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A study on spectrum of MRI findings in traumatic knee

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Abstract

MRI has emerged as an excellent modality for imaging of ligaments, cartilage, menisci and other structures around the knee joint. This is due to the combination of multiplanar capability and superior soft tissue characterization. This modality has superseded already available modalities like radiograph and CT, over last two decades. A prospective study consisting of 50 patients with traumatic knee joint was undertaken to study the spectrum of MRI findings in all consecutive cases of knee trauma referred from orthopedic OPD. Out of 20 patients with isolated medial meniscus tear, the posterior horn was commonest site of involvement occurring in 11 patients (55%) and the predominant type of tear was horizontal and oblique that occurred in 7 patients each (35%). Grade III tear were the commonest seen in 12 patient (60%) followed by grade II in 8 patients (40%).

Keywords: MRI, traumatic knee, meniscus

Introduction

Knee being one of the major joints involved in kinesis, also bears the consequences of increased mobility. The price of its mobility is a tendency to instability. With increasing involvement in sports related activities especially in young people, trauma related knee pathologies have increased^[1].

After its introduction in the mid-1980s, magnetic resonance imaging has rapidly become the imaging modality of choice for evaluating the bone and joint derangements.

The parameters that are critical to acquisition of an optimal image are signal-to-noise ratio (SNR), spatial resolution, anatomic depiction, tissue contrast, artifact control, and imaging time.

Major factors contributing to increased SNR include long repetition time (TR), short echo time (TE), increased number of excitations (NEX), narrow receiver bandwidth, large voxel sizes, high-field-strength systems and use of a local coil. Spatial resolution improves directly with increasing matrix size and inversely with slice thickness, interslice gap and field-of-view^[2].

Tissue contrast is the ability of an imaging modality to provide differing intensities between tissues that allow characterization of normal and abnormal tissues. This would be such as distinguishing synovial fluid from hyaline cartilage or infiltrating tumor from surrounding normal bone marrow.

A major advantage of MRI over other imaging modalities is that contrast varies according to the type of pulse sequence used (i.e., spin-echo versus gradient-echo) and imaging parameters (i.e., choice of TR, TE, and flip angle).

For a coil to work optimally, the field of the coil (B1) which is located in the direction at right angles to the plane of the coil must lie in a plane perpendicular to the main magnetic field (B0)^[2].

Flexible coils are used for joints and classic quadrature birdcage coil is used for knee joint.

Fat suppression with FSE imaging is a standard technique for joints, as it increases the conspicuity of differences among tissues based on both T1 and T2 relaxation. This effect is most prominent on PD- and T2- weighted sequences, rendering joint effusions and liquid in tendon defects more obvious^[3].

Detection of abnormal enhancement after contrast injection is also improved on T1-weighted images by using fat suppression.

MRI has emerged as an excellent modality for imaging of ligaments, cartilage, menisci and other structures around the knee joint [1]. This is due to the combination of multiplanar capability and superior soft tissue characterization. This modality has superseded already available modalities like radiograph and CT, over last two decades [4].

It is a non invasive diagnostic modality that lacks the radiation issues associated with radiograph and CT and is non-operator dependent unlike ultrasound.

Methodology

A prospective study consisting of 50 patients with traumatic knee joint was undertaken to study the spectrum of MRI findings in all consecutive cases of knee trauma referred from orthopedic OPD.

Inclusion Criteria

- All the patients referred with knee injuries following trauma.
- Cases of all age groups.

Exclusion Criteria

- Patient having history of claustrophobia
- Patient having history of cardiac pacemakers, metallic foreign body and cochlear implants insitu.

Imaging protocol

Technique – Imaging will be done with 1.5 Tesla Philips Achieva Machine using 8 channel SENSE knee coil.
Positioning- Imaging is done with full extension in neutral position. A small field of view (FOV) typically in the range 14-16 cm.

The following sequences will be selected as required.

- T2W axial-TE (100 MS), TR (5400 MS), FOV (160), Slice thickness (1-3 mm).
- PD fat sat sagittal-TE (30 MS), TR (2500 MS), FOV (155), Slice thickness (3 mm).
- STIR coronal-TE (60 MS), TR (3547 MS), FOV (150),

Slice thickness (3 mm).

- mFFE sagittal-TE (9.2 MS), TR (934 MS), FOV (165), Slice thickness (1-3 mm).
- T1W coronal-TE (7 MS), TR (500-700 MS), FOV (150) Slice thickness (1mm).

Results

Table 1: Site of tear-medial meniscus

Site	Medial meniscus tear					
	Absent		Present		Total	
	Number of cases	%	Number of cases	%	Number of cases	%
-	30	100	0	0	30	60
AH	0	0	1	5	1	2
AH/B	0	0	1	5	1	2
PH	0	0	11	55	11	22
PH/B	0	0	7	35	7	14
Total	30	100	20	100	50	100

Out of 20 patients with isolated medial meniscus tear, the posterior horn was commonest site of involvement occurring in 11 patients (55%) and the predominant type of tear was horizontal and oblique that occurred in 7 patients each (35%).

Grade III tear were the commonest seen in 12 patient (60%) followed by grade II in 8 patients (40%).

Table 2: Type of tear-medial meniscus

Type	Medial meniscus tear					
	Absent		Present		Total	
	Number of cases	%	Number of cases	%	Number of cases	%
-	30	100	0	0	30	60
BH	0	0	1	5	1	2
COMP	0	0	4	20	4	8
HOR	0	0	7	35	7	14
RAD	0	0	1	5	1	2
OBL	0	0	7	35	7	14
Total	30	100	20	100	50	100

Table 3: Meniscal tears-Grades

Grade	Medial meniscus tear						Lateral meniscus tear					
	Absent		Present		Total		Absent		Present		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
-	30	100	0	0	30	60	34	100	0	0.0	34	
II	0	0	8	40	8	16	0	0	6	37.5	6	
III	0	0	12	60	12	24	0	0	8	50.0	8	
IV	0	0	0	0	0	0	0	0	2	12.5	2	
Total	30	100	20	100	50	100	30	100	20	100	50	

Table 4: Site of tear-Lateral meniscus

Site	Lateral meniscus tear					
	Absent		Present		Total	
	Number of cases	%	Number of cases	%	Number of cases	%
-	34	100	0	0	34	68
AH	0	0	5	31.3	5	10
AH/B	0	0	1	6.3	1	2
AH/B/PH	0	0	1	6.3	1	2
PH	0	0	3	18.8	3	6
PH/B	0	0	6	37.5	6	12
Total	34	100	16	100.0	50	100

Out of 16 patients with isolated lateral meniscus tear the anterior horn was commonest site of involvement occurring in 5 patients (31.3%) and the predominant type of tear was horizontal and was seen in 5 patients (31.3%).

Grade III tears were the commonest and were seen in 8 patients (50%) followed by grade II in 6 patients (37.5%).

The commonest type of tear to involve the whole of meniscus both medial and lateral was horizontal tear and site was posterior horn. Grade III tear were commonest among both.

Table 5: Type of tear-Lateral meniscus

Type	Lateral meniscus Tear					
	Absent		Present		Total	
	Number of cases	%	Number of cases	%	Number of cases	%
-	34	100	0	0	34	68
BH	0	0	3	18.8	3	6
COMP	0	0	2	12.5	2	4
HOR	0	0	5	31.3	5	10
RAD	0	0	4	25.0	4	8
OBL	0	0	2	12.5	2	4
Total	34	100	16	100	50	100

Table 6: Grading of medial and lateral collateral ligament

Grade	Medial collateral ligament						Lateral collateral ligament					
	Absent		Present		Total		Absent		Present		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
-	31	100	0	0	31	62	39	100	0	0.0	39	
I	0	0	11	57.9	11	22	0	0	6	54.5	6	
II	0	0	4	21.1	4	8	0	0	3	27.3	3	
III	0	0	4	21.1	4	8	0	0	2	18.2	2	
Total	31	100	19	100	50	100	39	100	11	100	50	

Medial collateral ligament tears

Out of 50 patients studied, 19 patients (38%) had MCL tear. Out of 19 patients, 11 patients (57.9%) had grade I tear, 4 patients (21.1%) had grade II tear and 4 (21.1%) patients had grade III tears.

Lateral collateral ligament tears

Out of 50 patients studied, 11 (22%) patients had LCL tears. Out of these 11 patients, 6 patients (54.5%) had grade I tear, 3 patients (27.3%) had grade II and 2 patients (18.2%) had grade III tears.

Joint effusion and bone contusion

Out of 50 patients studied bone contusion were present in 17 patients (34%) and joint effusion were present in 41 patients (82%).

Table-7: Bone contusion

Bone contusion	Number of cases	Percentage
Absent (A)	33	66.0
Present (P)	17	34.0
Total	50	100.0

Table 8: Joint effusion

Joint effusion	Number of cases	Percentage
Absent (A)	9	18.0
Present (P)	41	82.0
Total	50	100.0

Discussion

There is preponderance of medial meniscus tears over lateral meniscus tears in our study which is well correlated with study done by Singh JP *et al* [5] in series of 173 cases of which they found 57 (38.23%) patients showed medial meniscus tears and 28 (29.41%) patients showed lateral meniscus tears. In our study out of total 43 patients with meniscal tears 20 (46.5%) patients were having isolated medial meniscus tears, 16 (37.2%) patients were having isolated lateral meniscus tears and in 7 (16.3%) patients both meniscus were involved.

Out of 20 patients (46.5%) with isolated medial meniscus tears, the posterior horn was commonest site of involvement

occurring in 11 patients (55%) and the predominant type of tear was horizontal and oblique that occurred in 7 patients (35%) each, followed by complex tears (20%), radial tear (5%) and bucket handle tear (5%). Grade III tears were the commonest seen in 12 patients (60%) followed by grade II in 8 patients (40%) which can be attributable to severity of trauma involved in young adults.

Our study findings are comparable to Jee *et al* [6] who reported prevalence of torn posterior horn of medial meniscus to be about 56%. Anterior horn tear was found in 5% of cases in our study which is comparable to the study done by De Smet *et al* [7] that showed involvement of anterior horn of medial meniscus in 2% cases. Helms *et al* [8] reported that 10% of tears of medial meniscus were of bucket handle type. Our study also nearly matching in occurrence of bucket handle tear (5%) which showed double PCL sign where the displaced fragment was seen as a hypointense structure parallel to PCL. Grade III tears were the commonest seen in 12 patients (60%). A study done by Ismael Silva *et al* [9], also showed the maximum number of tears involving the medial meniscus were of grade III.

In our study out of 16 patients (37.2%) with isolated lateral meniscus tears, the anterior horn was commonest site of involvement occurring in 5 patients (31.3%) followed by posterior horn (18.8%) and the predominant type of tear was horizontal and was seen in 5 patients (31.3%) followed by radial tear (25%), bucket handle tear (18.8%), oblique tear (12.5%) and complex tear (12.5%). Grade III tears were the commonest and were seen in 8 patients (50%) followed by grade II in 6 patients (37.5%). This is in similar to the study done by Ismael Silva *et al* [9] who in their study of 44 patients with meniscal tears graded them, with the maximum number of tears belonging to grade III and minimum number of tears belonging to grade I.

In our study grade III tears were common in both meniscus MM (60%) and LM (50%) which can be attributable to the severity of trauma involved in young adults.

In our study, out of 50 patients, only 15 patients (75%) were exposed for both medial meniscus tear and McMurray’s test. In 5 patients (25%) not suspected clinically on McMurray’s test but were detected on MRI. Similarly out of 50 patients,

only 10 patients (62.5%) were exposed for both lateral meniscus tear and McMurray's test. In 6 patients (37.5%) not suspected clinically on McMurray's test but were detected on MRI. Our findings are correlating with study done by Malanga *et al*^[10] for meniscal tears, the McMurray test is very specific but has a very low sensitivity.

In our study, out of 50 patients, 19 patients (38%) had MCL tears were found to be more common than LCL tear. Out of 19 patients, 11 patients (57.9%) had grade I tears, 4 patients (21.1%) had grade II tears and 4 patients (21.1%) had grade III tears. Ancillary findings of MCL tear include joint effusion, bone contusion of femoral and tibial condyles, osteochondral fracture of the tibial condyles and meniscal tears. In our study out of 19 patients with MCL tear, 7 patients (36.84%) had medial meniscal tear and only 3 patients (15.78%) had lateral meniscal tear. It is also noteworthy to find that 10 patients (52.63%) out of these 19 MCL tears also had ACL tears. O' Donoghue's triad (combination of ACL, MCL and medial meniscus tear) was seen in 2 patients.

This suggests presence of a single injury should prompt the examiner to look for other subtle associated injuries, which was further confirmed by Mink JH *et al*, they observed on MRI and arthroscopy of 11 patients who had tear of ACL, 7 patients had tear of MCL, 4 patients had tear of lateral meniscus and 1 patient had tear of medial meniscus.

In our study, out of 50 patients studied, 11 patients (22%) had LCL tears were found to be less common than MCL tears (38%). Lateral compartment injuries are less common than medial compartment injuries. Out of these 11 patients, 6 patients (54.5%) had grade I tears, 3 patients (27.3%) had grade II tears and 2 patients (18.2%) had grade III tears. Associated findings include joint effusion, bone contusion and meniscal tears. 4 patients (36.36%) out of total 11 LCL tears had associated lateral meniscus tear, while 2 patients (18.18%) had associated medial meniscus tear. There is a strong association between LCL tear and lateral meniscal tear.

In our study, out of 50 patients only 6 patients (31.6%) were exposed for both medial collateral ligament tear and valgus strain test. In 13 patients (68.4%) MCL tear were not suspected clinically on valgus strain test but were detected on MRI. Similarly only 2 patients (18.2%) were exposed for both lateral collateral ligament tear and varus strain test. In 9 patients (81.8%) LCL tear were not suspected clinically on varus strain test but were detected on MRI. According to Malanga *et al*^[10], although collateral ligament testing seems to be sensitive and specific, there is a lack of well designed studies that scientifically validate the sensitivity and specificity of these tests.

Conclusion

The commonest type of tear to involve the whole of meniscus both medial and lateral was horizontal tear and site was posterior horn. Grade III tear were commonest among both.

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