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Ultrasonographic Indicators for Early Diagnosis of Medial Meniscus Posterior Root Tear

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Faculty Disclosure Information

We have nothing to disclose.

Introduction

Medial meniscus posterior root tear (MMPRT) disrupts the hoop mechanism of the meniscus and accelerates knee osteoarthritis (OA) progression [1,2].

MMPRT should not be overlooked.

Several characteristic MRI findings have been reported to detect MMPRT [3,4].

MRI is considered to be the gold standard of diagnosis of MMPRT [5].

However, objective criteria for selecting patients for MRI have not been previously reported, leaving the decision largely to the physician's subjective judgment.

Some MMPRT patients may be overlooked without undergoing MRI.

Purpose

This study aimed to identify the characteristic ultrasonographic (US) findings of MMPRT and determine the criteria for recommending MRI.

Methods

100 patients (101 knees) were included in this study.

- ✓ Multicenter study
- ✓ With medial knee joint pain
- ✓ K-L grade 0 or 1
- ✓ With no previous ipsilateral lower extremity surgery

The US examination was performed by an orthopedic surgeon in an outpatient setting within two minutes.

Patients were divided into the MMPRT and non-MMPRT groups based on the MRI.

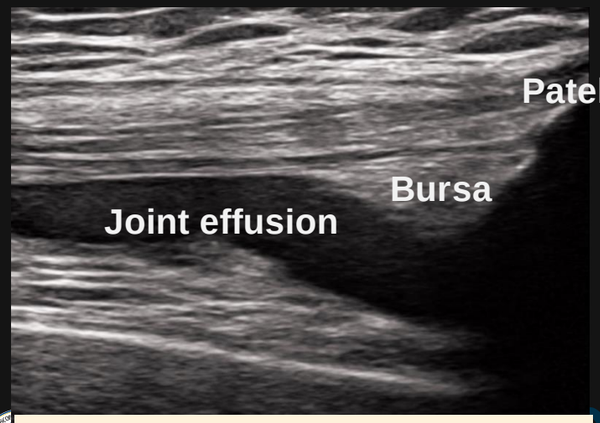
The Mann-Whitney U test, chi-square tests and Fisher's exact test was used to compare the both groups. Statistical significance was set at P-value < 0.05.

US assessment

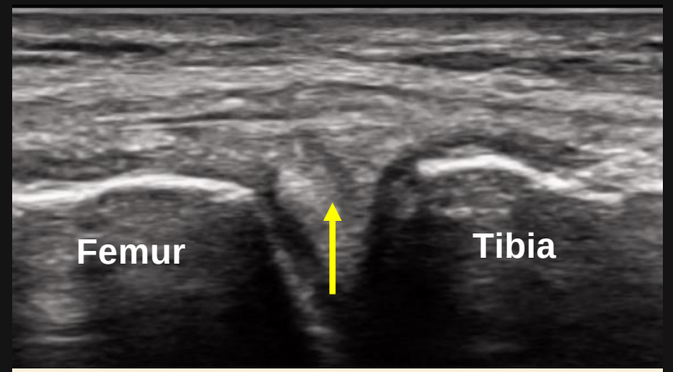
《B mode》

- Joint effusion (≧4mm)
- Synovial hypertrophy (≧4mm)
- Medial meniscus horizontal tear

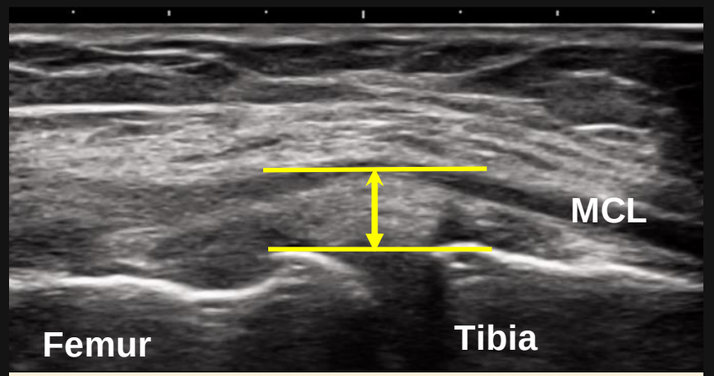
- Medial meniscus extrusion (MME)
  - supine position with 0-degree flexion (unloaded)
  - supine position with 90-degree flexion
  - standing with knee extension (loading)
- ΔMME
  - between loading and unloaded
  - between supine with knee flexion from 0 to 90-degree



Joint effusion
Synovial hypertrophy



Medial meniscus horizontal tear

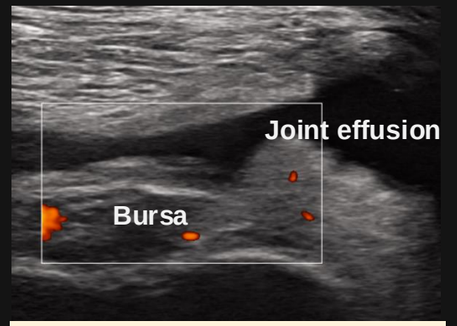


Medial meniscus extrusion

US assessment

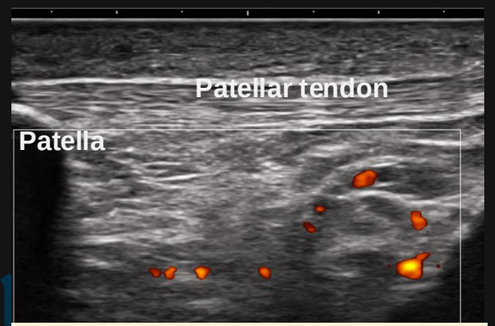
《Doppler mode》

- Doppler signal
  - at the Suprapatellar bursa
  - at the MCL bursa
  - at the Infrapatellar fat pad
  - into the femur
  - into the tibia

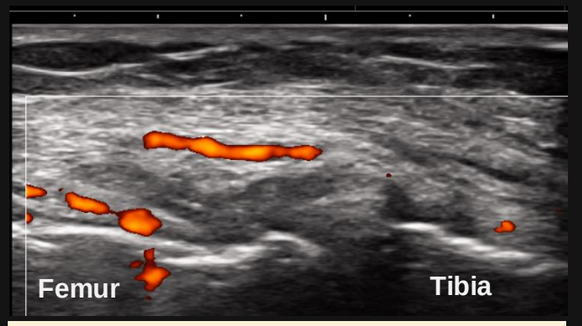


Suprapatellar bursa

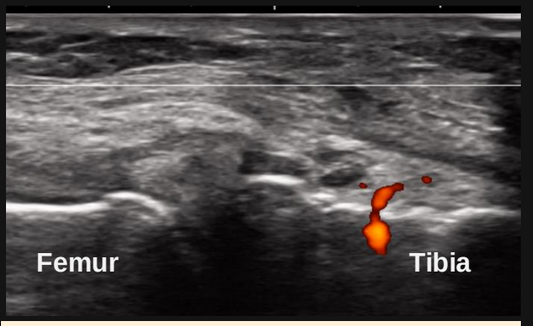
MCL bursa



Infrapatellar fat pad



Into the femur



Into the tibia

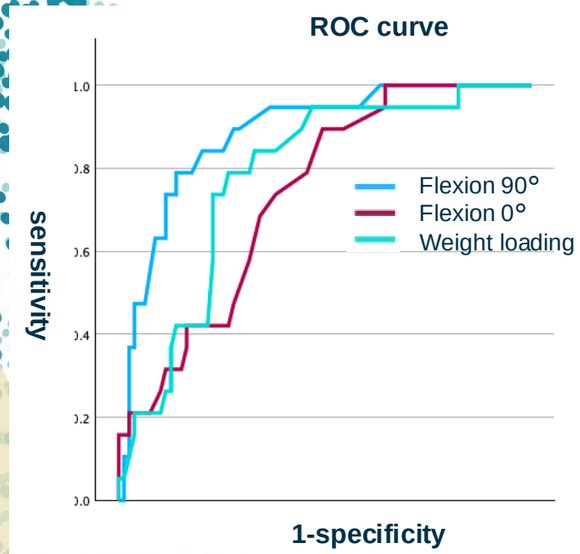
Results

	MMPRT (n = 20)	Non-MMPRT(n = 81)	P-value
Age	61.6 ± 9.96	57.5 ± 11.5	0.149
Gender (male/female)	3/17	40/41	< 0.05
BMI	25.3 ± 0.67	23.0 ± 0.41	0.003
Time to MRI (week)	16.1 ± 5.26	13.2 ± 1.95	0.877

		MMPRT	Non-MMPRT	P-value
《B mode》	Joint effusion (n, %)	12 (60%)	27 (33.3%)	0.028
	Synovial hypertrophy of the suprapatellar bursa (n, %)	3 (15%)	4 (4.9%)	0.179
	Medial meniscus degenerative tear (n, %)	4 (20%)	57 (70.4%)	< 0.001
《Doppler mode》	Doppler Signal at the suprapatellar bursa (n, %)	5 (25%)	22 (27.2%)	0.822
	Doppler Signal at the medial collateral ligament bursa (n, %)	9 (45%)	37 (45.7%)	0.920
	Doppler Signal at the infra patellar fat pad (n, %)	7 (35%)	29 (35.8%)	0.947
	Doppler Signal through the femur (n, %)	9 (45%)	14 (17.3%)	0.008
	Doppler Signal through the tibia (n, %)	10 (50%)	18 (22.2%)	0.013

Results

	MMPRT	Non-MMPRT	P-value
《B mode》			
MME at knee flexion 0°(mm)	3.04 ± 0.22	2.21 ± 0.11	0.001
MME at knee flexion 90°(mm)	3.08 ± 0.29	1.34 ± 0.12	< 0.001
MME under weight loading (mm)	3.72 ± 0.23	2.65 ± 0.13	< 0.001
ΔMME from 0°to 90°knee flexion (mm)	-0.05 ± 0.24	0.86 ± 0.12	0.003
ΔMME from unloaded to loading (mm)	0.68 ± 0.18	0.45 ± 0.10	0.162



	MME evaluation conditions		
	Flexion 0°	Flexion 90°	Weight-loading
Cutoff value (mm)	2.15	1.75	3.10
Sensitivity (%)	89.5	84.2	78.9
Specificity (%)	50.6	79.7	73.4
AUC	0.735	0.883	0.779
95%CI	0.625-0.844	0.805-0.962	0.674-0.884

Results

	MMPRT	Non-MMPRT	P-value
《Doppler mode》			
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➢ **Five US findings showing significant differences**

- Joint effusion
- Fewer horizontal meniscal tears
- Increased MME
- Smaller ΔMME between knee extension and flexion
- Doppler signal into the femur and/or tibia

When three or more are positive

Sensitivity	80%
Specificity	82.7%
Positive predictive value	53.3%
Negative predictive value	94.4%

Discussion

Five US findings considered helpful in identifying patients who require MRI.

- Joint effusion is associated with knee OA progression [6].

➡The timing of joint effusion onset after MMPRT requires further investigation.

- Fewer medial meniscus horizontal tear in MMPRT group.

➡It suggests that MMPRT, which is thought to be caused by shear stress[9], has a different mechanism of development.

- An increase in MME associated with the MMPRT has been widely reported [7].
- The phenomenon of minimal difference in MME between standing and supine positions has been termed the "dead meniscus sign" [8].

➡MME showed similar results to previous reports.

- Takemoto et al. reported that Doppler signal into the bone cortex on US could be used as a screening test for detecting BMLs on MRI in patients with early knee OA[10].

➡The increased Doppler signals observed into the femur and tibia in the MMPRT group may indicate a relationship with SIFK or BML.

Conclusions

- ✓ This study identified five key US findings associated with MMPRT.
  - Joint effusion
  - Fewer horizontal meniscal tears
  - Increased MME
  - Smaller MME changes between extension and flexion
  - Doppler signal into the femur or tibia
- ✓ When three or more parameters were positive, it was suggested that they could serve as an objective indicator for ordering an MRI.

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