DIAGNOSTIC ACCURACY OF CLINICAL AND MAGNETIC RESONANCE IN KNEE MENISCI AND LIGAMENTOUS INJURIES

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ABSTRACT

OBJECTIVE

The purpose of this study was to evaluate the reliability of clinical diagnosis compared to MRI findings in ligamentous and meniscal injuries with respect to arthroscopic confirmation as a gold standard.

METHODS

485 patients with knee injuries were prospectively assessed by clinical evaluation and magnetic resonance imaging and correlated after therapeutic arthroscopy. The overall accuracy, clinically productive values of sensitivity and specificity was derived. The actual value of the test with respect to positive predictive and negative predictive value was also derived, taking arthroscopic findings as confirmatory. The overall partial and total agreement among the clinical, MRI and arthroscopy was documented.

RESULTS

The overall accuracy for clinical examination was 85, 92, 100 and 100 and accuracy for MRI was 90, 97, 97 and 97 for detecting medial meniscus, lateral meniscus, ACL and PCL tears respectively. Clinically lateral meniscus tears are difficult to diagnose clinically with negative predictive value (90) whereas ACL injuries do not need MRI for diagnosis as evident by a high negative predictive value (100) of clinical examination. Total agreement with the clinical findings confirmed by arthroscopy was 64.40% which was relatively high as compared to total agreement of MRI findings which was only 31.50%. We found similar total agreement versus total disagreement of both clinical and MRI to be only 2.74% indicating very high accuracy in clinical diagnosis of meniscal and ligamentous injuries combined.

CONCLUSION

The clinical evaluation alone is sufficient to diagnose meniscal and ACL/PCL pathologies and MRI should be considered only as a powerful negative diagnostic tool. The arthroscopy decision should not be heavily dependent on MRI for ligamentous injuries but reverse is true for meniscal lesions. MR evaluation functions as a powerful negative diagnostic tool to rule out doubtful and complex knee injuries.

KEYWORDS

ACL, PCL, Meniscii, MRI, Arthroscopy.

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INTRODUCTION: Clinical diagnosis of meniscal and ligamentous knee injuries is heavily dependent on experience of the clinician. The MRI is bound to show multiple pathologies which may not be clinically relevant on clinical examination.[1] If the clinical test is confirmatory for instability or meniscal pathology then MRI is looked up for confirmation. But subtle clinical signs with non-confirming MRI makes arthroscopy indispensable for diagnosis. We can look upon MRI as a modality which might avoid unnecessary surgery and thereby obviate the surgical expense[2] apart from the legal and mediclaim ramifications in today's era.

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Although there is enough evidence in literature suggesting accurate history and physical evaluation as best modalities of diagnosing ligamentous and meniscal injuries as compared with MRI in specially in multiple nonrandomized studies. Also some studies have proved that MRI is cost effective before subjecting patient to arthroscopic knee surgery.[3,4,5,6]

OBJECTIVE: The study aimed to evaluate the accuracy of clinical diagnosis and MRI compared to arthroscopy, considering arthroscopic confirmation as a gold standard.

MATERIALS AND METHODS:

Sample Size: The study sought the detailed clinical evaluation and magnetic resonance imaging prospectively from the patients between July 2009 and February 2014,

wherein we recruited 485 patients who underwent therapeutic knee arthroscopic procedure.

Inclusion Criteria: All patients symptomatic with knee pain, limp, instability, locking with or without a history of trauma were included in the study. The duration of symptoms ranged from 6 weeks to 2 years.

Clinical evaluation was done using standard Lachman, pivot shift and anterior drawer for ACL. Meniscus pathology was examined with joint line tenderness along with Steinman II test. Posterior drawers and Godfreys posterior sag was utilised for PCL clinical evaluation. Direct signs of ACL tear on MRI included deficient, discontinuous, distorted wavy oedematous ACL. MRI diagnosis of meniscal tears was confirmed with grade 3 tear pattern. The findings of MRI were compared with arthroscopy as gold standard.

Exclusion Criteria: The patients excluded were those with concomitant posterolateral corner (PLC) knee injuries, patients with posteromedial corner (PMC) injuries, patients undergoing revision surgeries either for meniscal or ligamentous pathologies. The acutely injured knees were excluded from the study.

Clinical posterolateral drawers, dial test and Varus stress in 30-degree flexion and was used to exclude patients with PLC injuries and PMC injuries respectively.

Additionally, patients with positive drive through sign in lateral or medial compartment signifying PLC and PMC injuries were also excluded from the study.

Statistical Evaluation: We utilised the statistical test by evaluating the inherent quality testing in relation with outcome in form of sensitivity and specificity. Also the usefulness of the testing relating to test results in the form of positive predictive value (PPV) and negative predictive value (NPV) along with accuracy.

The following formulae were utilized for the parameter evaluation.
Sensitivity: Proportion of all outcome positives that are test positive.
Sensitivity=True positive/ (True positive+ False negative).
Specificity: Proportion of all outcome negatives that are test negative.
Specificity=True negative/ (True negative+ False positive).
Positive Predictive Value (PPV): proportion of all test positives that are outcome positive.Positive Predictive Value=True positive/ (True positive+ False positive).
Negative Predictive Value (NPV): proportion of all test negatives that are outcome negative.
Negative Predictive Value=True negative / (True negative + False negative).
Accuracy (Acc): proportion of all cases correctly diagnosed.
Accuracy Acc= (True positive+ True negative)/ (True positive +False positive+ False negative+ True negative).

The calculation of sensitivity, specificity, PPV, NPV and accuracy each of clinical evaluation and MRI was compared to knee arthroscopy.

The partial versus total agreement was also documented to evaluate any need for differential approach for meniscal and ligamentous knee injuries.

RESULTS: There were 394 patients with combined ligamentous and meniscal injuries and 91 patients with only meniscal lesions in the total cohort of 485 patients.

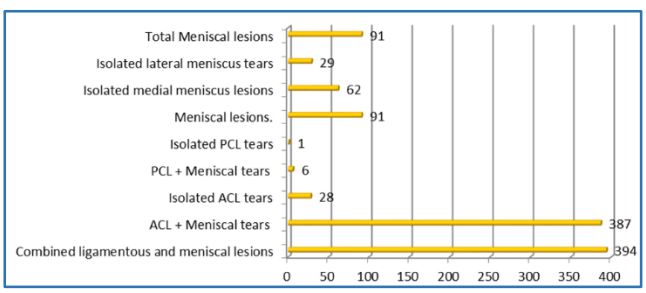

Fig. 1: Bar diagram for overall isolated and combined injuries distribution Meniscus tears: The total cases with only meniscal tears were 91 and 29 were isolated lateral meniscus tears

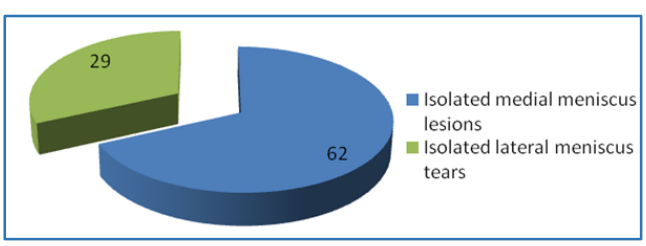

Fig. 2: Pie showing the distribution of total 91 meniscal tears.

Diagnosis	Sensitivity		Specificity		Accuracy		Positive predictive value		Negative predictive value	
	Clinical	MRI	Clinical	MRI	Clinical	MRI	Clinical	MRI	Clinical	MRI
Medial meniscus	70	88	97	77	85	90	96	84	76	82
Lateral meniscus	66	75	95	96	92	97	80	90	90	88

TABLE 1: Diagnostic values of medial and lateral meniscus tears

The study showed that MRI seemed superior to clinical examination in meniscal tears. Table 1 shows that for the medial meniscus tears, MRI has a sensitivity and specificity of 88% and 77% respectively. Whereas as in the lateral meniscus, the sensitivity and specificity of 75% and 96% respectively. The NPV of 82% & 88% of MRI diagnosed medial meniscus ad lateral meniscus tear was higher. The NPV for ACL tears was 100%.

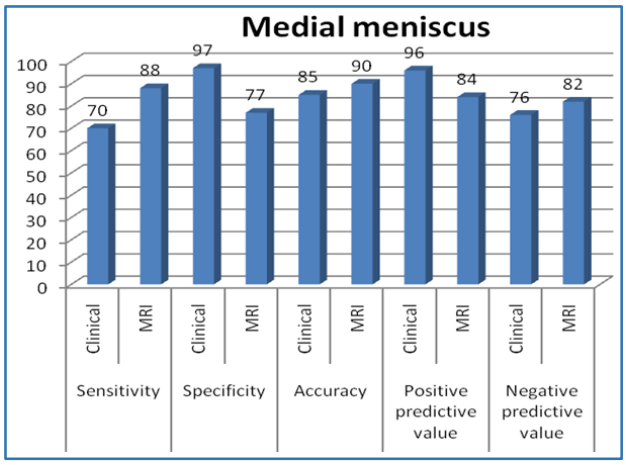

Fig. 3a

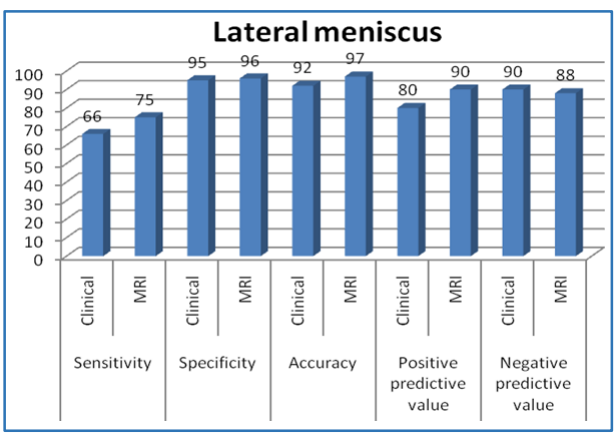

Fig. 3b

Figure 3 Bar diagram for medial (a)and lateral meniscus (b) accuracy indices (a) (b) ACL Tears: The combined ligamentous and meniscal injured cases were 394 and 8 meniscal injuries were associated with PCL injuries.

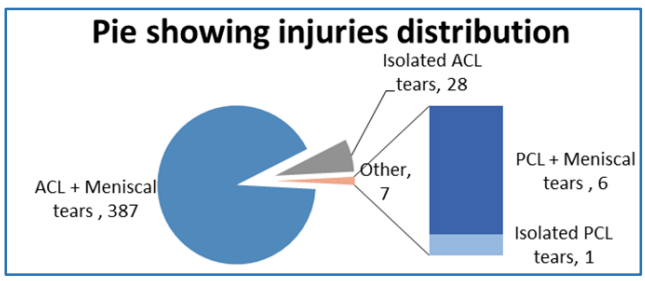

Fig. 4: Pie showing the distribution of total 394 ligamentous injuries in isolation and combined

The physical tests (100%) and MRI (97%) showed higher accuracy. Physical evaluation and MRI showed almost same sensitivity (100%) and almost similar specificity (97% v 92%) for ACL tears. Lachman and pivot shift tests showed a PPV and NPV of 98% and 100% respectively. The PPV and NPV of MRI is 96% and 100% respectively as shown in table 2.

Diagnosis	Sensitivity		Specificity		Accuracy		Positive predictive value		Negative predictive value	
	Clinical	MRI	Clinical	MRI	Clinical	MRI	Clinical	MRI	Clinical	MRI
ACL	100	100	97	92	100	97	98	96	100	100

Table 2: Diagnostic values of ACL tear diagnosis

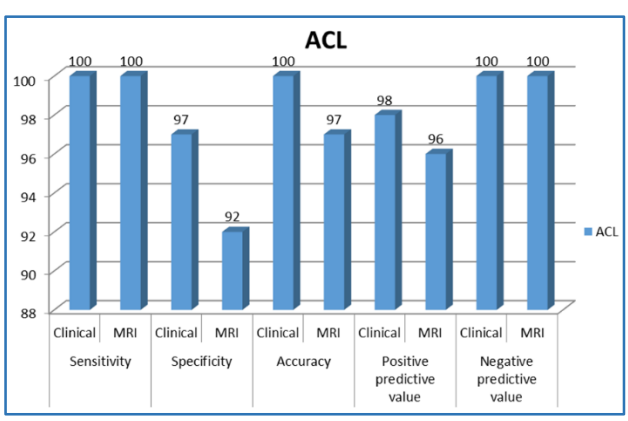

Fig. 5: Bar diagram for anterior cruciate ligament correlation accuracy indices PCL Tears

The study showed high accuracy of 100% for physical tests and 97% for MRI. Physical tests and MRI showed 100% sensitivity and almost similar specificity (100% vs 97%) for PCL tears. 100% PPV and NPV was found for physical tests for PCL tears whereas MRI showed PPV of 33% and NPV of 100% for MRI diagnosis.

The above is showed and tabulated in table 3.

Diagnosis	Sensitivity		Specificity		Accuracy		Positive predictive value		Negative predictive value	
	Clinical	MRI	Clinical	MRI	Clinical	MRI	Clinical	MRI	Clinical	MRI
PCL	100	100	100	97	100	97	100	33	100	100

Table 3: Diagnostic values of PCL tear

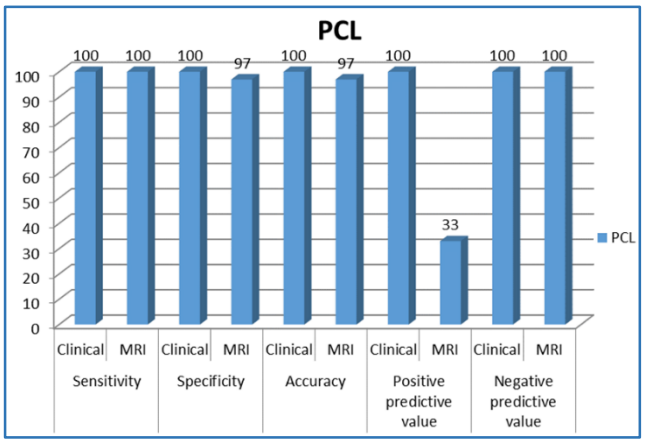

Fig. 6: Bar diagram for posterior cruciate ligament correlation accuracy indices

Group	Total Agreement	Partial Agreement	Total Disagreement
Clinical vs. MRI	47.90%	50.70%	1.40%
Clinical vs. A'scopy	64.40%	32.90%	2.74%
MRI vs. A'scopy	31.50%	65.80%	2.74%

Table 4: Combined meniscal and ligamentous conformation percentages Group

Total agreement with the clinical findings confirmed by gold standard arthroscopy was 64.40% which is relatively high as compared to total agreement of MRI findings which was only 31.50%.

We found similar total agreement versus total disagreement of both clinical and MRI to be only 2.74% of combined meniscal and ligamentous knee injuries.

DISCUSSION: MRI diagnoses the complete spectrum of injuries. Furthermore, it carries a great medico-legal value in the present era besides aiding in diagnosis. The study showed that an experienced clinician can diagnose ACL injury with an accuracy comparable to MRI showing higher accuracy of 100% and 97% respectively. This study showed 100% sensitivity and 97% specificity for clinical tests.

The high specificity is clearly because of a high expertise of the single examiner. Jackson et al[7] proved MRI sensitivity of 100% whereas Glashow[8] study got only 61%. Fischer et al[9] got accuracy of 93% for ACL diagnosis of ACL tears in his multi-centre analysis of 1014 patients. This study got accuracy of 97%.

The MRI sequence protocol and training of radiologist affects the accuracy. The high expertise of a single surgeon led to a PPV of 98% which is similar to multiple studies described.

The present study does points that MRI is not essential for diagnosing ACL tears similar to Nikolaou VS et al[10] study but remains a modality for ruling out or excluding concomitant knee injuries. Rayan[11] confirmed superiority of physical tests and is in conformation with the present study reiterating the immense value of clinical examination prior to the surgery and not solely relying on the MR report which can turn out to be misleading. Madhusudhan et al[12] got the sensitivity of 38.75% for meniscal tears by physical tests very much like a low 66% sensitivity for lateral meniscus and 70% sensitivity for medial meniscus in the present study.

The lateral meniscus showed higher specificity as compared to medial meniscus tears as shown in the studies by Raunest et al[13] and Oei et al[14] which is also substantiated by the present study which reports specificity of 96% and 77% for lateral and medial meniscus respectively.

This study showed MRI sensitivity 88% (Medial meniscus tears) and 75% (lateral meniscus tears). But Rangger et al[15] got MRI sensitivity of 93% (medial meniscus) and 78% (lateral meniscus tears). His MRI specificity was 74% (medial meniscus) and 89% (lateral meniscus).

Our MRI results are superior to many other reports as the MRI specificity was as high as 96% (lateral meniscus) and 77% (medial meniscus). This can be attributed to a better communication between the clinician and the radiologist. The grade 2 meniscal lesions are intra substance tears not warranting any surgery unless accompanied by a strong clinical suspicion of a tear. The literature does suggest that false positives meniscal tears on MRI can lead to unwarranted arthroscopy if clinical evaluation is overlooked.[16]

Stanitski[17] correlated clinical examination, MRI (magnetic resonance imaging) and arthroscopic findings of injured knees in children and adolescents. He found a highly positive correlation between clinical and arthroscopic findings (total agreement of 78.5%), a highly negative correlation between arthroscopic and MRI findings (total disagreement of 78.5%) and a negative correlation between clinical and MRI findings (total disagreement of 75%).

GROUP		TOTAL AGREEMENT			PARTIAL AGREEMENT			TOTAL DISAGREEMENT	
	Stanitski	Brooks et al	Present study	Stanitski	Brooks et al	Present study	Stanitski	Brooks et al	Present study
Clinical v/s MRI	14.30%	73%	47.90%	10.70%	7%	50.70%	75%	20%	1.40%
Clinical v/s A'scopy	78.50%	62%	64.40%	7.10%	14%	32.90%	14.30%	20%	2.74%
MRI v/s A'scopy	7.10%	61%	31.50%	14.30%	16%	65.80%	78.50%	23%	2.74%

Table 5: Combined meniscal and ligamentous conformation percentages as compared to other studies

Total agreement with the clinical findings confirmed by gold standard arthroscopy was 64.40% which is relatively high as compared to total agreement of MRI findings which was only 31.50%. We found similar total agreement versus total disagreement of both clinical and MRI to be only 2.74% indicating very high accuracy in clinical diagnosis of meniscal and ligamentous injuries combined.

Rangger et al[15] as well as Spiers et al[18] showed a 30% reduction in arthroscopy if the preoperative MRI is done before in meniscal tears but Bridgman et al[19] on the contrary showed that MRI had no value in dissuading patients from arthroscopy in his sample of 252 patients. Crotty[20] suggested magnetic resonance imaging to be used as screening tool.

Going by the result of the present study it is suggested that MRI should be favoured by novice surgeon to decrease his false positive arthroscopy indication and the experienced clinician should utilize MRI only for the purpose of negative screening.

Thus the literature is replete with multiple studies showing MRI as indispensable before arthroscopy but cannot match the experienced clinician in the diagnosis of meniscal and ligamentous injuries.

CONCLUSIONS: The study brings back the reliability of physical tests in diagnosing knee meniscal and ligamentous tears rather than relying on MRI predominantly for surgical decision making History and clinical evaluation is equally important and can obviate the need for further expensive and time consuming MRI evaluation for just diagnostic purposes unless concomitant injuries have direct bearing in outcome of therapeutic arthroscopy.

The experienced clinician can take a decision whether an MRI is deemed necessary for diagnosis ultimately affecting decision for therapeutic arthroscopy or just skip the expensive MRI prior to surgery.

Also more importantly many unwarranted pathologies diagnosed on MRI should be discussed with the patient beforehand thereby assisting the surgeon in medicolegal case scenarios. MRI can save unwarranted surgeries due to its high negative predictive value.

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