

The Lever “Lelli” test: why and how?

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Abstract

In case of an anterior cruciate ligament (ACL) rupture physical examination remains a tough question for both surgeons and physical therapists. An ideal test to diagnose the integrity of the ACL should be easy to perform and reproducible with high sensitivity and specificity, unfortunately it doesn't exist. After a simple intuition, I developed the lever sign test trying to overcome the limitations of other tests. It is an easy procedure, but must be performed with attention to some details that could falsify the result. During last few years different series proved that the lever sign appears to have high interrater reliability and is the most specific test, showing a maximal positive predictive value. From this perspective, the lever test seems to be a good test for clinicians in acute, chronic and ACL injuries.

Keywords: Anterior cruciate ligament; Lelli test; Lever sign test; Sport knee injuries; Diagnostic tool

The anterior cruciate ligament (ACL) is the most common ligament injured of the knee joint(1). Despite the high frequency of cruciate lesions the clinical practice for detecting an ACL rupture is still an issue of debate. Three basic tests are historically used during physical examination: the anterior drawer test described by Marshal, the Lachman test proposed by Torg and the pivot shift test suggested by Galway and MacIntosh (2–4). Physicians, with sport trauma experience, know that these tests are all recommended diagnostic tools, although with some limitations.

Anterior drawer test could be appropriate for diagnosing chronic injuries, but it lacks of sensitive in case of meniscal tear and isolate ACL tear. Secondary knee restraints as collateral ligaments, capsule and ileo tibial band could limit tibia anterior translation distorting results. In

a recent review anterior drawer test has an overall moderate specificity (SP) of 93% and poor sensitivity (SN) of 73%(5). The pivot shift test (PST) has been described as highly specific (81-99%) but without sensitive enough (18-48%) (1,6). PST is difficult to perform if exist a bucket handle tear, patellar instability or tight ileo tibial band. Furthermore we should not forget that PST is often painful and uncomfortable for the patient. The Lachman test is suggested to be more reliable than the three test due its good SP and SN that are respectively 97% and 87,1%, even if Lachman test has some limitations because of the difficulty to control the force applied to the knee, and the effort required to perform the maneuver in obese patient and in case of physician with small hands (5). In clinical practice these tests are sequentially used to enhance accuracy of clinical diagnosis, however is quite frequent to observe all three tests negative in patient who complain instability, especially in case of partial ACL tear, moreover none had showed a sufficient accuracy to diagnose acute lesion right away to

the trauma (7,8).

In 2005 I start to developed a new test called “Lelli Test” with the aim to overcome mentioned limitations(9). It was designed to being equally definitive for partial as well as complete tears, which can be use easily by inexpert physicians and additionally being diagnostic even for acute injuries.

The idea behind the test was that ACL is the only one knee ligament attached over the tibial plateau, so we consider the extended lower limb as a lever arm the ACL is the only one structure able to maintain the lever in effect, preventing the posterior slippage of the femur by a downforce applied on quadriceps. The lever test has the purpose to verify the dynamic function of the ACL regardless its anatomical condition. At best of my knowledge this mechanism is still a hypothesis based on my personal experience, for sure it need a biomechanical study validation to analyze in deep all the anatomical structures involved during maneuver.

To perform the “Lelli Sign” test [Fig.1] the patient is placed supine on the examining table, the physician stand on

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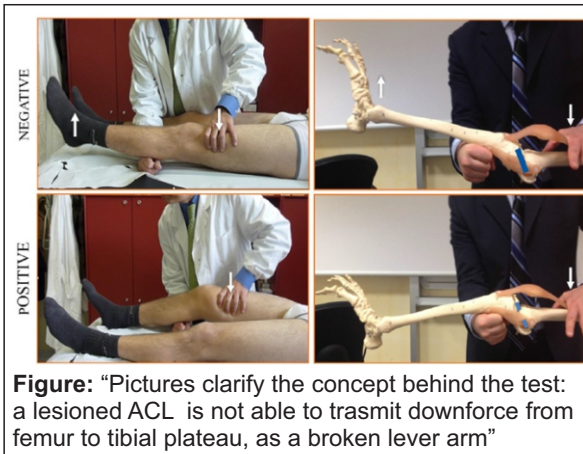


Figure: “Pictures clarify the concept behind the test: a lesioned ACL is not able to transmit downforce from femur to tibial plateau, as a broken lever arm”

the side of injured knee. One hand is placed with closed fist under the proximal third calf of the patient, while the other hand applies a moderate downforce to distal quadriceps. In case of an healthy knee the force is transmitted by ACL from femur to tibial plateau, in this situation the lever arm is like a lever with a fulcrum (the examiner hand) which is able to contrast gravity and lift up the heel from the table. Instead in case of complete or partial tear the ACL is unable to transmit downforce to the tibia, femur will slide down breaking the “lever arm” which fails to move the heel from the table. Even if could seem a very simple test if performed by expert hands, I would analyse some important details that should compromise its accuracy. For first note that positioning the “fulcrum hand” under the patient leg will cause a slight flexion of the knee, it is needed to obtain

an effective test. Please Pay attention to place the “fulcrum hand” in the correct place, that is essential to avoid unreliable results: proximal third of the calf, just distally to the projection of tibial tuberosity. The surface of examining table should be hard to support the fulcrum, a too soft layer could false the sign. You need a progressive and soft downforce to perform correctly the test,

avoid strong and aggressive maneuver on quadriceps. I suggest to perform the test on both knees especially during the learning curve, it could be a good check to avoid mistakes.

In 2014 we reported a prospective study on 400 patients, with a definitive MRI diagnosis of unilateral ACL rupture, to determinate the accuracy of the new test (9). Results were promising, we found an excellent specificity (100%) even in case of acute and partial tears. However the study had two main limitations: the first one is that the exams were performed by a single expert clinician, and the second one is that we used the “healthy” contralateral knee as control group without any exams which could exclude contralateral ACL rupture. During the last 5 years seven other original article have investigated the lever test, these were

analyzed in an interesting review by Reinman et al. in 2018 (10–16). Anyway other high-quality diagnostic studies are required to better understand the accuracy of this test and the biomechanical basics. The previous reports confirmed the high specificity of the lever that seems to be an accurate test to detect a rupture by itself, but obtain reduced results concerning sensibility that range from 39% to 94%. The high number of test described in literature demonstrates that is difficult, or even impossible, assess a gold standard that cover all different situation to detect an ACL rupture, anyway lever has strong points as simplicity, reliability in acute lesions, accuracy in partial tears. In light of the above I agree with Lichtenberg et al that propose to exploit the high SP of lever test together with the good SN of Lachman test with a serial application of both (13). If starting the examination with the lever test a positive outcome confirms an ACL rupture close to 100%, in this case there is any need of further testing. In case of negative lever the Lachman test can be applied: a positive Lachman still diagnoses an ACL rupture with a 9% false-positive chance, instead a negative outcome excluded an ACL rupture with a 13% of a false-negative possibility(13).

References

1. Benjaminse A, Gokeler A, van der Schans CP. Clinical diagnosis of an anterior cruciate ligament rupture: a meta-analysis. *J Orthop Sports Phys Ther.* 2006 May;36(5):267–88.
2. Galway HR, MacIntosh DL. The lateral pivot shift: a symptom and sign of anterior cruciate ligament insufficiency. *Clin Orthop.* 1980 Apr;(147):45–50.
3. Marshall JL, Wang JB, Furman W, Girgis FG, Warren R. The anterior drawer sign: what is it? *J Sports Med.* 1975 Aug;3(4):152–8.
4. Torg JS, Conrad W, Kalen V. Clinical diagnosis of anterior cruciate ligament instability in the athlete. *Am J Sports Med.* 1976 Apr;4(2):84–93.
5. Huang W, Zhang Y, Yao Z, Ma L. Clinical examination of anterior cruciate ligament rupture: a systematic review and meta-analysis. *Acta Orthop Traumatol Turc.* 2016;50(1):22–31.
6. van Eck CF, van den Bekerom MPJ, Fu FH, Poolman RW, Kerkhoffs GMMJ. Methods to diagnose acute anterior cruciate ligament rupture: a meta-analysis of physical examinations with and without anaesthesia. *Knee Surg Sports Traumatol Arthrosc Off J ESSKA.* 2013 Aug;21(8):1895–903.
7. DeFranco MJ, Bach BR. A comprehensive review of partial anterior cruciate ligament tears. *J Bone Joint Surg Am.* 2009 Jan;91(1):198–208.
8. Zantop T, Brucker PU, Vidal A, Zelle BA, Fu FH. Intraarticular rupture pattern of the ACL. *Clin Orthop.* 2007 Jan;454:48–53.
9. Lelli A, Di Turi RP, Spenciner DB, Dòmini M. The “Lever Sign”: a new clinical test for the diagnosis of anterior cruciate ligament rupture. *Knee Surg Sports Traumatol Arthrosc Off J ESSKA.* 2016 Sep;24(9):2794–7.
10. Chong AC, Whitetree C, Priddy MC, Zimmerman PR, Haeder PR, Prohaska DJ. Evaluating Different Clinical Diagnosis of Anterior Cruciate Ligament Ruptures In Providers with Different Training Backgrounds. *Iowa Orthop J.* 2017;37:71–9.
11. Deveci A, Cankaya D, Yilmaz S, Özdemir G, Arslantaş E, Bozkurt M. The arthroscopical and radiological corelation of lever sign test for the diagnosis of anterior cruciate ligament rupture.

- SpringerPlus. 2015;4:830.
12. 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 Oct;5(10):2325967117729809.
 13. Lichtenberg MC, Koster CH, Teunissen LPJ, Oosterveld FGJ, Harmsen AMK, Haverkamp D, et al. Does the Lever Sign Test Have Added Value for Diagnosing Anterior Cruciate Ligament Ruptures? *Orthop J Sports Med.* 2018 Mar;6(3):2325967118759631.
 14. Massey PA, Harris JD, Winston LA, Lintner DM, Delgado DA, McCulloch PC. Critical Analysis of the Lever Test for Diagnosis of Anterior Cruciate Ligament Insufficiency. *Arthrosc J Arthrosc Relat Surg Off Publ Arthrosc Assoc N Am Int Arthrosc Assoc.* 2017 Aug;33(8):1560–6.
 15. Mulligan EP, Anderson A, Watson S, Dimeff RJ. The diagnostic accuracy of the lever sign for detecting anterior cruciate ligament injury. *Int J Sports Phys Ther.* 2017 Dec;12(7):1057–67.
 16. Reiman MP, Reiman CK, Décary S. Accuracy of the lever sign to diagnose anterior cruciate ligament tear: a systematic review with meta-analysis. *Int J Sports Phys Ther.* 2018 Aug;13(5):774–88.

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