The accuracy of the lever sign test in a diagnostic exam of an acute anterior cruciate ligament (ACL) injury: A critically appraised topic.

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INTRODUCTION

The lever sign has been developed and researched, within the last ten years, as an alternative physical examination of the anterior cruciate ligament (ACL). The simplicity and practicality of the test has increased its presence within ACL clinical assessment literature. Multiple studies investigating the lever sign have shown significant sensitivity in diagnosing ACL tears. However, the patient population in the majority of these studies are those reporting with chronic knee injuries. Therefore, there is limited research showing the effectiveness of the lever sign in acute evaluations. This critically appraised topic explores the potential for the lever sign to be significantly effective in diagnosing acute ACL tears within the general population.

Clinical Question

What is the accuracy of the lever sign test compared to the Lachman's, pivot shift, and anterior drawer tests for the physical examination of acute ruptures to the anterior cruciate ligament (ACL) in the general population? .
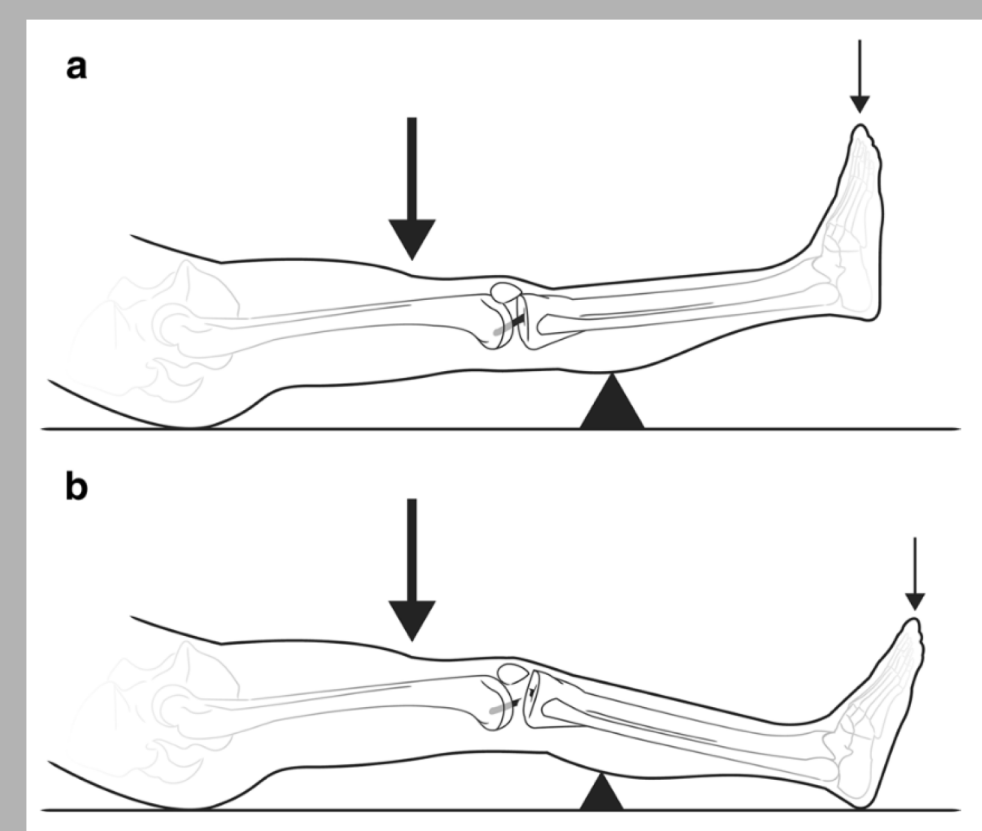
Summary of Key Findings

The literature yielded three cohort studies evaluating acute anterior cruciate ligament (ACL) ruptures using the lever sign test within the general population. Two of the three studies analyzed the sensitivity of the lever sign, Lachman, and anterior drawer test in emergency department acute ACL injuries. One of the three studies compared the accuracy of the lever sign to the Lachman, anterior drawer and pivot shift clinical assessment of ACL. There were high sensitivity findings of the lever sign in all three cohort studies; however, one cohort study found the Lachman test to be more sensitive and accurate.

Summary of Articles

Authors	Guiraud et al.	Jarbo et al.	McQuivey et al.
Study Design	Cohort Study (diagnostic)	Cohort Study (diagnostic)	Cohort Study (diagnostic)
Participants	52 adult male and female patients (2M/1F sex distribution) reporting to ED for acute knee pain (19-56 year olds).	102 male (n=58) and female (n=44) patients with acute knee trauma (15-66 year olds).	45 male (n=25) and female (n=20) patients reporting to the ED for an acute knee injury (12-54 year olds).
Inclusion/Exclusion Criteria	Inclusion: Patients above 18 y/o. Report knee trauma within 8 days. One negative radiograph for fracture. Exclusion: Rupture of knee extensor mechanism or patella dislocation.	Inclusion: Patients reporting knee trauma within 4 weeks of visit. Exclusion: PMHx of knee surgery.	Inclusion: Patients reporting with probably acute ACL tears. Exclusion: Simultaneous acute/chronic pathology, PMHx of knee surgery, acute trauma requiring hospital admission, and/or no MRI results.
Investigation	The integrity of the anterior cruciate ligament (ACL) in participants was tested using the lever sign, Lachman, and anterior drawer test. Emergency department residents were previously trained with the techniques and applied them in evaluations of patients fitting the inclusion criteria. Participants received an MRI within 3 weeks of the evaluation as the standard of assessing the ACL. Researchers used the MRI results to compare them to the findings of the lever sign, Lachman, and anterior drawer test. The validity of the tests were calculated.	The diagnostic accuracy of the lever sign, Lachman, anterior drawer, and pivot shift test in detecting ACL ruptures was evaluated. The study was divided into pre-anesthesia and post-anesthesia examinations depending upon patient surgical date. All four tests were conducted on each patient and compared to different standards. The post-anesthesia group ACL integrity was determined by arthroscopy; whereas, the pre-anesthesia group used MRI results. Researchers used the comparisons of the diagnostic tests to formulate the diagnostic accuracy of the test within the study.	The lever sign, anterior drawer, and Lachman special tests were used to evaluate the anterior cruciate ligament (ACL) in patients. The nine month study evaluated all patients with suspected ACL injuries using a nonrandomized schedule. The first 4.5 months residents used the lever sign to test the ACL; then, residents used the anterior drawer and Lachman test in the second 4.5 months. The anterior drawer and Lachman results were calculated together. Researchers used MRI findings to compare the results of the diagnostic tests to formulate the diagnostic accuracy of the test within the study.
Outcome measures	Primary Outcomes: Lever sign, Lachman, anterior drawer: sensitivity, specificity, positive-predictive value (PPV), and negative-predictive value (NPV).	Primary Outcomes: Lever sign, Lachman, anterior drawer, and pivot shift: sensitivity, specificity, positive-predictive value (PPV), and negative-predictive value (NPV), and diagnostic accuracy.	Primary Outcomes: Lever sign, Lachman, anterior drawer: sensitivity, specificity, positive-predictive value (PPV), and negative-predictive value (NPV), diagnostic accuracy.
Results	The study reported a sensitivity of 92.5% for the lever sign; which was significantly different compared to the Lachman(54%) and anterior drawer(56%) test (p-value: 0.03). No significant differences calculated between specificity, NPV and PPV.	Overall, the lever sign reported a 63% sensitivity and 90% specificity in all patients. The accuracy of the lever sign between groups was calculated by researchers to be 77% in diagnosing ACL ruptures. These results were low compared the accuracy of the Lachman's test (93%); the highest within the study.	The study found the lever sign to be 100% sensitive with a diagnostic accuracy of 94.7%. In comparison, the anterior drawer and Lachman test reported a 40% sensitivity and 87.5% accuracy. No significant differences were calculated between all outcome measures.
Level of Evidence	GRADE B	GRADE B	GRADE B
Support For Answer	Yes	Yes	Yes
Support for Answer	The significant difference in sensitivity supports the use of the lever sign in diagnosing ACL ruptures in adults presenting with acute knee injuries. Additional research in acute settings with larger populations is needed to further increase the efficacy of the lever sign over the Lachman's test.	The results of the study showed the lever sign to have a relatively high accuracy; however, the results did not compare to the Lachman test. There was no difference between pre- and post-anesthesia groups of the lever sign. Overall, this study supports the use of the lever sign, but the Lachman's should be used in addition in order to accurately diagnose ACL ruptures in acute knee patients.	The diagnostic accuracy and sensitivity of the lever sign calculated within the study reveals a high efficacy as a clinical test for the ACL. However, this efficacy is only viewed within the emergency department. Additional research in other acute settings, such as on-field evaluations, should be conducted to increase the reliability of the lever sign in multiple acute settings.

Clinical Bottom Line

There is moderate evidence to support high sensitivity of the lever sign as a diagnostic test; however, there is limited research to support the accuracy of the lever sign in acute evaluations of the anterior cruciate ligament (ACL).

Strength of Recommendation: Grade B evidence does exist to show the effectiveness of the lever sign in identifying ACL ruptures during acute evaluations of the general population.

Conclusion

The lever sign is a relatively new ACL clinical assessment with limited evidence-based research supporting the use of the test in clinical practice. With this in mind, this critical appraisal was limited in the amount of studies and resources included. However, the results of current studies examining the efficacy of the lever sign in acute settings increases its validity within clinical practice. Based on the results of this paper, the lever sign is effective for diagnosing acute ACL tears. Therefore, evidence-based medicine researchers should place emphasis on continuing lever sign research in order to generate a larger pool of significant data supporting or arguing the use of the clinical assessment. Once future research is conducted, the exposure of the lever sign can increase towards athletic training, physical therapy, and orthopedic clinics. This will effectively allow evidence-based practitioners to accurately assess the integrity of the ACL in acute knee injuries.

REFERENCES

[1]Guiraud K, Silvestre G, Bastin C, Lecouvet F, Masip AB. Higher Sensitivity with the lever sign test for diagnosis of anterior cruciate ligament rupture in the emergency department. *A Ortho Trauma Surg.* 2021: 1-5.

[2]Jarbo KA, Hartigan DE, Scott KL, Patel KA, Chhabra A. Accuracy of the Lever sign test in the diagnosis of anterior cruciate ligament injuries. *Orthop J Sports Med.* 2017; 5(10): 2325967117729809.

[3]McQuivey K, Christopher Z, Chung A, *et al.* Implementing the lever sign in the emergency department: Does it assist in acute anterior cruciate ligament rupture diagnosis? A pilot study. *J Emergency Med.* 2019; 57(6): 805-11.

[4]Lelli A. Di Turi RP. Spenciner DB, Domini M. The "Lever sign": a new clinical test for the diagnosis of anterior cruciate ligament rupture. *Knee Surg Sports Trciumatol Arthrosc.* 2016; 24: 2794-2797.

[5]Squillantini R, Ringle B, Cavallaro J. Comparing the diagnostic accuracy of two selective tissue tests for anterior cruciate ligament injuries: A critically appraised topic. *Int J Ath Ther & Train.* 2019; 24(4): 145-150.

[6]Deveci A, Cankaya D, Yilmaz S, Ozdemir G, *et al.* The arthroscopical and radiological correlation of lever sign test for the diagnosis of anterior cruciate ligament rupture. *Springer.* 2015; 4: 830.

[7]Reiman M, Reiman C, Decary S. Accuracy of the lever sign to diagnose anterior cruciate ligament tear; A systematic review with meta-analysis. *Int J Sport Phys Ther.* 2018; 13(5): 774-788.

[8]Singh G, Singh M, Gupta P. An observational study to compare diagnostic accuracy of lever sign test, anterior drawer, and lachman test in cases of anterior cruciate ligament tears. *J Doc Research.* 2021; 1(1): 21-28.