

ORIGINAL ARTICLE

Accuracy of Clinical Examination versus MRI in the Diagnosis of Anterior Cruciate Ligament Tears taking Arthroscopic Examination as Gold Standard

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ABSTRACT

Objective: To compare the accuracy of clinical examination versus MRI in the diagnosis of ACL tears taking arthroscopic examination as gold standard.

Design: Cross sectional survey.

Place and Duration of Study: This study was conducted in the department of Orthopedics, Sir Ganga Ram Hospital, Lahore from June 2013 to September 2014.

Patients and Methods: In this study, a total of 108 patients suspected of ACL injury presenting in the outdoor of Orthopedic Department, Sir Ganga Ram Hospital, Lahore who subsequently underwent arthroscopy were included. A detailed clinical examination was done to assess ACL status prior to MRI. Findings of clinical examination and MRI were noted. Arthroscopic findings were taken as gold standard and clinical examination and MRI were judged accordingly. A written informed consent was taken from every patient.

Results: The mean age of the patients was 28.81 ± 5.33 years while majority (n=103, 95.4%) patients were male and only 5 (4.6%) were female. Arthroscopy was positive in 62 (57.41%) patients while in the remainder 46 (42.59%) patients it revealed intact ACL. The sensitivity, specificity, accuracy, positive predictive value and negative predictive values of clinical examination were 98.39%, 91.30%, 95.37%, 93.85% and 97.67% respectively and those for MRI were 98.39%, 82.61%, 91.67%, 88.41% and 97.44% respectively.

Conclusion: According to the results of our study, both the clinical examination and MRI are extremely sensitive and accurate in the diagnosis of ACL tear. However, due to higher false positive rate and cost, MRI should be reserved only for doubtful cases or where concomitant other injuries are suspected.

Keywords: ACL Tear, Diagnostic Accuracy of Clinical Examination, Diagnostic Accuracy of MRI

INTRODUCTION

Anterior cruciate ligament (ACL) rupture is a frequent and serious knee injury in the young active population¹ and leads to inadequate knee function, decreased activity, and poor knee related quality of life. It often results in a premature end to a career in sports. Many patients with a torn ACL ultimately develop osteoarthritis of the knee joint regardless of treatment¹⁻³. An estimated global rate of ACL reconstruction is more than 200,000 per year^{4,5}.

Treatment of a torn ACL is mostly surgical. However, an accurate diagnosis is essential before any active intervention^{6,7}. When performed by an expert, clinical examination can accurately

diagnose ACL tear and an MRI evaluation may not be required⁸. Madhusudhan et al. in 2008 reported that clinical examination was more sensitive (100% vs. 54%), specific (97.73% vs. 91.83%) and had higher positive predictive value (85.71% vs. 42.85%) than MRI⁹. Later in 2014, Navali et al. documented that clinical examination was equally sensitive (98.6% vs. 98.6%) but more specific (91.7% vs. 83.3%) than MRI and carried higher positive predictive value (94.7% vs. 89.9%) and accuracy (95.8% vs. 92.5%). They concluded that MRI should not be performed in routine and should be reserved only for doubtful cases¹⁰.

However, clinical examination is subjective and as positive predictive value varies with prevalence, the purpose of the current study was to compare

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the diagnostic accuracy of clinical examination with MRI in local setup with a hope that this study may provide a quick, cheap and effective way of patient assessment in the form of clinical examination limiting the use of MRI only in difficult cases in future, thus reducing economic burden on the society. To the best of author's knowledge, no such local study was available previously.

PATIENTS AND METHODS

108 patients presenting at the outdoor of Orthopedic Department, Sir Ganga Ram Hospital, Lahore with history of sports or accidental injury of knee joint and who subsequently required arthroscopic knee examination were included in the study. Patients with acute trauma, history of previous arthroscopic knee examination or septic knee arthritis were excluded. A written informed consent was taken from every patient. The pivot-shift test, anterior drawer test and Lachman test were performed to establish ACL tear on clinical examination. Clinical examination was considered positive when at least 2 of the tests were positive. These patients later had MRI scan and ACL status on MRI was noted. Arthroscopic findings were taken as gold standard and the findings of clinical examination and MRI were judged accordingly. All the clinical examinations and arthroscopies were performed by a single consultant and all the MRI scans were performed on a single machine by a single radiologist to eliminate bias. Confounding variables were controlled by exclusion.

RESULTS

The mean age of the patients was 28.81±5.33 years as shown in Table 1. Majority (n=103, 95.4%) patients were male and only 5 (4.6%) were female as shown in Table 2.

Arthroscopy was performed in all the 108 patients and it revealed ACL tear in 62 (57.41%) patients while in the remainder 46 (42.59%) patients it revealed intact ACL as shown in Table 3.

Table 1: Descriptive statistics for age

	N	Mean	Std. Deviation
Age	108	28.81	5.325
Valid N (listwise)	108		

Table 2: Gender distribution of the study sample

		Frequency	Percent	Valid Percent
Valid	Male	103	95.4	95.4
	Female	5	4.6	4.6
	Total	108	100.0	100.0

Table 3: ACL status on arthroscopy

		Frequency	Percent	Valid Percent
Valid	Torn	62	57.41	57.41
	Intact	46	42.59	42.59
	Total	108	100.0	100.0

There were 61 true positive, 4 false positive, 1 false negative and 42 true negative cases on clinical examination which yielded sensitivity, specificity, accuracy, positive predictive value and negative predictive value of 98.39%, 91.30%, 93.85%, 97.67% respectively for clinical examination. While there were 61 true positive, 8 false positive, 1 false negative and 38 true negative cases on MRI which yielded sensitivity, specificity, accuracy, positive predictive value and negative predictive value of 98.39%, 82.61%, 88.41%, 97.44% respectively for MRI as shown in Table 4.

Table 4: Statistical analysis of clinical examination (C/E) vs. MRI taking arthroscopy as gold standard.

	True Positive	False Positive	False Negative	True Negative	Sensitivity	Specificity	PPV	NPV	Accuracy
C/E	61	4	1	42	98.39%	91.30%	93.85%	97.67%	95.37%
MRI	61	8	1	38	98.39%	82.61%	88.41%	97.44%	91.67%

DISCUSSION

In patients with knee injuries, MRI offers the advantage of being safer and non-invasive investigation with high sensitivity and accuracy¹¹. Yet its use is limited due to requirement of special hardware and cost¹². Clinical examination on the other hand is free, equally safe and can be readily

performed. However, literature contains conflicting results on the diagnostic accuracy of clinical examination in comparison with MRI where if Nikolaou et al.¹³ in 2008 reported MRI to be superior than clinical examination, Madhusudhan et al.⁹ in 2008 and Navali et al. in 2014¹⁰ reported vice versa.

A recent local study by Rahman et al. in 2010 reported the sensitivity, specificity and accuracy of MRI to be 89.4%, 62% and 76.4% respectively in the diagnoses of Medial Meniscal injuries, while 87%, 88% and 88.2% respectively in the diagnosis of lateral meniscal injuries¹⁴. However, the study didn't consider ACL tear and didn't compare MRI with clinical examination. Another local study by Khanda et al. in 2008 reported sensitivity, specificity, accuracy, PPV and NPV of MRI in diagnosing ACL tear to be 86.67%, 91.43%, 88%, 81%, 94% respectively¹⁵. However, clinical examination was not considered in this study as well. So, during this study, we not only evaluated diagnostic accuracy of MRI but we also compared with that of clinical examination taking arthroscopic findings as gold standard.

In the present study, arthroscopy revealed ACL tear in 57.41% patients while in the remainder 42.59% patients ACL was intact. Clinical examination was equally sensitive (98.39% vs. 98.39%) but more specific (91.30% vs. 82.61%) and accurate (95.37% vs. 91.67%) than MRI having higher positive (93.85% vs. 88.41%) and negative predictive values (97.67% vs. 97.44%). Similar results were reported by Navali et al. in 2014; sensitivity (98.6% vs. 98.6%), specificity (91.7% vs. 83.3%), accuracy (95.8% vs. 92.5%), positive predictive value (94.7% vs. 89.9%) and negative predictive value (97.8% vs. 97.6%)¹⁰.

In the present study we didn't included patients with acute trauma where muscle spasm, swelling and pain can limit range of motion at knee and prevent an appropriate knee examination¹⁶. In such cases, there may be a false drop in the accuracy of clinical examination and MRI may therefore give better results.

One of the limitations of the current study is that we only considered ACL tear and didn't compare the clinical examination and MRI in meniscal injuries which frequently complicate such cases.

CONCLUSION

Clinical examination is thus equally sensitive but more specific and has higher positive predictive value than MRI yet being quick, safe and cheap. It is therefore advisable that it should be preferred over MRI which is expensive and has higher false positive rate. However, in cases where clinical examination is doubtful or where concomitant other injuries are suspected, MRI can be of added help.

REFERENCES

1. Spindler KP, Wright RW. Clinical practice: anterior cruciate ligament tear. *N Engl J Med* 2008;359(20):2135-42.
2. Lohmander LS, Englund PM, Dahl LD, Roos EM. The long-term consequence of ACL and meniscus injuries: osteoarthritis. *Am J Sports Med* 2007;35(10):1756-69.
3. Oiestad BE, Engebretsen L, Storheim K, Risberg MA. Knee osteoarthritis after anterior cruciate ligament injury: a systematic review. *Am J Sports Med* 2009;37(7):1434-43.
4. Meuffels DE, Favejee MM, Vissers MM, Heijboer MP, Reijnen M, Verhaar JA. Ten year follow-up study comparing conservative versus operative treatment of anterior cruciate ligament ruptures. A matched-pair analysis of high level athletes. *Br J Sports Med* 2009;43(5):347-51.
5. Mather RC 3rd, Koenig L, Kocher MS, Dall TM, Gallo P, Scott DJ, et al. Societal and economic impact of anterior cruciate ligament tears. *J Bone Joint Surg Am* 2013;95(19):1751-9.
6. Strehl A, Eggl S. The value of conservative treatment in ruptures of the anterior cruciate ligament (ACL). *J Trauma* 2007;62(5):1159-62.
7. Frobell RB, Roos HP, Roos EM, Roemer FW, Ranstam J, Lohmander LS. Treatment for acute anterior cruciate ligament tear: five year outcome of randomised trial. *BMJ* 2013;346:f232.
8. Cimino F, Volk BS, Setter D. Anterior Cruciate Ligament Injury: Diagnosis, Management, and Prevention. *Am Fam Physician* 2010;82(8):917-22.
9. Madhusudhan TR1, Kumar TM, Bastawrous SS, Sinha A. Clinical examination, MRI and arthroscopy in meniscal and ligamentous knee injuries - a prospective study. *J Orthop Surg Res* 2008;3:19.
10. Navali AM, Bazavar M, Mohseni MA, Safari B, Tabrizi A. Arthroscopic evaluation of the accuracy of clinical examination versus MRI in diagnosing meniscus tears and cruciate ligament ruptures. *Arch Iran Med* 2013;16(4):229-32.
11. Alex WH, Griffith JF, Hung EHY, Paunipage B, Law BKY, Yung PSH. Imaging of the anterior cruciate ligament. *World J Orthop* 2011;2(8):75-84.
12. DAMASK (Direct Access to Magnetic Resonance Imaging: Assessment for Suspect Knees) Trial Team. Cost-effectiveness of

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- magnetic resonance imaging of the knee for patients presenting in primary care. *Br J Gen Pract* 2008;58(556):e10-6.
13. Nikolaou VS, Chronopoulos E, Savvidou C, Plessas S, Giannoudis P, Efstathopoulos N, et al. MRI efficacy in diagnosing internal lesions of the knee: a retrospective analysis. *J Trauma Manag Outcomes* 2008;2:4.
 14. Rahman A, Nafees M, Akram MH, Andrabi AH, Zahid M. Diagnostic accuracy of magnetic resonance imaging in meniscal injuries of knee joint and its role in selection of patients for arthroscopy. *J Ayub Med Coll Abbottabad* 2010;22(4):10-4.
 15. Khanda G, Akhtar W, Ahsan H, Ahmad N. Assessment of menisci and ligamentous injuries of the knee on magnetic resonance imaging: correlation with arthroscopy. *J Pak Med Assoc* 2008;58(10):537-40.
 16. Frobell RB, Lohmander LS, Roos HP. Acute rotational trauma to the knee: poor agreement between clinical assessment and magnetic resonance imaging findings. *Scand J Med Sci Sports* 2007;17(2):109-14.