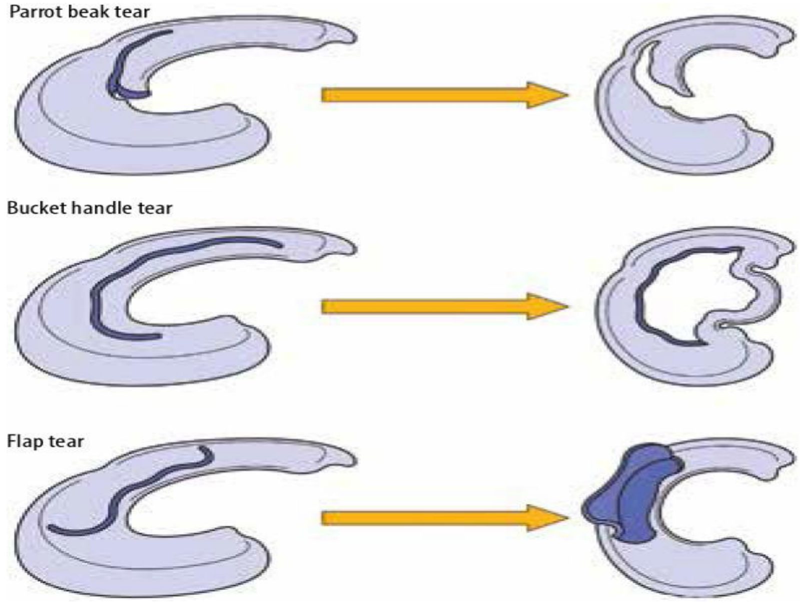
While there are a few studies in radiology literature that support the efficacy of ultrasound in identifying medial knee injuries, there is a paucity of literature that directly compares ultrasound to MRI. The primary aim of this study was to determine the validity of ultrasound in diagnosing medial meniscus and MCL injuries when compared to MRI.So, the purpose of this study was to assess the accuracy of sonographic examination for thedetection of medial knee injuries, taking MRI findings as the gold standard. And thereby toassess if sonography is an ideal screening tool to diagnose medial knee injuries and todetermine whether more detailed knee examination is warranted.

AIM AND OBJECTIVE

To assess the validity of ultrasound in the diagnosis of medial knee injuries in comparison with MRI findings.



Horizontal, longitudinal, radial, and transverse tears depicted in three-dimensional and cross-sectional drawings



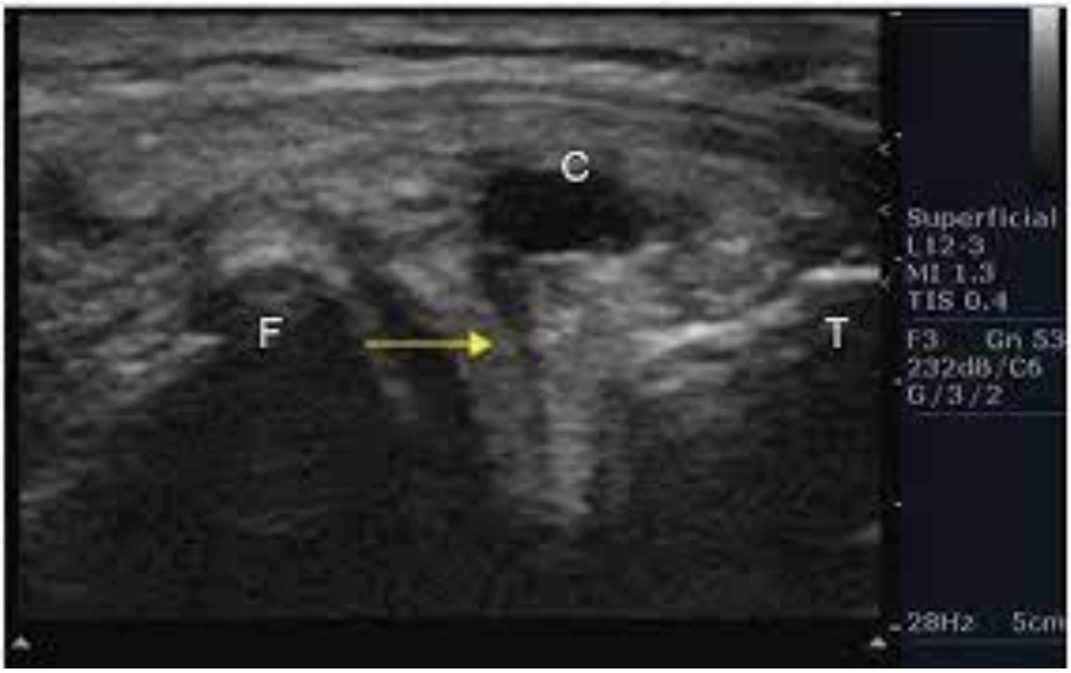
Meniscal tears with displaced fragments. Parrot beak, bucket handle, and flap tears in three-dimensional drawings.

USG EVALUATION:

The normal medial meniscus is identified as a triangular reflective structure between the femur and the tibia, with a homogeneous spotted internal matrix.

Sonographic findings of meniscal tears include a hypoechoic band or stripe that can be seen within the meniscus, resulting in heterogeneity of the meniscus [14]. The size and shape of the hypoechoic band will vary depending on the size, shape, and location of the meniscal tear. It should be noted that the posterior horn is usually larger than the anterior horn, and it is easier to visualize tears in the outer margin of the medial meniscus compared to the inner margin due to it being more superficial [14].

Meniscus degeneration: Loss of homogeneous internal echo structure, linear or nodular hypoechoic/echogenic areas which do not involve an articular surface.



Longitudinal view showing anechoic Parameniscal cyst (C) with hypoechoic tear (Arrow) involving the posterior horn of MM, Femur (F), Tibia (T)

RELEVANCE OF THE STUDY

The knee joint is one of the most vulnerable joint of the body and is commonly injured in trauma resulting in pain and instability. MCL injuries are one of the most common ligamentous injuries of the knee and may be seen as isolated injuries or associated with other ligamentous injuries such as ACL or MM injuries. The majority of MCL injuries, including some grade III injuries, have traditionally been conservatively treated. However, conservative treatment of MCL injury particularly in the setting of multi ligamentous injuries may result in chronic medial instability and predispose to failure of cruciate ligament reconstruction.

Accurate and timely diagnosis of a meniscal tear is critical for reducing morbidity and planning treatment. It is well established that meniscal damage predisposes the adjacent articular cartilage to increased axial and sheer stress, resulting in early degenerative osteoarthritis.

Hence an early detection of these injuries is vital for early intervention to prevent further degeneration. Magnetic resonance imaging (MRI) has been considered to be the best non-invasive imaging modality to diagnose medial knee injuries. However, there are significant limitations of using MRI, such as the presence of indwelling cardiac pacemakers, metal implants, patient intolerance due to claustrophobia and delay in treatment due to long wait periods [7,49,50]. As a result, recent studies have demonstrated musculoskeletal ultrasound as an alternative, non-invasive and real-time imaging modality to evaluate the injuries to the medial meniscus and medial collateral ligament (MCL) [1,50,51,52,53,54].

So the aim of my study was to assess the role of ultrasound in the evaluation of medial knee injuries in comparison withMRI and to determine whether ultrasound will serve as a useful screening tool to diagnose medialknee injuries.

METHODOLOGY

This study was a prospective study conducted at the department of radiodiagnosis.
Prospective patients with medial knee injury scheduled for an MRI of the knee were evaluated by Ultrasound examination prior to the MRI. Sonographic findings were then compared to MRI results.

STUDY DESIGN:

Descriptive study with diagnostic test evaluation.

Study period:

From January 2020 to June 2021

Study setting:

Department of Radiodiagnosis and Department of Orthopaedics, Govt. T D medical college Alappuzha - A tertiary care centre in Kerala.

Study population:

Patients attending department of Orthopaedics and referred to department of Radiodiagnosis of T.D. Medical College Alappuzha, who were clinically suspected to havemedial knee injury, during the study period.

INCLUSION CRITERIA

- All patients of age more than 18 years presenting with knee injuryand clinicallysuspected to have MCL or MM injuries.

EXCLUSION CRITERIA

- Contraindication for MRI such as cardiac pacemaker, cochlear implants, aneurysmal clips etc.
- Patients who are not willing to participate.
- Patients who have undergone prior knee surgery/arthroscopy.
- Patients with severe osteoarthritis.

SAMPLE SIZE AND SAMPLING METHOD

Sample size was calculated using the following formula:

$$\text{Sample size, } N = \frac{(1.96)^2 \times (\text{sensitivity}) \times (100 - \text{sensitivity})}{d^2}$$

According to the study by Gosh en et al[55], sensitivity was 90%.With the desired precision of 10%, N is calculated as 35. Taking prevalence as 60%, actual sample size is calculated as 58.3

Hence the sample size for this study is taken as 60.

All consecutive patients who are clinically suspected to have medial knee injury by the Orthopedician, referred to the department of Radiodiagnosis for MR imaging and satisfying the inclusion and exclusion criteria were enrolled for the study.

EQUIPMENT

a. Ultrasound Machine

GE VOLUSON E8 machine (GE healthcare, Milwaukee, USA) equipped with ML6-15 Broad spectrum linear matrix array transducer.

GE VOLUSON E-8 Machine

b. MRI SCANNER
Siemens MagnetomAera 1.5 tesla.

Siemens MagnetomAera1.5 Tesla Machine

TECHNIQUE:

MRI:

Patient preparation: The procedure was briefly explained to the patient and consent was taken. Detailed history for contraindication of MRI was specifically taken. They were provided with earplugs to minimize the noise within the MRI room**.**

MRI examination was done with 1.5 TeslaMagnetomAera MRI Machine using kneeextremity circumferential coil.

Magnetic resonance imaging protocol:

The following sequences were attained
PDFS Coronal, Axial and Sagittal,
PD Coronal, T1 Coronal, T1 Axial,
T2 Sagittal, Gradient T2 Sagittal (Sagittal taken with a 15 degree internal rotation axis)
3D Sagittal

Image interpretation:

MRI: All images are interpreted with adequate gray-scale center level and window width settings.

US EXAMINATON

US evaluation of the medial knee was performedwith high-frequency linear transducer with the patient in the supine position, with hip in external rotation.

Initial evaluation was done in the coronal plane by finding the MCL along the medial aspect of the joint line. This was done by placing the transducer along the knee in the true coronal plane and toggling the transducer anteriorly and medially until the bulky fibrillar tissue of the MCL was identified. The entire extent of the MCL was evaluated in the long and short axes.

STUDY PROCEDURE

A protocol was devised for the study and approval was obtained from the Institution Ethics Committee. Patients who presented to the Department of Radiodiagnosis for MRI examination with suspected MCL or MM injuries were recruited for the study. After obtaining an informed consent the patients were asked a brief history and subjected to USG evaluation, prior to the MRI. A proforma which included patient credentials, history, clinical findings and investigations were prepared.

MCL INJURIES:

In MRI , MCL injuries were graded as follows:

• Grade I – Lesions are defined as high signal intensity superficial to the MCL representing oedema, with intact MCL fibres.
• Grade II- Lesion in which fluid signal extend partially through MCL, although some fibres remain intact
• Grade III- Lesion with complete discontinuity of the MCL fibres seen along with surrounding oedema, consistent with a complete tear.

In USG, MCL ligamentous thickening and/or heterogeneous hypoechogenicity of the ligament was taken as MCL injury

MM TEAR

In MRI, linear high or intermediate signal intensity that extends to the superior and/or inferior articular surface of medial meniscus was taken as tear.

In USG focal hypoechoic or anechoic linear defects extending to the superior or inferior meniscus surfaces was taken as tear. Other findings such as abnormal meniscal morphology and secondary signs of meniscal injury such as parameniscal cyst and meniscal extrusion were also assessed.

DATA ENTRY

Data entry was done in Microsoft excel sheet.

DATA ANALYSIS

All the data collected were coded and entered in Microsoft Excel sheet which was re-checked and analysed using SPSS statistical software version 22. Quantitative variables were summarised using mean and standard deviation (SD). Categorical variables were represented using frequency and percentage. Diagnostic characteristics of USG were evaluated by comparing it with MRI and sensitivity, specificity, PPV, NPV, accuracy were found out. Pearson Chi-square test and Fisher's Exact test were used for comparing categorical variables between groups. A p value of <0.05 was considered statistically significant.

RESULTS

Total Number of subjects (N): 60

1. **AGE GROUP**

Table 1: Frequency distribution of Age

Age group-	no(%)
0-20 years	2(3.3)
21-40 years	32(53.3)
41-60 years	26(43.3)

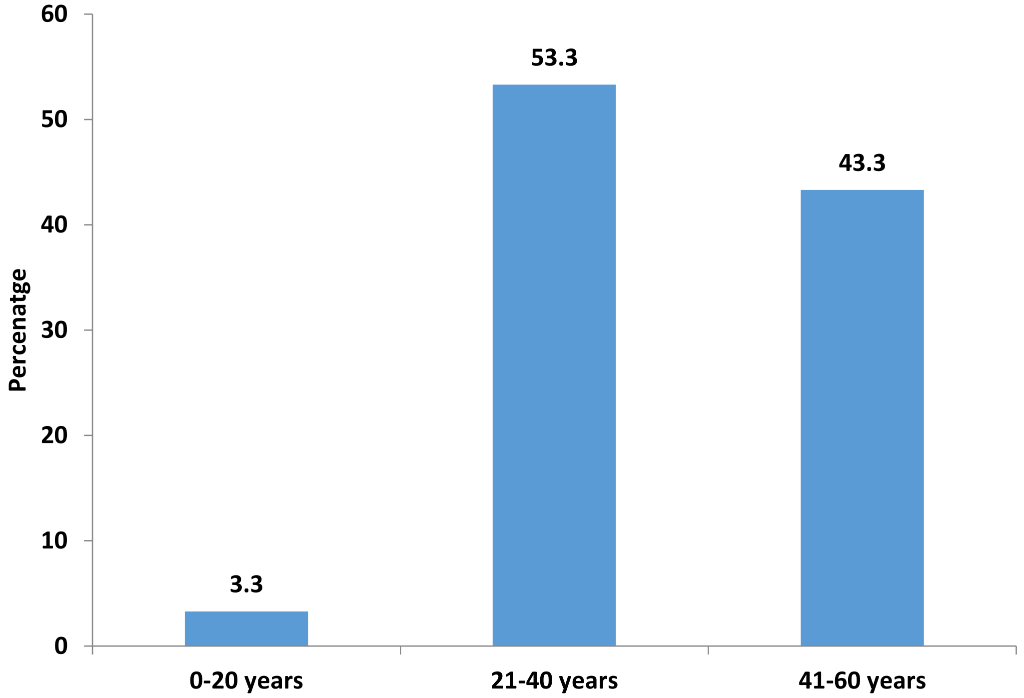
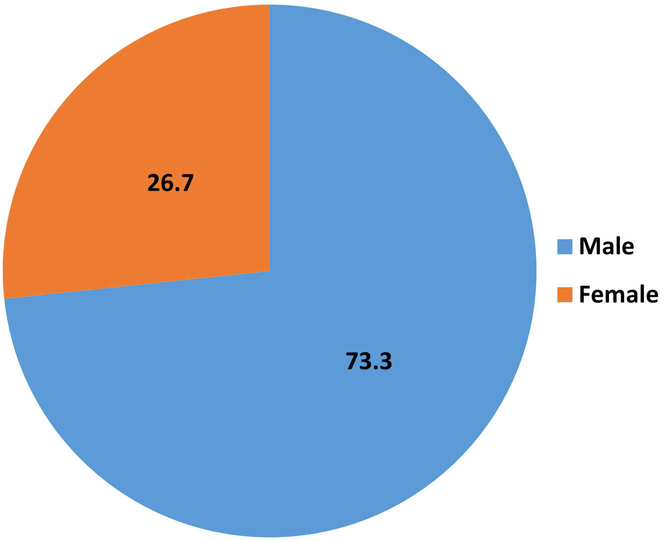


Figure 22: Bar diagram showing age group distribution

2. **GENDER**
   - Males: 44
   - Females: 16

Table 2: Frequency distribution of Gender

Gender-	no(%)
Male	44(73.3)
Female	16(26.7)



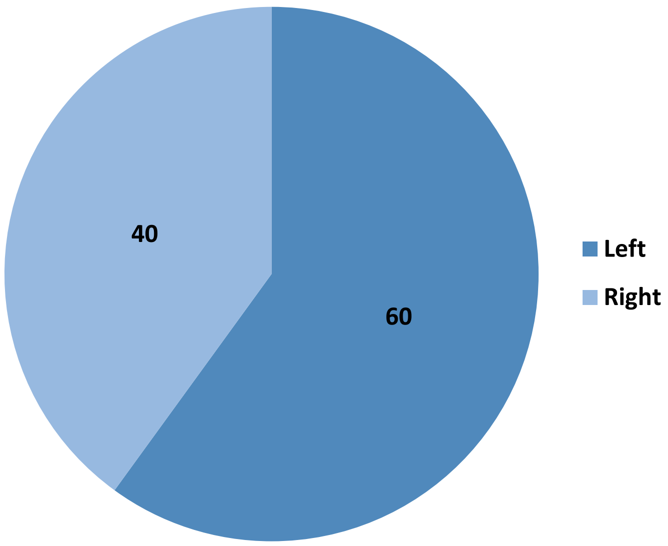
Pie chart showing distribution of gender among the study population

3. SIDE

Following is the data regarding the side of the knee studied.

Frequency distribution of the side of the knee studied

Side-	no(%)
Left	36(60)
Right	24(40)



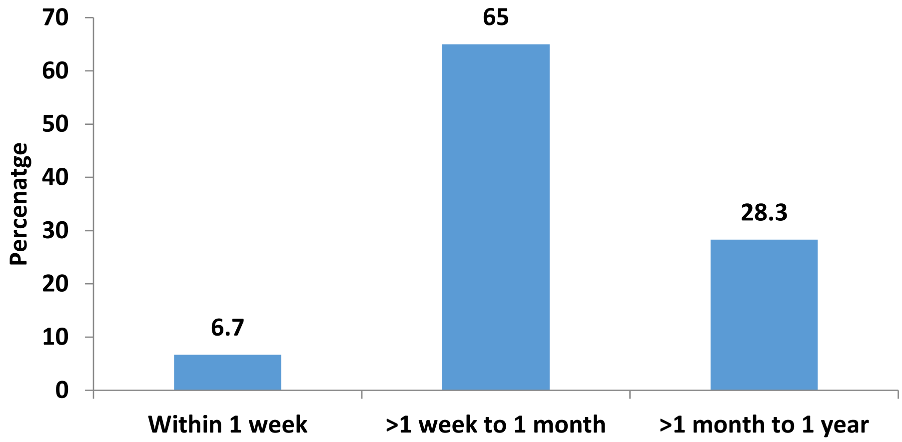
Pie chart showing distribution of side of the knee studied

4. TIME SINCE INJURY

Following is the data regarding the time since injury till the radiological evaluation.

Frequency distribution of the time since injury

Time since injury-	no(%)
Within 1 week	4(6.7)
>1 week to 1 month	39(65)
>1 month to 1 year	17(28.3)



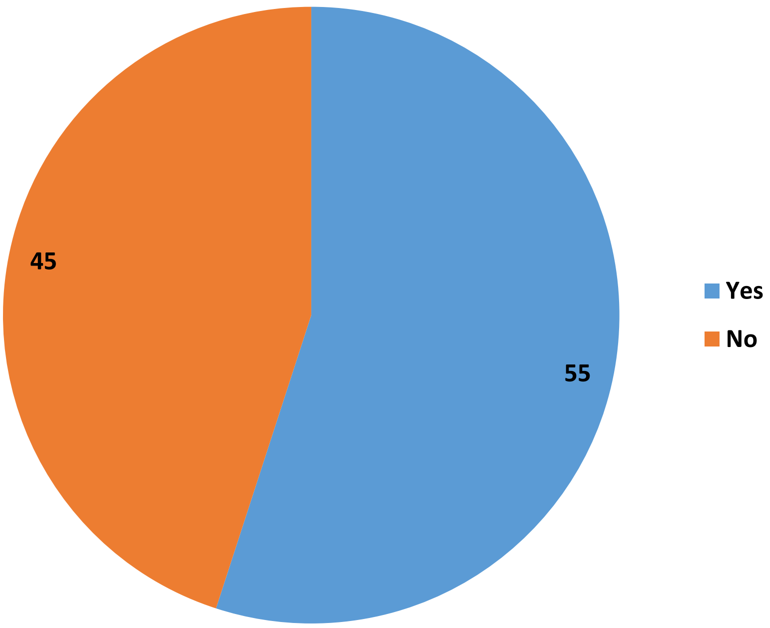
Bar diagram showing time since injury

5. USG FINDINGS:

(i) MM tear in USG

Table 5: Frequency distribution of medial meniscus tear in USG

Medial meniscus tear in USG-	**no(%)**
Yes	33(55)
No	27(45)



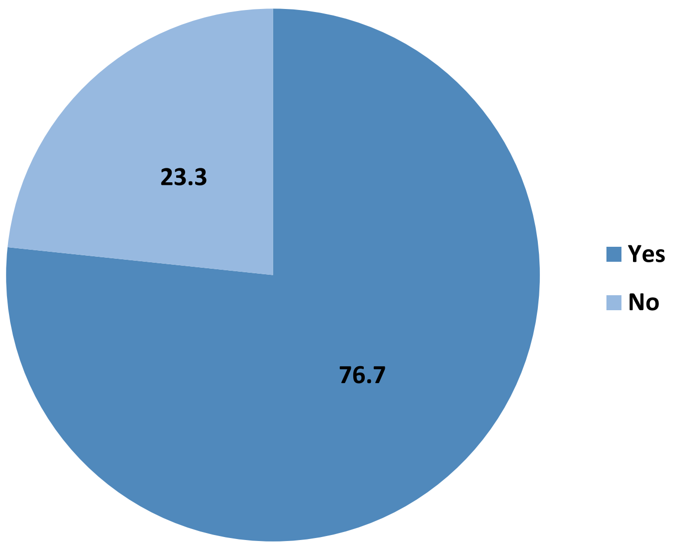
Pie chart showing medial meniscus tear in USG

(ii) MCL injury in USG

Of the 46 patients that showed MCL injury in USG, all of them showed MCL hypoechogenicity, whereas only 29 patients showed MCL thickening.

Frequency distribution of MCL injury in USG

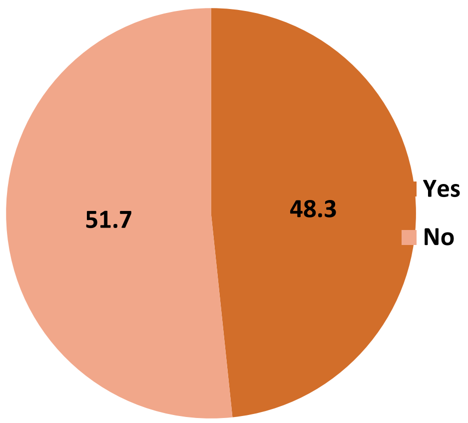
MCL injury in USG-	**no(%)**
Yes	46(76.7)
No	14(23.3)



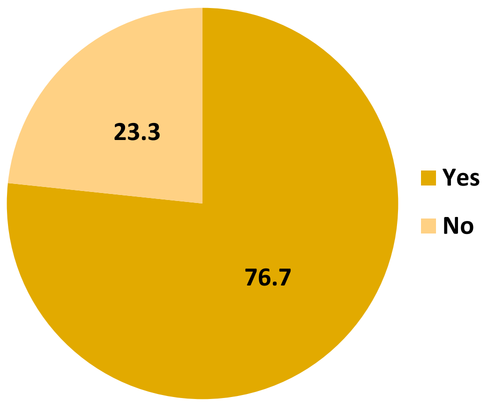
Pie chart showing MCL injury in USG

Frequency distribution of MCL thickening and hypoechogenicity in USG

MCL thickening in USG-	**no(%)**
Yes	29(48.3)
No	31(51.7)
MCL hypoechogenicity in USG-	**no(%)**
Yes	46(76.7)
No	14(23.3)



Pie chart showing MCL thickening in USG



Pie chart showing MCL hypoechogenicity in USG

(iii) Effusion in USG

Frequency distribution of effusion in USG

Effusion in USG-	no(%)
Yes	48(80)
No	12(20)

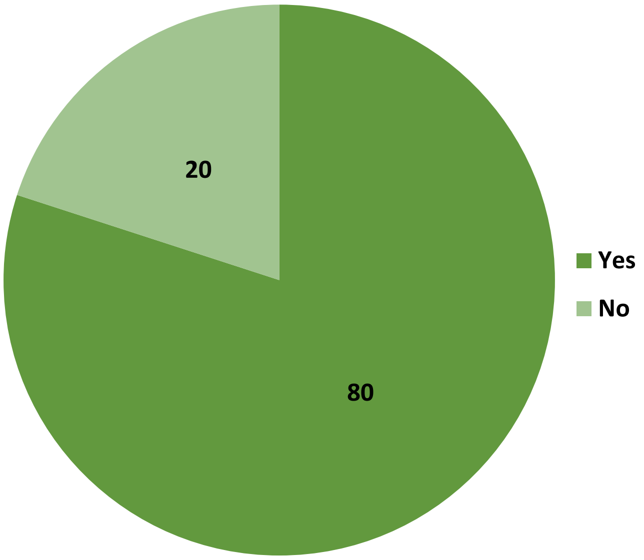
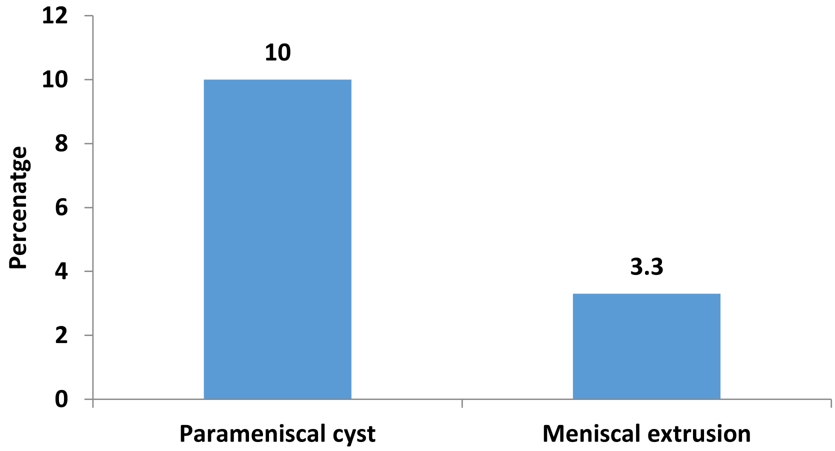


Figure 30: Pie chart showing effusion in USG

(iv) Other findings in USG

Table 9: Frequency distribution of other findings in USG

Other findings in USG-	no(%)
Parameniscal cyst	6(10)
Meniscal extrusion	2(3.3)



Bar diagram showing other findings in USG

5. MRI FINDINGS:

(i) MM tear in MRI

Table 10: Frequency distribution of medial meniscus tear in MRI

Medial meniscus tear in MRI-	no(%)
Yes	34(56.7)
No	26(43.3)

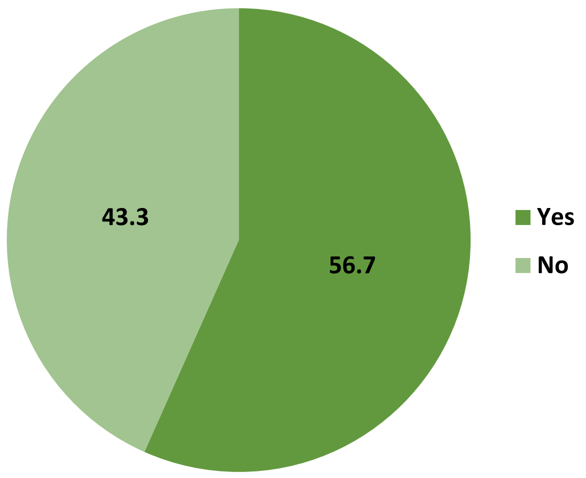


Figure 32: Pie chart showing medial meniscus tear in MRI

(ii) Type of MM tear in MRI

Table 10: Frequency distribution of type of medial meniscus tear in MRI

MM tear type in MRI-	no(%)(N=33)
Complex	15(45.5)
Vertical	8(24.2)
Horizontal	6(18.2)
Bucket handle	2(6.1)
Radial	1(3)
Oblique	1(3)

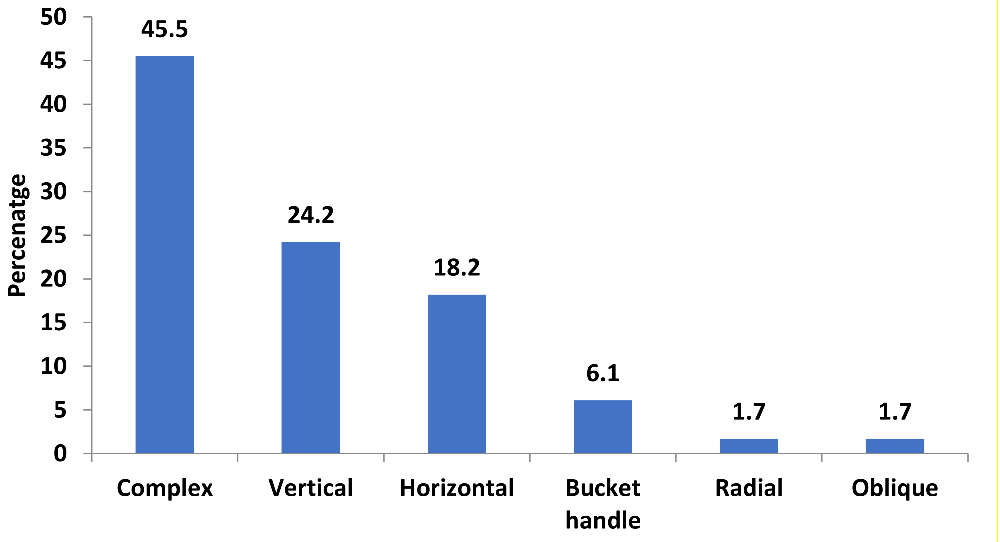
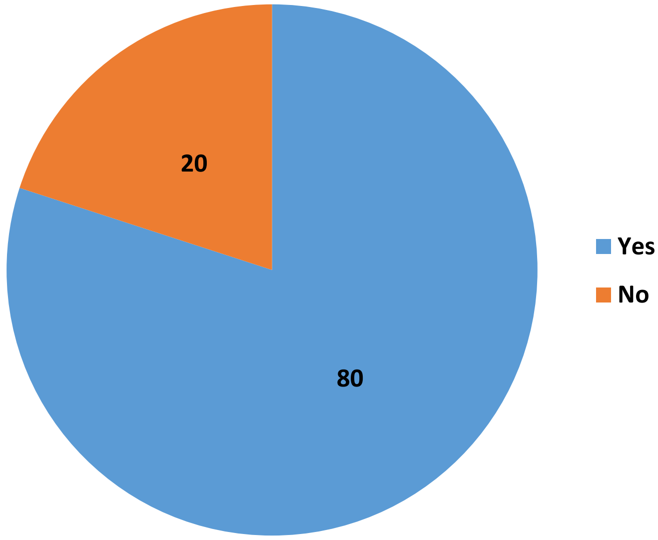


Fig 37: Bar diagram showing MM tear types in MRI

(iii) MCL injury in MRI

Table 11: Frequency distribution of MCL injury in MRI

MCL injury in MRI-	no(%)
Yes	48(80)
No	12(20)

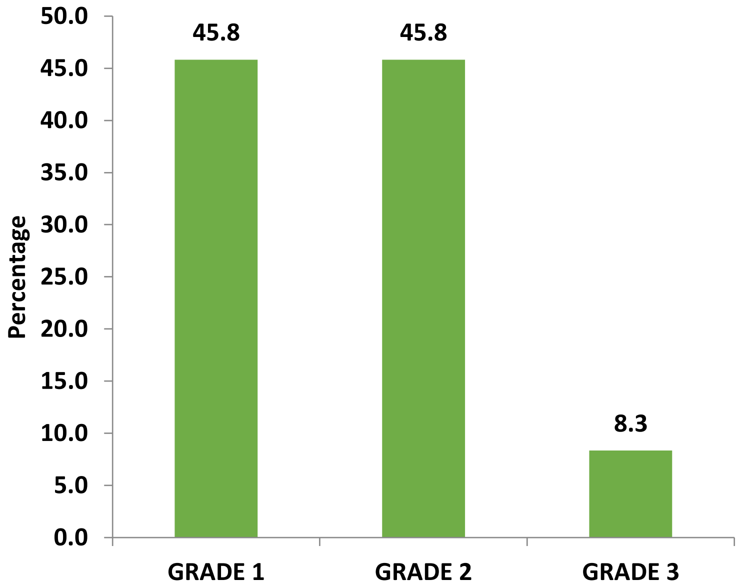


Pie chart showing MCL injury in MRI

(iv) MCL injury grading in MRI

Table 11: Frequency distribution of various grades of MCL injury in MRI

MCL injury grades in MRI-	no(%) (N=48)
Grade 1	22(45.8)
Grade 2	22(45.8)
Grade 3	4(8.3)



Bar diagram showing MCL injury grades in MRI

(v) Effusion in MRI

Table 12: Frequency distribution of effusion in MRI

Effusion in MRI-	no(%)
Yes	50(83.3)
No	10(16.7)

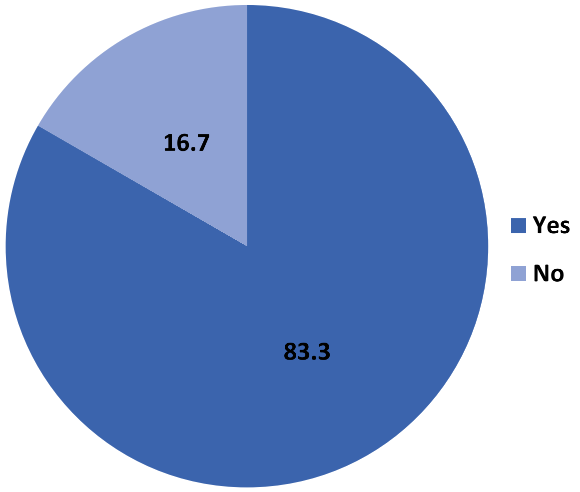


Figure 35: Pie chart showing effusion in MRI

(vi) Other findings in MRI

Frequency distribution of other findings in MRI

Other findings in MRI-	no(%)
Parameniscal cyst	8(13.3)
Meniscal extrusion	2(3.3)
Semimembranosus tendinosis	1(1.7)

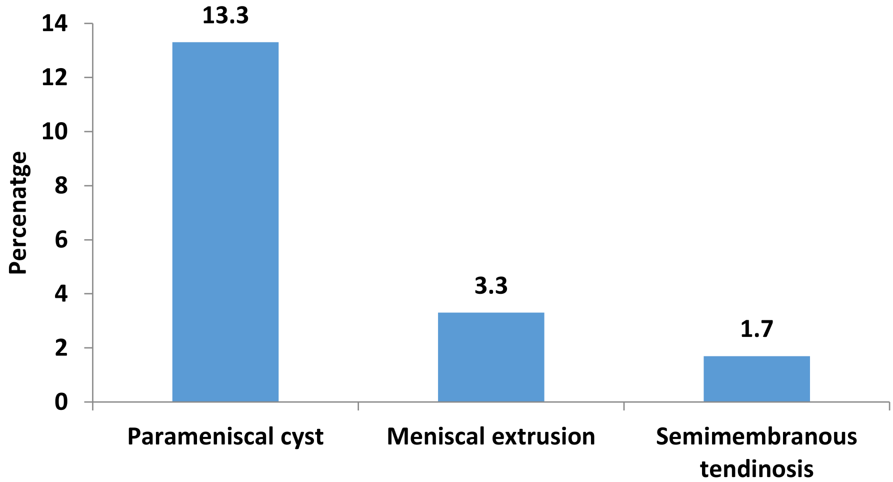


Figure 36: Bar diagram showing other findings in MRI

6. COMPARISON OF USG AND MRI FINDINGS

Table 14: Medial meniscus tear in USG in comparison with MRI

Medial meniscus tear in USG	Medial meniscus tear in MRI	
	Yes	**No**
Yes	29	4
No	5	22

Sensitivity	Specificity	PPV	NPV	Accuracy
85.3%	84.6%	87.9%	81.5%	85%

Table 15:MCL injuryin USG in comparison with MRI

MCL tear in USG	MCL tear in MRI	
	Yes	No
Yes	43	3
No	5	9

Sensitivity	Specificity	PPV	NPV	Accuracy
89.6%	75.0%	93.5%	64.3%	86.7%

Table 16: Effusion in USG in comparison with MRI

Effusion in USG	Effusion in MRI	
	Yes	No
Yes	48	0
No	2	10

Sensitivity	Specificity	PPV	NPV	Accuracy
96.0%	100%	100%	83.3%	96.7%

7. FACTORS ASSOCIATED WITH MM TEAR, MCL INJURY AND EFFUSION IN THE PRESENT STUDY

Table 17: Factors associated with medial meniscus tear

Variable	Medial meniscus tear		P value
	Yes (N=34)	No (N=26)	
Age-no(%)			
0-20 years	2(100)	0(0)	0.427
21-40 years	17(53.1)	15(46.9)	
41-60 years	15(57.7)	11(42.3)	
Gender-no(%)			
Male	26(59.1)	18(40.9)	0.530
Female	8(50)	8(50)	
Side-no(%)			
Left	17(47.2)	19(52.8)	0.071
Right	17(70.8)	7(29.2)	

Time since injury-no(%)			
Within 1 week	0(0)	4(100)	0.024*
>1 week to 1 month	26(66.7)	13(33.3)	
>1 month to 1 year	8(47.1)	9(52.9)	

*statistically significant

Table 18: Factors associated with MCL injury

Variable	MCL tear		P value
	Yes (N=48)	**No (N=12)**	
Age-no(%)			
0-20 years	0(0)	2(100)	0.004*
21-40 years	29(90.6)	3(9.4)	
41-60 years	19(73.1)	7(26.9)	
Gender-no(%)			
Male	35(79.5)	9(20.5)	1.000
Female	13(81.2)	3(18.8)	
Side-no(%)			
Left	31(86.1)	5(13.9)	0.193
Right	17(70.8)	7(29.2)	
Time since injury-no(%)			
Within 1 week	4(100)	0(0)	0.525
>1 week to 1 month	30(76.9)	9(23.1)	
>1 month to 1 year	14(82.4)	3(17.6)	

*statistically significant

Table 19: Factors associated with effusion

Variable	Effusion		P value
	Yes (N=50)	**No (N=10)**	
Age-no(%)			
0-20 years	0(0)	2(100)	0.003*
21-40 years	29(90.6)	3(9.4)	
41-60 years	21(80.8)	5(19.2)	
Gender-no(%)			
Male	39(88.6)	5(11.4)	0.112
Female	11(68.8)	5(31.2)	
Side-no(%)			
Left	29(80.6)	7(19.4)	0.725

Right	21(87.5)	3(12.5)	
Time since injury-no(%)			
Within 1 week	4(100)	0(0)	0.202
>1 week to 1 month	34(87.2)	5(12.8)	
>1 month to 1 year	12(70.6)	5(29.4)	

*statistically significant

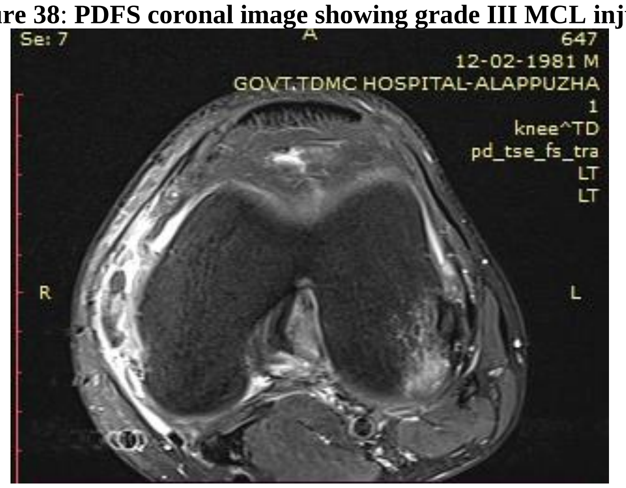
REPRESENTATIVE CASE 1

Age:39/M. History: Pain, history of trauma, Time since injury: 3 weeks
Side of knee joint: Left

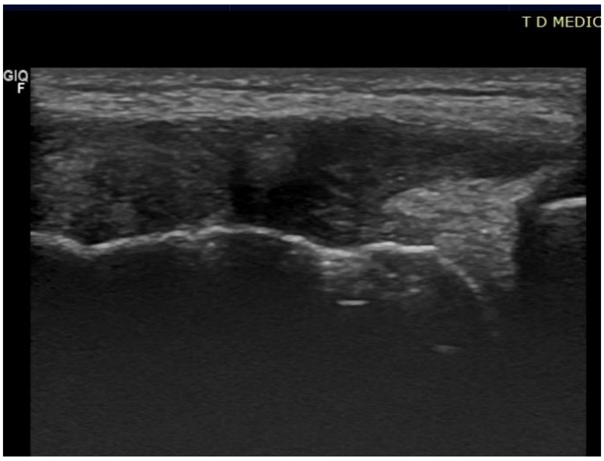
MRI findings:
Grade III MCL injury.
Both menisci are normal in signals and configuration. No evidence of tears.
Mild joint effusion.

USG findings:
MCL thickening and hypoechogenicity suggestive of MCL injury.
Both menisci showed no evidence of tears.
Mild joint effusion.

Figure 38: **PDFS coronal image showing grade III MCL injury**



PDFS axial image showing grade III MCL injury



USG longitudinal view showing MCL tear: both MCL thickening and hypoechogenicity is noted

DISCUSSION

This study, conducted in the Department of Radiodiagnosis, GovernmentT.D Medical College Alappuzha had a totalof 60 subjects. Among them 44 were men and 16 were women. All had undergoneMRI and high-resolution ultrasonography for their knee joint with symptoms andclinical findings suggestive of MCL or MM injury and was detected to have either or both of these injuries.

In our study, among the subjects with MCL or MM injuries, 73.3 % were males and 26.7% were females.

This result was similar to a study conducted by Amandeep Singh et al [56], where 70 % of the study population were males and only 30% were females.

This could be explained by the fact that men are more vulnerable to traumatic knee injury during daily activityand sports injury, while females are more vulnerable to meniscal degeneration.

In the presentstudy, the most common age group of patients presenting with medial knee injuries were in the 2nd and 3rd decades, constituting 53.3% of the cases, followed by people inthe 4th and 5th decades, constituting 43.3% of the cases. Two of the study subjects were in the 18 – 20 age group and none of the study subjects were above 60 years.

In the present study, inabout 60 % of the study subjects, left knee was injured, and right knee was injured in the remaining 40%. This was similar to a study conducted byAmandeep Singh et al [56], where 60% had injury in the leftknee and 40% had injury in the right knee.Thus, the left knee was more frequently involved than theright knee.

Most of the patients, 65%, presented to the department of radiodiagnosis after 1 week and within 1 month of the knee injury.

In our study, the most frequent knee finding was knee effusion. About 83.3% of the study subjects showed effusion in MRI and about 80 % of the study subjects showed effusion in USG.This is correlating with a study by Singh B et al. [28], in which joint effusion was the most frequent finding, seen in about 88% of the study population.So MCL and MM injuries are commonly seen associated with knee effusion.

In the current study, the sensitivity of ultrasound in assessing knee joint effusion was 96.0%.This is slightly higher compared to a study byChung-Yuan Wang et al [57] The sensitivity of sonographicexamination in detecting effusion was found to be 79.1%.

The importance of detecting effusion is that, it is a common sign of knee pathology, either traumatic. In the same study by to a study by Chung-Yuan Wang et al, the sensitivity of knee effusion to internal derangementwas 80.0% and the specificity was 60.0% [57]. So sonographic examination is a useful imaging tool for detecting knee effusion.

MRI was regarded as the gold standard examination for evaluation of MCL and MM injuries and sensitivity,specificity and accuracy of US in evaluating the same were computed.

MCL INJURIES:

In the present study, out of the 60 patients, 48 patients [80%] had MCL injury. USdetected MCL injury in 46 patients in the study population.In the current study,3 MCL injuries were detected by USG, which were not seen in MRI and 5 injuries were missed on US.The sensitivity and specificity of US in detection of MCL injuries were 89.6 % and 75 % respectively. And USG had a PPV of 93.5% and NPV of 64.3%.

In our study,the accuracy of USG in assessing MCL injuries was found to be 86.7%.

According to a study done by Singh B et al. [28], accuracy, sensitivityand specificity of USG in diagnosing medial collateral ligamenttears were 96%, 83% and 97% respectively.This is slightly higher compared to the present study.

In comparison to the study done by Amandeep Singh et al [56], where the sensitivity and specificity of USG in detecting MCL injuries were 84.6% and 100% and the sensitivity obtained in the present study is comparable to this.

In another similar study byGosh en et al [55], Ultrasound was able to show a 67% sensitivity and 83% specificity and a PPV of 67% andNPV of 83% for MCLinjuries.

In the current study, on assessing the grading of the MCL injuries by MRI, it was found that most of the tears were grade I or grade II [45.8% each]. In the present study only 4 [8.3%] of the MCL injuries were in the grade III category and all the Grade III injuries were detected by USG.

MM TEARS:

In the present study, out of the 60 patients,34 patients [56.7 %] had MM tear. Out of these, US detected MM tear in 33 patients.4 of the MM tears detected by USG, were not found in MRI. 5 MM tears were missed on US.

The sensitivity and specificity of USG in detection of MM tear in our study, were 85.3% and84.6 % respectively.And the PPV and NPV are87.9% and 81.5% respectively.

The accuracy of USG in the current study in assessing MMtears were found to be 85%.
According to a study by Ravichandra G et al. [58], the sensitivity and specificityof USG in diagnosing medial meniscus tear was 62% and80% respectively.Incomparison to the study done byAmandeep Singh et al [56], the sensitivity and specificity of USG in detecting MM tears were 77.7% and 90.4%.The specificity obtained in our study is comparable to this study, however sensitivity is higher in the present study.
In another similar study by Gosh en et al [55], Ultrasound was able to show a 100%
sensitivity and 50% specificity and a PPV of 87.5% and NPV of 100% for MM tears.
In the current study, on assessing the type of the MM tears by MRI, which could not be assessed by USG, it was found that most of the tears were complex [45.5%], followed by vertical tear [24.2%] , then by horizontal tear [18.2%]. In the present study only 2 bucket handle tears were there[6.1%], which could not be detected by USG. Also there was one case each of radial and oblique tears [3%] , which were also missed by USG.This was similar to studies by Richter et al. [59] andRiedlet al. [60], where USG waslimited in differentiating types of tears, and especiallyproblematic in detection of radial and oblique tears. In a study byCasser HRet al [61]also, USG was limited in detecting bucket handle tears and the failure to detect bucket handle tearswhich had dislocated to the intercondylar notch wasrelated to limited beam penetration in US.

In our study, about 8 cases parameniscal cysts were detected along with meniscal tear in MRI, out of these 6 were detected by USG and these appeared as well defined sonolucent structures in USG.
In our study, about 2 cases of meniscal extrusion wereseen in MRI, which were also detected in USG. Meniscal extrusion was noted as abnormal displacement of meniscal tissue and associated oedema.

There was a single case of semimembranosis tendinosis in our study which was detected in MRI, however this could not be picked up in USG.
It was found that US was limited in differentiating the type of meniscal tears and is unable to detect bucket handle tears of meniscus.Also, utility of USG is limited in detecting radial and oblique tears. However,formedial collateral ligament tears, USG is more sensitive investigation compared to medial meniscal tears. USG is highly sensitive in detecting grade III MCL injuries which may require surgical intervention, and hence USG may serve as an effective presurgical evaluation tool.

LIMITATIONS OF THIS STUDY

1. Relatively small sample size of 60 was used.
2. MRI was taken as the gold standard, even though arthroscopy is considered as the gold standard for assessing meniscal injuries.
3. Correlation with arthroscopy was not obtained as diagnostic arthroscopy was not routinely done at our institution.
4. There is a lack of a standardized protocol to diagnose MCL and medial meniscus tears. This leads to operatordependence of performingand interpreting the scan, which is subjective and variable.
5. There may have been some bias present from the lead investigator, as the patients enrolled were already scheduled for an MRI, indicating the presence of an injury. Thus, perhaps there was an increased amount time and attention spent scanning with the ultrasound probe looking for injury, yielding higher quality images.

CONCLUSION

The knee joint is one of the most important joints in the human body responsible for weight bearing as well as for a wide variety of movements during ordinary life activities and sports, making it one of the commonly injured joint. The MCL and MM are among the commonly injured ligaments of the knee.
If there is a patient with history of knee trauma and clinical suspicion of isolated MCL or MM injuries, we recommend starting with high resolution ultrasound as a screening tool. For negative examinations, follow up, if no improvement, then the second step is MRI examination to rule out ligamentous injuries.However, if there is a strong clinical suspicion of medial meniscal tear, then MRI is recommended for the evaluation of the same as USG is limited in detecting bucket handle tears as well as radial and oblique tears, of which bucket handle tears need immediate clinical intervention.
For positive results, MRI examination is recommended to prove MCL and MM injuries, to assess the grading as well as the type of ligamentous injuries and for further details.
Ultrasonography even though cannot replace MRI, is a good low-cost alternative and may be used as a screening tool prior to diagnostic arthroscopy in selected cases where MRI is contraindicated, is not available or if the patient is not affording or when the waiting period for MRI can cause unnecessary delay in management.