Clinical Diagnostic Tests Versus MRI Diagnosis of ACL Tears

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Clinical Scenario: The anterior cruciate ligament (ACL) injury is a common knee injury within varying athletic levels. Clinical diagnostic tests and magnetic resonance imaging (MRI) are two methods of evaluating ACL injuries. **Clinical Question:** Are clinical diagnostic tests as accurate as MRI when diagnosing ACL tears? **Summary of Key Findings:** Three cross-sectional design studies were included. One study found that clinical diagnostic tests were superior to MRI when diagnosing an ACL tear. Another study found that clinical diagnostic tests were equal to MRI when measuring sensitivity, but scored higher in specificity, positive predictive value, negative predictive value, and diagnostic accuracy. The last study found that clinical diagnostic tests scored higher than MRI on specificity and positive predictive value, were equal when measuring accuracy, and scored lower when measuring sensitivity and negative predictive value. **Clinical Bottom Line:** The evidence supports the use of clinical diagnostic tests when diagnosing an ACL tear. **Strength of Recommendation:** Level 2–3.

Keywords: anterior cruciate ligament, evaluation, knee joint, clinical evaluation, magnetic resonance imaging

Clinical Scenario

A common injury among elite, recreational, and youth athletes is the anterior cruciate ligament (ACL) tear.¹ Approximately 200,000 ACL injuries occur every year.² The gold standard in ACL injury evaluation is diagnostic arthroscopy^{3,4}; however, the diagnostic accuracy of clinical diagnostic tests and magnetic resonance imaging (MRI) is debatable.^{1,3–6} Because of the frequency of knee injury,³ MRI is a common diagnostic tool used for imaging and diagnosis.⁵ ACL tears are also diagnosed using clinical diagnostic tests.^{1,3–6} Patient outcomes are dependent on a clinician's ability to detect an ACL tear, as the length of time required to obtain an MRI and results can be extensive. If an ACL tear is initially diagnosed accurately with clinical diagnostic tests, then the patient could be removed from athletics or work activities to prevent further injury to the knee and could be referred to an orthopedic surgeon for further evaluation. If clinical diagnostic tests are as accurate as MRI when diagnosing an ACL tear, both time and money could be saved for the patient. The patient could be referred to an orthopedic surgeon sooner, and surgical reconstruction could be completed. By saving time and not waiting for an MRI and results, the patient could return to athletics or work activities sooner. If the ACL is diagnosed as intact via clinical diagnostic tests, the patient could save money by avoiding an MRI. Clinical diagnostic tests with a high specificity could allow patients to return to athletics or work sooner, saving time and money by avoiding an MRI test and results. These factors combined could improve patient outcomes.

Focused Clinical Question

Are clinical diagnostic tests as accurate as MRI when diagnosing ACL tears?

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Summary of Search, “Best Evidence” Appraised, and Key Findings

- One study found that clinical diagnostic tests were superior to MRI when diagnosing an ACL tear.⁶
- One study found that, when conducted proficiently, clinical diagnostic tests were equal to MRI when measuring sensitivity, but scored higher in specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy.⁵
- One author determined that when diagnosing ACL tears, clinical diagnostic tests scored higher than MRI on specificity and PPV, were equal when measuring accuracy, and scored lower when measuring sensitivity and NPV.⁴

Clinical Bottom Line

The evidence supports the use of clinical diagnostic tests when diagnosing an ACL tear. Clinical diagnostic tests are equally or more diagnostically accurate as an MRI in the diagnosis of an ACL tear.

Strength of Recommendation

Grade C evidence supports that clinical diagnostic tests are equally or more diagnostically accurate than MRI in the diagnosis of ACL tears. Limited sample sizes are available, and further investigation is needed. Therefore, these findings should not be considered definitive.

Search Strategy

Terms Used to Guide Search Strategy

- Patient/Client group: individuals with an ACL injury
- Assessment: clinical diagnostic tests

- Comparison: MRI
- Outcome: ACL tear diagnosis

Sources of Evidence Searched (Databases)

- Medline/PubMed
- ScienceDirect
- University library databases
 - Academic OneFile (Gale)
 - CINAHL (EBSCO)
 - Education Full Text (EBSCO)
 - ERIC (EBSCO)
 - Health Source: Nursing/Academic (EBSCO)
 - JSTOR
 - PubMed
 - ScienceDirect (Elsevier)
 - SPORTDiscus (EBSCO)
- Review of reference lists

Inclusion and Exclusion Criteria (Include Search Limits)

Inclusion Criteria

- Studies investigated participants with an ACL tear.
- Studies compared clinical diagnostic tests to MRI in diagnosis of ACL tears.
- Studies used arthroscopy as diagnostic gold standard.
- Level 3 evidence or higher.
- Limited to English language.
- Limited to humans.
- Limited to last 5 years (2013–2017).

Exclusion Criteria

- Studies including participants with acute injuries.
- Studies including participants with inconclusive MRI and clinical diagnostic test diagnoses.
- Studies including participants who were treated nonoperatively.
- Studies including participants with history of previous knee injury.
- Studies including participants with history of prior knee surgery.

Results of Search

Three relevant studies^{4–6} were identified and are listed as shown in Table 1.

Best Evidence

The studies^{4–6} in Table 2 were identified as the best evidence and selected for inclusion in this literature review. These studies were selected because they investigated the following:

- Participants with ACL tears

Table 1 Summary of Study Designs of Articles Retrieved

Level of evidence	Study design/methodology of articles retrieved	Number located	Reference
2	Cross-sectional, descriptive analytical study	1	Navali et al ⁵
3	Local nonrandom sample	2	Kostov et al ⁶ Siddiqui et al ⁴

- Cross-sectional design comparing diagnostic accuracy of clinical diagnostic tests to MRI in the diagnosis of ACL tears
- The use of arthroscopy as the gold standard

Implications for Practice, Education, and Future Research

Knee injuries, specifically ACL tears, are increasing every year.² Clinical examination of knee injuries is indicated immediately following injury.⁶ The clinical exam will include observation, palpation, clinical diagnostic tests, and a neurological exam.⁷ Positive clinical diagnostic tests should prompt the examiner to refer the patient for further diagnostic testing. Three methods of ACL injury diagnosis utilized are clinical diagnostic tests, MRI, and diagnostic arthroscopy.^{4–6} The 3 commonly used diagnostic tests are Lachman test, anterior drawer test, and pivot shift test.^{1,4–6} The Lachman test is conducted with the patient lying supine. The knee is passively flexed to 20 to 25 degrees of flexion. One of the examiner's hands is placed just superior to the femoral condyles, and the other hand grasps the patient's tibia about the tibial tuberosity. The examiner applies posterior pressure to the femur, while simultaneously attempting to translate the tibia anteriorly. When compared bilaterally, a positive Lachman test is indicated by increased anterior tibial translation or absence of a firm endpoint.⁷ The anterior drawer test is performed with the patient supine, hip flexed to 45° and knee flexed to 90°. The examiner sits on the examination table near the patient's foot, placing both hands around the proximal lower leg, just inferior to the joint line of the knee. The examiner's thumbs are placed on the patient's medial and lateral joint lines on both sides of the patellar tendon. The examiner attempts to draw the patient's tibia anteriorly. When compared bilaterally, a positive anterior drawer test is indicated by increased anterior tibial translation or absence of a firm endpoint.⁸ When conducting the pivot shift test, the patient is supine, and the hip is passively flexed to 30°. The examiner stands lateral to the patient, grasps the patient's ankle, and internally rotates the tibia 20°. The examiner allows the knee to fully extend and places the opposite hand on the lateral aspect of the lower leg at the superior tibiofibular joint. The examiner maintains tibia internal rotation, then flexes the knee and applies a valgus force to the knee. Between 30 and 40 degrees of flexion, the patient's tibia reduces on the femur, indicating a positive test.⁸ According to van Eck et al,¹ when diagnosing an acute, complete ACL tear, the Lachman test has the highest sensitivity. The authors also concluded that specificity was comparable between the Lachman test, anterior drawer test, and pivot shift test.¹ These findings by van Eck et al¹ support the

Table 2 Characteristics of Included Studies

	Siddiqui et al ⁴	Navali et al ⁵	Kostov et al ⁶
Study design	Local, nonrandom study	Cross-sectional, descriptive analytical study	Local, nonrandom study
Participants	75 participants (14–71 y; 31 men and 20 women) with traumatic knee injury and suspected meniscal or ACL injury undergoing both MRI and arthroscopy Exclusion criteria: no additional injury to the knee between time of clinical diagnosis/MRI and arthroscopy, inconclusive findings on clinical exam and MRI, evidence of degenerative changes on plain radiography, history of previous knee injury or surgery, patients treated conservatively All participants completed the study	120 participants (29.13 [7.37] y) with meniscus tears and cruciate ligament injuries Exclusion criteria: acute injuries, patient with previous history of arthroscopy, patients with history of any other knee surgery	103 patients (16–58 y; 81 men and 22 women) with a history of knee injuries Exclusion criteria: none listed
Intervention investigated	All participants were examined by an experienced orthopedic surgeon ACL injury was diagnosed based on a Lachman test and an anterior drawer test After clinical examination, plain radiographs and MRI were performed A single radiologist reported on all MRI scans	All participants completed the study Physical examinations were conducted by physicians who lacked prior knowledge of the patient's MRI results All physical exams were performed by a physician specialized in knee surgery and included examinations of ACL, anterior drawer tests, lateral pivot shift, Lachman, posterior cruciate ligament, active quadriceps, and posterior drawer Arthroscopy surgeries were conducted by an experienced surgeon with cooperation of his assistants. All MRI results were reported by a radiologist specialized in this field Arthroscopic findings were used as final, definitive diagnosis, and compared with the physical exam and MRI scans	Assigned to normal group or complete tears and partially torn ligaments group All participants completed the study MRI of the knee joint was done before admission and in some cases before the clinical diagnostic tests Clinical diagnostic tests involved assessing anterior drawer test, pivot shift test, and positive Lachman test All clinically diagnosed patients underwent diagnostic and therapeutic knee arthroscopy to assess the accuracy of clinical diagnostic tests All arthroscopic procedures were performed in a standard manner by an experienced arthroscopic surgeon

(continued)

Table 2 (continued)

	Siddiqui et al ⁴			Navali et al ⁵			Kostov et al ⁶		
Outcome measure(s)	Study 1 (Siddiqui et al ⁴)			Study 2 (Navali et al ⁵)			Study 3 (Kostov et al ⁶)		
	CDT	MRI		CDT	MRI		CDT	MRI	
	Sensitivity	Sensitivity		TP	TP		Sensitivity	Sensitivity	
	Specificity	Specificity		TN	TN		Specificity	Specificity	
	PPV	PPV		FN	FN		PPV	PPV	
	NPV	NPV		Sensitivity	Sensitivity		NPV	NPV	
	Accuracy	Accuracy		Specificity	Specificity		Accuracy	Accuracy	
				PPV	PPV				
				NPV	NPV				
				Accuracy	Accuracy				
Main findings		CDT	MRI		CDT	MRI		CDT	MRI
	Sensitivity	77.8%	88.9%	TP	71 (59.2%)	1 (59.2%)		AD	PS
	Specificity	97.6%	95.2%	TN	4 (3.3%)	8 (6.7%)	Sensitivity	94.5%	91.7%
	PPV	87.5%	80.0%	FP	44 (36.7%)	40 (33.3%)	Specificity	100%	100%
	NPV	95.4%	97.6%	FN	1 (0.8%)	1 (0.8%)	PPV	100%	100%
	Accuracy	94.1%	94.1%	Sensitivity	98.6%	98.6%	NPV	89.4%	85.7%
				Specificity	91.7%	83.3%	Accuracy	96.1%	71.8%
				PPV	94.7%	89.9%			
				NPV	97.8%	97.6%			
				Accuracy	95.8%	92.5%			
Level of evidence	CEBM level 2			CEBM level 3			CEBM level 3		
Validity score (if applicable)	PEDro score: 6/10			PEDro score: 4/10			PEDro score: 5/10		
Conclusion	When performed proficiently and in the case of single injuries, clinical diagnostic tests were more accurate than MRI when diagnosing an ACL tear. If the case was complex, MRI was more sensitive for diagnosing ACL injuries			When performed proficiently, clinical diagnostic tests were more accurate than MRI when diagnosing ACL injuries			When performed proficiently, clinical diagnostic tests were as accurate as MRI when diagnosing ACL tears		

Abbreviations: ACL, anterior cruciate ligament; AD, anterior drawer; CDT, clinical diagnostic tests; CEBM, Centre for Evidence-Based Medicine; FN, false negative; LT, Lachman test; MRI, magnetic resonance imaging; NPV, negative predictive value; PPV, positive predictive value; PS, pivot shift; TN, true negative; TP, true positive.

clinical diagnostic test findings of the articles reviewed in this critically appraised topic.⁴⁻⁶

When comparing the diagnostic accuracy of clinical diagnostic tests and MRI in the diagnosis of ACL tears, Kostov et al⁶ conducted a prospective study to compare clinical diagnostic tests with MRI in the diagnosis of ACL tears. Kostov et al⁶ found that clinical diagnostic tests were superior to the MRI in diagnosing an ACL tear in all measured categories: sensitivity (94.3% vs 83%), specificity (110% vs 88.3%), PPV (100% vs 93%), NPV (89.4% vs 74.5%), and accuracy (96.1% vs 82.5%). Additionally, Navali et al⁵ determined that, if conducted proficiently, the clinical diagnostic tests were equal to MRI when measuring sensitivity (98.6%), but scored higher in specificity (91.7% vs 83.3%), PPV (94.7% vs 89.9%), NPV (97.8% vs 97.6%), and diagnostic accuracy (95.8% vs 92.5%). Siddiqui et al⁴ determined that clinical diagnostic tests scored higher than MRI on specificity (97.6% vs 95.2%) and PPV (87.5% vs 80.0%), were equal when measuring accuracy (94.1%), and scored lower when measuring sensitivity (77.8% vs 88.9%) and NPV (95.4% vs 97.6%).

The ability to diagnose an ACL tear using clinical diagnostic tests could have major implications for the patient. Diagnosing an ACL tear accurately using clinical diagnostic tests could disqualify the patient from further physical or work-related activity and prevent increased trauma to the knee.^{9,10} Additionally, if an ACL tear is promptly and accurately diagnosed with clinical diagnostic tests, preoperative rehabilitation can be initiated immediately, improving patient functional outcomes and return to sport rates.¹¹ Moreover, an MRI can be a costly diagnostic test, and the sensitivity is variable and based on the ability of the examiner.³ According to Kostov et al,⁶ if an ACL tear is diagnosed clinically, an MRI is an unnecessary and expensive test. A clinically diagnosed ACL tear may not warrant an MRI, due to lack of significance,⁶ and if the clinical diagnostic tests are accurate, a negative clinical exam could negate the need for the MRI. Accurately diagnosing or ruling out an ACL tear with clinical diagnostic tests could save the patient, patient's family, employer, or school money by avoiding an MRI. Early diagnosis and prevention of additional knee trauma,⁹ along with preoperative rehabilitation,¹¹ and cost savings may lead to improved patient outcomes.

Future research is necessary to determine if clinical diagnostic tests are more diagnostically accurate than MRI in the diagnosis of ACL tears. More studies will need to be conducted to compare specificity, sensitivity, PPV, NPV, and accuracy of clinical diagnostic tests and MRI, as well as clinical diagnostic tests proficiency of the examiner.

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