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Comparative study of MRI and arthroscopy in diagnosing meniscal and cruciate ligament tears

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Abstract

Background: MRI is done extensively to assess knee injuries as clinical examination is difficult in painful knees. It is the need of the hour to know the accuracy and limitations of MRI in diagnosing meniscus and cruciate ligaments tears by comparing with arthroscopy, which is the gold standard in assessing the joints.

Materials and methods: Prospective study of one hundred patients with clinically suspected internal injuries of knee, who underwent MRI knee and arthroscopy were assessed and compared for a period of two years from 2017 to 2019 in our hospital.

Results: The accuracy of MRI in diagnosing medial meniscal injury is 89%, lateral meniscus is 95%. Accuracy of anterior cruciate ligament complete tear (97%) is higher than for partial tear (90%). Similar findings for posterior cruciate ligament as well, 100% in complete tear and 96% for partial tears. We had more number of false positives in diagnosing medial and lateral meniscal tears and partial tear of anterior cruciate ligament.

Conclusion: MRI will be most accurate noninvasive modality in diagnosing meniscal and cruciate ligament tears, if the reporting radiologist is aware of the pitfalls of MRI in assessing these structures. However, MRI is the excellent screening tool to avoid unnecessary invasive diagnostic arthroscopies.

Keywords: MRI, arthroscopy, diagnosing meniscal, cruciate ligament tears

Introduction

The knee injuries due to road traffic accidents and sports are common resulting in ACL and meniscus tears. Clinical examination is difficult in assessing painful knee. Failure to diagnose will result in chronic knee pain, instability and early set in of osteoarthritis which in turn has many socioeconomic implications ^[1, 2]. In the present scenario, MRI being non-invasive, with development of newer sequences, higher resolution, shorter imaging times and improved accuracy has changed the traditional workup in diagnosing knee injuries ^[3].

Traditionally clinical examination was relied. Later role of arthroscopy came in diagnosis and treatment of various knee disorders. Diagnostic arthroscopy though invasive, has accuracy to 64 - 94% ^[4]. Being invasive, there are associated complications like infection, hemarthrosis and adhesions ^[5]. Hence MRI is now widely used to confirm internal injuries of the knee to avoid invasive diagnostic arthroscopy and financial burden for patients.

Our study is intended to study the accuracy of MRI as compared to arthroscopy and understand the common pitfalls of MRI in assessing menisci and cruciate ligaments.

Materials and Methods

This is the prospective study of hundred patients who presented to our orthopaedic OPD with knee injuries.

Inclusion criteria: Patients with clinically suspected internal injuries of knee who underwent both MRI of both or either knee and arthroscopy for the period of two years from January 2017 to December 2019.

Exclusion criteria: patients with neoplasms, infections and inflammatory knee pathologies. Patients with conditions like pacemaker, aneurysmal clips, metallic foreign body in the eye, claustrophobia etc, that are contraindications to MRI.

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100 patients with clinically suspected internal injuries of the knee was studied using Philips Achieva 1.5T MR scanner placing knee using knee coil. The sequences used are sagittal, coronal and axial PDW STIR, T2W sag, T1 W axial and sag, FFE sag and Wats sequences. Images were analysed by the radiologist with 5 years of experience in reporting musculoskeletal MRI.

Arthroscopy was done by a scopy specialist with patient in supine position and thigh supported laterally under spinal anaesthesia. Findings and images were recorded. MRI findings were then compared with arthroscopy findings as gold standard.

Statistical analyses

Statistical analyses were done using SPSS software package. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy was calculated.

Results

The present study was done on 100 patients with clinically suspected internal injuries of knee, who were referred radiology department from orthopaedic department for the period of two years from January 2017 to December 2019 in our ESICPGIMSR, Rajajinagar hospital. All patients underwent dedicated knee MRI to assess internal injuries, findings were recorded. The intraoperative arthroscopy findings of same patients were recorded and compared with the findings of MRI. The following observations were done:

Table 1: Depicting sex and age ranges of sample population.

Male	Female	20-30yrs	30-40yrs	40-50yrs	50-60 yrs
72	28	38	39	13	20

Out of 100 patients, 72 were males and 28 were females with ages ranging from 20 to 60 years.

Table 2: Comparison MRI and arthroscopy in medial meniscus tear.

Medial Meniscus		Arthroscopy		
		Tear	No Tear	Total
MRI	Tear	(TP) 18	(FP) 9	27
	No Tear	(FN) 2	(TN) 71	73
	Total	20	80	100

Table 3: Comparison MRI and arthroscopy in lateral meniscus tear.

Lateral Meniscus		Arthroscopy		
		Tear	No Tear	Total
MRI	Tear	(TP) 10	(FP) 5	15
	No Tear	(FN) 0	(TN) 85	85
	Total	10	90	

Table 4: Comparison MRI and arthroscopy in partial anterior cruciate ligament tear.

Anterior cruciate ligament partial tear		Arthroscopy		
		Tear	No Tear	Total
MRI	Tear	(TP) 9	(FP) 7	16
	No Tear	(FN) 3	(TN) 81	84
	Total	12	88	100

Table 5: Comparison MRI and arthroscopy in complete anterior cruciate ligament tear.

Anterior cruciate ligament complete tear		Arthroscopy		
		Tear	No Tear	Total
MRI	Tear	(TP) 55	(FP) 2	57
	No Tear	(FN) 1	(TN) 42	43
	Total	56	44	100

Table 6: Comparison MRI and arthroscopy in partial posterior cruciate ligament injury.

Posterior cruciate ligament partial tear		Arthroscopy		
		Tear	No Tear	Total
MRI	Tear	(TP) 4	(FP) 1	5
	No Tear	(FN) 3	(TN) 92	95
	Total	7	93	100

Table 7: Comparison MRI and arthroscopy in complete posterior cruciate ligament injury.

Posterior cruciate ligament complete tear		Arthroscopy		
		Tear	No Tear	Total
MRI	Tear	(TP) 6	(FP) 0	6
	No Tear	(FN) 0	(TN) 94	94
	Total	6	94	100

Table 8: Statistical analyses after comparison of MRI and arthroscopy findings.

	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Diagnostic accuracy
medial meniscus tear	90%	88.70%	66.60%	97.20%	89%
lateral meniscal tear	100%	94.40%	66.60%	100%	95%
anterior cruciate ligament					
partial tear	75%	92%	56.20%	96.40%	90%
complete tear	98.20%	95.40%	96.50%	97.60%	97%
posterior cruciate ligament					
partial tear	57.10%	98.90%	80%	96.80%	96%
complete tear	100%	100%	100%	100%	100%

In our study, the most common injury of internal structure of the knee is anterior cruciate ligament. Complete tear was common than partial tear. There were more false positives in diagnosing partial tear of anterior cruciate ligament.

Injury of posterior cruciate ligament was rare, but MRI was 100% accurate in diagnosing complete tear of posterior cruciate ligament.

In meniscal injury, medial meniscus was commonly injured than lateral meniscus, however there were false positives and negatives in assessing both menisci.

However the diagnostic accuracy of MRI in diagnosing both cruciate ligaments and menisci ranges from 90-100%.

Discussion

Out of 100 patients, 72 were male and 28 were female with ages ranging from 20 to 60 years, most of them are at 20 to 40 years, accounting to 67%.

Medial meniscus

27 patients had medial meniscus tear, 15 had lateral meniscus tear showing medial meniscus is the most common to get injured because of its attachment to the capsule and deep layers of medial collateral ligament [6, 7].

Most common medial meniscus tear was involving posterior horn, out of 27 patients, 15 had posterior horn which correlates with Singh P *et al.* study of 173 patients with twisted injuries of knee [8].

Out of 27 patients with MRI diagnosis of medial meniscus tear, only 22 patients had tear on arthroscopy, 9 patients had false positive on MRI, 2 were involving peripheral one third of body and 2 were tears involving posterior horn and 4 patients had grade 2 tears of anterior horn.

De Smet *et al.* in their large study including 533 patients had proved that out of various medial meniscus tears, longitudinal tears of medial meniscus in posterior horns and peripheral one third had high false positives which was attributed to spontaneous healing of the tear [9]. The posterior horn is difficult to assess in arthroscopy with anterior approach making it less accurate as per the study of Levinson *et al.* who studied the accuracy of arthroscopy in detecting inferior articular surface of posterior horn [10].

Degenerative changes extending to articular surface sometimes have a high signal like tear, which can be mistaken for grade 2 tear and vice versa, more so common in patients more than 40 years. The "two touch rule" should be followed while reporting MRI, where tear should be diagnosed only when it is seen in two or more consecutive images [10]. Operator dependency of arthroscopy sometimes can be considered as other cause for such cases [11].

Two false negative MRI can be attributed to the grade 2 tears which involves inferior articular surface that can be easily missed on arthroscopy with anterior approach and overlooking of the tear while reporting the MRI [12].

In our study sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of MRI in diagnosing medial meniscal tear are 90%, 88.7%, 66.6%, 97.2% and 89% respectively which can be compared with similar study done by Baghel AS done on 30 patients who had sensitivity, specificity, positive predictive value and negative predictive value of 87.5 %, 85.7%, 87.5% and 86.6. % respectively [13].

Lateral Meniscus

Out of 100 patients, 15 patients had tear on MRI, 10 being true positive and 5 being false positive when compared to arthroscopy findings and none false negative. 85 patients had no tear in both MRI and arthroscopy.

The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of MRI diagnosing lateral meniscus are 100%, 94%, 66.6%, 100% and 95% respectively, which are comparable with similar

study by krati Khandelwal *et al.* study on 210 patients, who had sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy for lateral meniscus tear as 86.04%, 97.01%, 88.09%, 96.42% and 94.76%, respectively [14].

We had 5 false positive cases on MRI, with retrospective critical analyses, we found that meniscofemoral ligament were wrongly read as tear and in other two patients the trapped synovial fluid along the popliteus tendon was misinterpreted as tear [15].

The sensitivity and specificity of MRI in detecting meniscal injuries was 93.3% and 80% respectively which is comparable with Chang *et al.* who studied 148 patients showed 92% sensitivity and 87% specificity for meniscal tears [16].

Anterior Cruciate Ligament

Anterior cruciate ligament was the commonest tear (64%) seen in our study. Complete tear (55%) was common than partial tear (9%). We had only selective patients with partial tear that had undergone arthroscopy.

Out of 100 cases, 55 had complete tear and 9 had partial tear in both MRI and arthroscopy, two false positive complete tear and 7 false positive partial tears was diagnosed on MRI. 3 patients with partial tear and one case with complete tear of anterior cruciate ligament were missed on MRI.

False negative in one patient could be due to chronic complete tear where the torn ligament will be taught and attached to posterior cruciate ligament, making it difficult to differentiate from normal appearing anterior cruciate ligament on MRI [17]. Studies have shown that the accuracy of MRI in diagnosing acute complete tear is better than in chronic tears [18].

Two false positive cases having complete ACL tear on MRI, had high grade partial tear in arthroscopy.

Studies have shown that MRI cannot accurately differentiate high grade partial tear from complete tear due to intrasubstance oedema.

We had 7 false positive and 3 false negative in diagnosing partial tear of anterior cruciate ligament. High false positives in detecting partial tear because normal ACL appears hyperintense on PDWSTIR with fat in between fibres, which can be overread by radiologist in the background history of trauma. Thumb rule is if intrasubstance hyperintensity is not seen in other sequences. We shouldn't call it as partial tear. Same is true for false negative as well, where in the radiologist will overlook thinking that its normal appearance or considering partial volume averaging as the possibility. Here the role of clinical assessment is important. Orthopaedician shouldn't rely completely on MRI for the management. Decision should be taken based on both clinical evaluation and MRI findings.

Posterior Cruciate Ligament

We had 9 posterior cruciate ligament tears out of 100 patients. 6 cases had complete tear and 4 cases had partial tear both on MRI and arthroscopy. There were no false positives and false negatives in diagnosing complete tear of PCL on MRI. Complete tear of posterior cruciate ligament will have classical MRI findings, which cannot be overlooked or overread by radiologists.

There was one false positive for partial tear in MRI, this is because even normal PCL can have focal intrasubstance hyperintensity which can be mistaken partial tear.

Especially when the reporting radiologist is in early learning curve.

Conclusion

Though accuracy of MRI in diagnosing internal derangement of knee is comparable with arthroscopy, MRI alone cannot be relied for decision making. Management of internal deranged patients should be planned based on the combined clinical and MRI findings. Many anatomical variants and normal appearance of structures mimics as tears on MRI. Reporting radiologist should be aware of these for accurate analyses. Clinician should always correlate MRI findings with clinical evaluation for decision making. MRI should be done before planning for arthroscopy to confirm clinical findings and to avoid unnecessary interventions which can be a burden to patients. It is always to discuss with radiologist whenever the clinical assessment and MRI findings are matching.

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