

Diagnostic Accuracy Of Lachman Test For Diagnosis Of Anterior Cruciate Ligament Tear In Adults With Knee Injuries Using Arthroscopy As Gold Standard

Danyal Ashraf¹, Muhammad Sheraz Mustafa², Sarmad Nasir Janjua³, Shaheen Iqbal⁴, Khurram Habib⁵

Abstract

Objective: To evaluate the Lachman test's ability to identify an ACL rupture using arthroscopy as the gold standard.

Methods: This cross-sectional (validation) study was done from September 2022 to March 2023. Individuals presenting with a knee injury were enrolled and underwent Lachman test and later on arthroscopy and findings will be recorded. SPSS version 25 was used to analyze the collected data.

Results: 150 patients were enrolled with a mean age of 39.95 ± 11.46 years. There were 80 (53.3%) male patients and 70 (46.7%) were females. In this study, we observed that the Lachman test had 81.8% sensitivity, 95.2% specificity, PPV & NPV were 93.1% and 87.0%, respectively and diagnostic accuracy of 89.3%.

Conclusion: Thus, the Lachman test is a reliable test for the diagnosis of anterior cruciate ligament tear in knee injuries, which can replace arthroscopy and other invasive or expensive modalities.

Keywords: Diagnostic accuracy, Lachman test, anterior cruciate ligament tear, arthroscopy, knee injury

¹ Postgraduate Trainee, PAEC General Hospital, Islamabad; ^{2,3,4,5} Consultant Orthopedics Surgeon, PAEC General Hospital Islamabad.

Correspondence: Dr. Danyal Ashraf, Postgraduate Trainee, PAEC General Hospital, Islamabad. Email: danyal_roy@hotmail.com

Cite this Article: Ashraf D, Mustafa MS, Janjua SN, Iqbal S, Habib K. Diagnostic Accuracy Of Lachman Test For Diagnosis Of Anterior Cruciate Ligament Tear In Adults With Knee Injuries Using Arthroscopy As Gold Standard. JRMC. 2023 Dec. 30;27(4). <https://doi.org/10.37939/jrmc.v27i4.2287>.

Received May 03, 2023; accepted October 26, 2023; published online December 30, 2023

1. Introduction

The anterior cruciate ligament (ACL) is one of the knee's two cruciate ligaments. It is the most frequent knee ligament injury, especially among athletes who play contact sports like football, soccer, and basketball.¹ The anterior cruciate ligament is one of the knee's two cruciate ligaments. Anterior to the intercondylar region of the tibial plateau, this thick band of connective tissue and collagenous fibres runs posteromedially to join the lateral femoral condyle.²⁻⁴ There is no difference in prevalence based on age or gender, but there is some evidence to suggest that women may be more likely to suffer an anterior cruciate ligament injury than men. Researchers have shown that women tend to rely more on their quadriceps than their hamstrings when slowing down. The anterior cruciate ligament is disproportionately stressed when the quadriceps are used to slow down, as they are less effective than the hamstrings at avoiding anterior tibial translation. Increased valgus angulation of the knee is another possible contributor to ACL damage.^{5,6}

Even though an anterior cruciate ligament tear can be diagnosed clinically, MRI is often applied to confirm the diagnosis of anterior cruciate ligament injury. With a sensitivity of 86% and specificity of 95%, MRI is the gold standard for diagnosing anterior

cruciate ligament disease. Knee arthroscopy can distinguish between total and partial tears, as well as persistent tears. Due to its invasive nature and need for anaesthesia, arthrography is seldom used as the first step in the diagnosis, despite its excellent accuracy (92%-100% sensitive) and high sensitivity (95%-100%).¹ The Lachman test is a specific kind of clinical examination used to evaluate an injury to the anterior cruciate ligament. The test's sensitivity and specificity depend on the ability of an individual to do it in the correct posture and manner, and it is considered the gold standard for identifying recent anterior cruciate ligament tears.⁷

The Lachman test is a noninvasive and potentially effective diagnostic technique for anterior cruciate ligament tear. Yet, evidence is lacking in a local context. As a result, there is a pressing need for research into the utility of the Lachman test in the diagnosis of anterior cruciate ligament injuries, so that the number of needless operations and the application of costly, inconvenient modalities may be reduced. As a result, we set out to undertake this research to collect data applicable to the area. This would have allowed us to collect data from the area, and in the future, we can use this evidence to design more effective tests and modalities, thereby reducing the need for invasive treatments.

2. Materials & Methods

Study design: Cross-sectional (validation) study

Study place: Department of Orthopaedic Surgery, PAEC Hospital, Islamabad

Study period: 6 months i.e. 1st September 2022 to 1st March 2023

Sample size: B using two proportion formula of sample size, 150 cases were estimated taking confidence level at 95%, the margin of error at 7.5% & percentage of anterior cruciate ligament tear i.e. 68.6% in patients with knee injury⁸

Sampling technique: "Non-probability, consecutive sampling"

Selection of patients: Individuals aged 20-60 years, both genders, presented with a knee injury were registered for the study. Individuals with previous arthroscopy of the same knee, who already had knee implants and muscular or skeletal dystrophy were excluded.

Data collection method: Individuals who fulfilled the above criteria were enrolled from the emergency. Informed consent was taken. Demographics like name, age, sex, duration of injury, lateral side, and type of injury were noted. Then patients underwent the Lachman test by the researcher. The patient was placed in a supine position. The knee was flexed between 20 and 30 degrees. The leg should be externally rotated ever-so-slightly, as instructed by Bates' Handbook to Physical Examination. The thigh was grasped with one hand and the tibia with the other. The thumb should be resting on the tibial tuberosity. The intact anterior cruciate ligament should avert the tibia from translating forward on the femur in response to an anterior tibial pull ("firm end-feel"). A good result is indicated by the presence of anterior tibial translation and a mushy or soft end feel. A ruptured anterior cruciate ligament is suspected when there is about >2 mm anterior translation relative to an uninvolved knee. When measuring displacement in millimetres, a device known as a "KT-1000" is useful. Positive ACL injury testing was defined as >2 mm of injured knee anterior translation, relative to the un-injured side, and tibial movement >5 mm in the normal limb was considered a positive test. Meanwhile, arthroscopies were performed on patients while they were unconscious. The operational definition will be used to determine whether a patient will be classified as positive or negative. A complete set of information was compiled in a proforma.



Fig-1 Application of Lachman Technique to diagnose anterior tibial translation

Statistical analysis: All the data was analyzed in SPSS v. 25. A 2x2 table was generated to calculate diagnostic accuracy including: "sensitivity, specificity, PPV & NPV."

3. Results

A total of 150 patients were enrolled in the study with a mean age of 39.95 ± 11.46 years. There were 80 (53.3%) male patients and 70 (46.7%) were females. The mean BMI of patients was 28.87 ± 4.34 kg / m². The mean duration of injury was 6.30 ± 3.25 hours. Out of 150 patients, 71 (47.3%) cases came from rural areas while 79 (5.7%) cases came from urban areas. About 70 (46.7%) patients had injuries to the left knee while 80 (53.3%) patients had injuries to the right knee. Diabetes was present in 63 (42.0%) cases, while 59 (39.3%) patients were hypertensive and 48 (32.0%) patients were smokers. Out of 150 patients, 24 (16.0%) patients had a history of hitting with football, 38 (25.3%) patients had a history of hitting with the bat, 22 (14.7%) patients had a history of hitting with table or furniture, 21 (14.0%) patients hit to ground while fall from height, 17 (11.3%) patients got injury during fighting and 28 (18.7%) patient had injury due to accident with traffic vehicle. Out of 150 patients, 33 (22.0%) patients had injuries at the play-ground, 28 (18.7%) patients had injuries in the playground at home, 21 (14.0%) patients had injuries inside the home (mostly hit with furniture), 37 (24.7%) patients had an injury at the workplace, and 31 (20.7%) patients had an injury on the road during a traffic accident. Table-1

Table-1 Baseline features of patients

Feature	Mean \pm SD, F (%)
n	150
Age (in years)	39.95 \pm 11.46
Gender	
Male	80 (53.3%)
Female	70 (46.7%)
BMI (in kg/m ²)	28.87 \pm 4.34
Duration of injury (in hours)	6.30 \pm 3.25
Residence	
Rural	71 (47.3%)
Urban	79 (5.7%)
Lateral side	
Left	70 (46.7%)
Right	80 (53.3%)
Comorbidities	
Diabetes	63 (42.0%)
Hypertension	59 (39.3%)
History of Smoking	48 (32.0%)
Cause of injury	
Football hit	24 (16.0%)
Hit with Bat	38 (25.3%)
Hit with Table/Furniture	22 (14.7%)
Hit to ground	21 (14.0%)
Fighting	17 (11.3%)
Hit with vehicle	28 (18.7%)
Place of injury	
Playground	33 (22.0%)
Home ground	28 (18.7%)
Inside home	21 (14.0%)
Workplace	37 (24.7%)
On road	31 (20.7%)

In this study, we observed that the Lachman test showed 81.8% sensitivity, while 95.2% specificity, PPV & NPV were 93.1% and 87.0%, respectively and the overall diagnostic accuracy of the test was 89.3%.

Table-2

Table-2 Screening of Patients

		Arthroscopy		Total
		Positive	Negative	
Lachman test	Positive	54	4	58
	Negative	12	80	92
Total		66	84	150

Sensitivity = 81.8%, specificity = 95.2%, PPV = 93.1%, NPV = 87.0%, diagnostic accuracy = 89.3%.

5. Discussion

Injury of the anterior cruciate ligament is the most common knee injury among teenagers and young adults when participating in sports that require quick starts, stops, changes in direction, and landings.⁹ Acute signs and symptoms, such as pain, oedema, and hemarthrosis, make it challenging to diagnose an anterior cruciate ligament injury during the initial medical consultation. Previous research conducted in the United Kingdom found that only 28.2% and 14.4% of anterior cruciate ligament injuries were correctly diagnosed during the acute phase. This suggests that diagnostic accuracy is lower and more challenging during this time. The median time to diagnosis was six weeks after the injury occurred.^{10, 11} The risk of secondary knee injury is increased when the diagnosis is inaccurate within the first six weeks following the injury. This is commonly due to a delay in the diagnosis and subsequent treatment.¹ Reducing these subsequent hazards and managing ACL injuries properly requires prompt and accurate diagnosis in the acute period.¹²

When an ACL injury is suspected, a doctor will perform a test called the Lachman test to determine how much of the ligament has been compromised. This variant of the anterior drawer test measures how far the tibia has advanced in front of the femur. Compared to the anterior drawer test and the pivot shift test, the Lachman test has been shown in several trials to be more reliable in detecting recent ACL damage.^{13, 14}

In this study, we observed that the Lachman test had a Sensitivity of 81.8% and, a specificity of 95.2%, overall while PPV & NPV were 93.1% and 87.0%, respectively and diagnostic accuracy of 89.3%. According to research by Jackson et al., Lachman's test has the highest sensitivity (87%) and specificity (93%)

for determining whether or not the anterior cruciate ligament is intact.¹⁵ Another study found that the Sensitivity of the Lachman test was 98% and specificity was 90%.¹⁶ Benjaminse's meta-analysis found that the combined sensitivity of the Lachman test was 85%.¹⁷ According to Liu's research, the sensitivity of the Lachman test was 95%.¹⁸

Comparable research by Thapa et al. reported that the sensitivity of the Lachman test was 91.42 per cent and its specificity was 95.55 per cent.¹⁹ The findings were consistent with those found in a meta-analysis by Benjamin et al., who pooled the sensitivity and specificity of the Lachman test to be 85% and 94%, respectively, for the diagnosis of ACL tears across 28 investigations.²⁰ Kostov et al., in a similar study, found Sensitivity of the Lachman test was 91.7%, and Specificity was 100%.²¹ In a study by Makhmalbaf et al., the Sensitivity of Lachman test was 93.5%.²² The reliability of the Lachman test may be affected by several external variables. Hemarthrosis may cause substantial hamstring guarding and spasms due to discomfort during the range of motion caused by the increased intra-articular volume. If the patient's knee has limited mobility, the Lachman test may not be accurate.²³ The Lachman test's sensitivity may be improved in individuals with suspected hemarthrosis if the knee joint is suctioned before the examination.^{24, 25.}

5. Conclusion

Thus, the Lachman test is a reliable test for the diagnosis of anterior cruciate ligament tear in knee injuries, which can replace arthroscopy and other invasive or expensive modalities. Now in future, we will apply the Lachman test for diagnosis of anterior cruciate ligament tear in knee injuries instead of going for invasive methods. This would ultimately reduce the need for other tools for surgery including anesthesia and surgical expertise.

CONFLICTS OF INTEREST- None

Financial support: None to report.

Potential competing interests: None to report

Contributions:

D.A, K.H - Conception of study

M.S.M, S.N.J - Experimentation/Study Conduction

S.I - Analysis/Interpretation/Discussion

D.A, S.N.J - Manuscript Writing

K.H - Critical Review

M.S.M - Facilitation and Material analysis

References

1. Evans J. Anterior cruciate ligament knee injuries. StatPearls [Internet]: StatPearls Publishing; 2022.
2. Gupta R, Malhotra A, Sood M, Masih GD. Is anterior cruciate ligament graft rupture (after successful anterior cruciate ligament reconstruction and return to sports) a graft failure or a re-injury? *J Orthop Surg*. 2019;27(1):2309499019829625. doi.org/10.1177/2309499019829625
3. Hoogeslag RAG, Brouwer RW, Boer BC, de Vries AJ, Huis In 't Veld R. Acute anterior cruciate ligament rupture: repair or reconstruction? two-year results of a randomized controlled clinical trial. *Am J Sport Med*. 2019;47(3):567-77. doi: 10.1177/0363546519825878
4. Barfod KW, Rasmussen R, Blaabjerg B, Hölmich P, Lind M. [Return to play after anterior cruciate ligament reconstruction]. *Ugeskrift for læger*. 2019;181(8).
5. Davey A, Endres NK, Johnson RJ, Shealy JE. Alpine Skiing Injuries. *Sports health*. 2019;11(1):18-26. doi: 10.1177/1941738118813051
6. Vaudreuil NJ, Rothrauff BB, de Sa D, Musahl V. The Pivot Shift: current experimental methodology and clinical utility for anterior cruciate ligament rupture and associated injury. *Curr Rev Musculoskel Med*. 2019;12(1):41-9. doi: 10.1007/s12178-019-09529-7
7. Coffey R, Bordoni B. Lachman test. StatPearls [Internet]: StatPearls Publishing; 2022.
8. Sanders TL, Maradit Kremers H, Bryan AJ, Larson DR, Dahm DL, Levy BA, et al. Incidence of anterior cruciate ligament tears and reconstruction: a 21-year population-based study. *Am J Sport Med*. 2016;44(6):1502-7. doi: 10.1177/0363546516629944
9. Wang L-J, Zeng N, Yan Z-P, Li J-T, Ni G-X. Post-traumatic osteoarthritis following ACL injury. *Arth Res Therap*. 2020;22(1):57. doi: 10.1186/s13075-020-02156-5
10. Li Z, Li Q, Tong K, Zhu J, Wang H, Chen B, et al. BMSC-derived exosomes promote tendon-bone healing after anterior cruciate ligament reconstruction by regulating M1/M2 macrophage polarization in rats. *Stem Cell Res Therap*. 2022;13(1):295. doi: 10.1186/s13287-022-02975-0
11. Losciale JM, Zdeb RM, Ledbetter L, Reiman MP, Sell TC. The association between passing return-to-sport criteria and second anterior cruciate ligament injury risk: a systematic review with meta-analysis. *J Orthop Sports Phys Therap*. 2019;49(2):43-54. doi: 10.2519/jospt.2019.8190
12. Tanaka S, Inoue Y, Masuda Y, Tian H, Jung H, Tanaka R. Diagnostic accuracy of physical examination tests for suspected acute anterior cruciate ligament injury: a systematic review and meta-analysis. *Int J Sports Phys Therap*. 2022;17(5):742. doi: 10.26603/001c.36434
13. Krause M, Freudenthaler F, Frosch KH, Achtnich A, Petersen W, Akoto R. Operative versus conservative treatment of anterior cruciate ligament rupture. *deut Arztebl Int*. 2018;115(51-52):855-62. doi: 10.3238/arztebl.2018.0855
14. Singh S, Ul Haq R, Arora J. The outcome of arthroscopic anterior cruciate ligament reconstruction in low-demand, non-

- athletic patients following a home-based rehabilitation protocol. *Cureus*. 2023;15(6):e39851. doi: 10.7759/cureus.39851
15. Jackson JL, O'Malley PG, Kroenke K. Evaluation of acute knee pain in primary care. *Ann Intern Med*. 2003;139(7):575-88. doi: 10.7326/0003-4819-139-7-200310070-00010
 16. Makhmalbaf H, Moradi A, Ganji S, Omid-Kashani F. Accuracy of lachman and anterior drawer tests for anterior cruciate ligament injuries. *Arch Bone Joint Surg*. 2013;1(2):94-7.
 17. Benjaminse A, Gokeler A, van der Schans C. Clinical diagnosis of an anterior cruciate ligament rupture. *J Orthop Sports Phys Ther*. 2006;36:67-88. doi: 10.2519/jospt.2006.2011
 18. Liu SH, Osti L, Henry M, Bocchi L. The diagnosis of acute complete tears of the anterior cruciate ligament. Comparison of MRI, arthrometry and clinical examination. *Bone Joint J*. 1995;77(4):586-8.
 19. Thapa S, Lamichhane A, Mahara D. Accuracy of Lelli test for anterior cruciate ligament tear. *J Inst Med*. 2015;38(2).
 20. Benjaminse A, Gokeler A, van der Schans CP. Clinical diagnosis of an anterior cruciate ligament rupture: a meta-analysis. *J Orthop Sports Phys Therap*. 2006;36(5):267-88. doi: 10.2519/jospt.2006.2011
 21. Kostov H, Arsovski O, Kostova E, Nikolov V. Diagnostic assessment in anterior cruciate ligament (ACL) tears. *Pril (Makedon Akad Nauk Umet Odd Med Nauki)*. 2014;35(1):209-18.
 22. Makhmalbaf H, Moradi A, Ganji S, Omid-Kashani F. Accuracy of lachman and anterior drawer tests for anterior cruciate ligament injuries. *Arch Bone Joint Surg*. 2013;1(2):94.
 23. Lee S, Chae D-S, Song B-W, Lim S, Kim SW, Kim I-K, et al. ADSC-Based Cell Therapies for Musculoskeletal Disorders: A Review of Recent Clinical Trials. *Int J Mol Sci*. 2021;22(19):10586. doi: 10.3390/ijms221910586
 24. Wang JH, Lee JH, Cho Y, Shin JM, Lee BH. Efficacy of knee joint aspiration in patients with acute ACL injury in the emergency department. *Injury*. 2016;47(8):1744-9. doi: 10.1016/j.injury.2016.05.025
 25. Jenkins SM, Guzman A, Gardner BB, Bryant SA, del Sol SR, McGahan P, et al. Rehabilitation after anterior cruciate ligament injury: review of current literature and recommendations. *Curr Rev Musculoskel Med*. 2022;15(3):170-9. doi: 10.1007/s12178-022-09752-9.