Rupture of Anterior Cruciate Ligaments and the Lever Test in diagnosis: a critical review

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ABSTRACT

Anterior Cruciate Ligament (ACL) rupture is known to be one of the most common musculoskeletal injuries in active individuals especially athletes. Approximately 200,000 ACL injuries occur every year, of which 100,000 require surgery. Once ruptured, it becomes very difficult to regain its previous function and it does not have the capacity to heal on its own. It is thus very important to diagnose an ACL rupture as early as possible. Clinicians need to perform a test which has a high sensitivity to rule out a negative test and specificity in order to rule in a positive test in the diagnosis. In this review four different tests (Lever Sign Test, Lachman Test, Anterior Drawer Test and Pivot Shift Test) are put to comparison and it is aimed to find the accuracy of the Lever Sign Test in diagnosing ruptured ACL as a diagnostic tool.

INTRODUCTION

One of the most common musculoskeletal injuries in physically active individuals is a tear of the Anterior Cruciate Ligament (ACL).[1] Every year, approximately 200,000 ACL injuries occur and 100,000 of the injuries undergo surgery.[2] It has been reported that 68.6 per 100,000 athletes every year face a tear in their ACL.[3] Females are noted to have a higher incidence of ACL tears compared to males even if it is in the same sport.[4] A ruptured ACL leads to increased risk of articular cartilage damage, meniscal degeneration and functional instability as the ACL provides the anterior stability to the knee.[5] ACL ruptures often occur with concomitant ligament sprains, meniscal tears, lesions of the bone marrow, articular cartilage injuries and intraarticular fractures.[6] The rates of these concomitant lateral collateral ligament (LCL) and posterior cruciate ligament (PCL) injuries are generally low, and that of meniscal tears (prevalence 30%) and medial collateral ligament (MCL) (prevalence 42%) are the most common ones.[7] The ACL once torn, does not have the capacity to heal on its own and regain previous function.[8] Early diagnosis is thus important to determine the best course of care and in order to reduce the risk of any further injury.

Individuals who participate in high-risk activities and the ones who are part of the athletic population are noted to be the ones suffering from contact and non-contact injuries of the ACL[1] which can be a result of deceleration and/or pivoting motions constantly required in athletics.[4]

Arthroscopic visualisation, as an invasive procedure, is considered to be the 'gold standard' in diagnosing ruptured ACLs[9] while MRI is considered as the 'gold standard' among the non-invasive procedures.[10] Thorough history, physical examination and special diagnostic tests are required to diagnose ACL tears.[11] History from the patient includes an injury mechanism where there is involvement of deceleration/acceleration in combination with a knee valgus load where patient will mention hearing/feeling a 'pop' during the time of the injury,[12] experiences of buckling of the knee that has been affected, may include hemarthrosis within two hours of the injury, swelling and deficit in range of motion.[13]

To evaluate the integrity of the ACL, the Lachman Test, Anterior Drawer Test and Pivot-shift Test are performed as clinical examinations.[14] Among these three, the Lachman Test gives a more accurate diagnosis for ruptured ACL, with a pooled reported sensitivity of 85% and specificity of 94%.[15] The Anterior Drawer Test possesses high specificity (91%) and sensitivity (92%) for chronic cases of ruptured ACL but not as much in acute cases.[15] The Pivot-shift Test, if positive, gives 98% specificity but a negative test is not sufficient to rule out injury (24% sensitivity).[15] Magnetic resonance imaging (MRI) and radiographs also play important roles in the diagnosis of a torn ACL.[15] A combination of history taking and clinical examination might not give a diagnosis of ruptured ACL in an acute case.[6] It can be a common scenario where a ruptured ACL has been misdiagnosed; half of the patients who came to an orthopaedic emergency unit were misdiagnosed as uncomplicated knee sprain.[16]

There has been a recent addition to the clinical examination of a ruptured ACL, and it is called the Lever Sign Test.[9] Diagnostic tests of good quality are always required to assist clinicians to make the diagnosis early and accurately. The rest of this critical review aims to find out the accuracy of diagnosis of ruptured ACL by using the Lever Sign Test as a diagnostic tool.

STUDY CHARACTERISTICS

Four cohort studies[17-20] have been selected in this critical review to find out whether the Lever Sign Test (LST) can be considered as an appropriate clinical examination to diagnose ACL rupture. The studies are from the last five years (2018-2022), participants include both male and female genders. Table 1 shows the study characteristics. To determine the diagnostic value of the LST in diagnosing ruptured ACL, comparison has been made among three other physical examination tests that are used to determine injury of the ACL which are- the Lachman Test, Anterior Drawer Test and Pivot-shift Test. The cases that have been considered are acute cases (<4 weeks) and the determination done through sensitivity; specificity; positive predictive value and negative predictive value, all shown in percentages (Table 2).

Study	No of patients	Male	Female	Mean age (years)
Lichtenberg et al[17]	94	57	37	34
Gürpınar et al[18]	78	69	9	26.2
Bilgin et al[19]	103	57	5	24.6
Shair et al[20]	73	49	24	34.5

Table 1: Study Characteristics.

Name of the test	Study	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)	Accuracy (%)
Lever Sign Test (LST)	Lichtenberg et al[17]	39	100	100	65	71
	Gürpınar et al[18]	91.9	93.8	98.3	75	92.3
	Bilgin et al[19]	37.1	100	100	50.6	Not Mentioned
	Shair et al[20]	86	90	92	82	88

Table 2(a): Showing sensitivity, specificity, positive predictive value, negative predictive value and accuracy regarding the Lever Sign Test in the selected four studies.

Name of the test	Study	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)	Accuracy (%)
Anterior Drawer Test (ADT)	Lichtenberg et al[17]	71	94	91	77	82
	Gürpınar et al[18]	77.4	68.8	90.6	44	75.6
	Bilgin et al[19]	90.3	92.5	94.9	90.2	Not Mentioned
	Shair et al[20]	88	90	93	85	88

Table 2(b): Showing sensitivity, specificity, positive predictive value, negative predictive value and accuracy regarding the Anterior Drawer Test in the selected four studies.

Name of the test	Study	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)	Accuracy (%)
Lachman Test (LT)	Lichtenberg et al[17]	87	91	91	88	94
	Gürpınar et al[18]	80.6	62.5	89.3	45.5	76.9
	Bilgin et al[19]	96.7	100	100	45.9	Not Mentioned
	Shair et al[20]	93	93	95	91	93

Table 2(c): Showing sensitivity, specificity, positive predictive value, negative predictive value and accuracy regarding the Lachman Test in the selected four studies.

Name of the test	Study	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)	Accuracy (%)
Pivot-shift Test (PVT)	Lichtenberg et al[17]	50	98	95	71	78
	Gürpınar et al[18]	51.6	93.8	97	33.3	60.3
	Bilgin et al[19]	24.2	100	100	45.9	Not Mentioned
	Shair et al[20]	81	84	87	76	82

Table 2(d): Showing sensitivity, specificity, positive predictive value, negative predictive value and accuracy regarding the Pivot-shift Test in the selected four studies.

Based on the results seen in Tables 2(a, b, c, d), through the literature regarding the use of the LST, it can be seen that the LST (Table 2a,) is favourable in detecting ACL ruptures in acute cases. Both sensitivity and specificity in case of the LST are seen to be comparable to the sensitivities and specificities of the Anterior Drawer Test (Table 2b), Lachman Test (Table 2c,) and Pivot-shift Test (Table 2d). The Clinical Practice Guidelines in Knee Stability and Movement Coordination Impairments: Knee Ligament Sprain Revision 2017[12] recommend use of the Lachman Test and Pivot-shift Test in every suspected ACL tear. This recommendation and other literature indicate that diagnosis of ruptured ACL by the LST, through a proper history and clinical examination done by someone who is an experienced clinician, may be as accurate as the result from an MRI which is a gold standard in non-invasive diagnosis of ACL tears where specificity ranges from 91.83-96% and sensitivity ranges from 54-100%. Through Table 2a it can be seen that specificity ranges from 90-100% and sensitivity from 39-86% for LST, which is near to that of MRI.

LIMITATIONS

Some limitations can be seen in this review. As the LST is a relatively new test, there is limited research on the topic. There were a limited number of studies available for inclusion and there was a variation in the sample sizes and the male:female ratio; where the number of males was seen to be larger than that of females. There is data missing regarding false positives and false negatives. The Bilgin et al study[19] did not discuss the accuracy of the tests performed on the patients. The authors have not been reached out to for an explanation of the missing data. There is bias noted in all the studies[17-20] as there is inadequate description of the examiners who were involved in performing the tests. The patients who had a previous history of ACL tear and the ones with concomitant tears have not been mentioned in the included literatures in this review, which can be important as re-ruptures can range from 1-11% of cases[21] and concomitant injuries are common.[7]

CONCLUSION

For a successful diagnosis, clinicians need to perform tests which have a high sensitivity to rule out a negative test, and specificity in order to rule in a positive test in the diagnosis. This review shows that it is favourable to use the LST as a diagnostic tool for ACL injury as the sensitivity and specificity observed in the selected four studies are seen to be comparable with the other three tests (Lachman Test, Anterior Drawer Test and Pivot-shift Test). The LST, if carried out properly, will provide the clinician with a more complete clinical picture regarding the status of the ACL after an injury. ACL being one of the commonest musculoskeletal injuries, especially among athletes, needs attention during diagnosis as if not diagnosed properly, could leave a permanent impact on the patient's health.

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