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The Validity Of Lever Sign Test For The Diagnosis Of ACL Injury

By

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ABSTRACT

Background: Injury of the anterior cruciate ligament (ACL) is the most frequently seen ligamentous injury of the knee joint. Diagnosis is based on history, physical examination and MRI findings and a definitive diagnosis is confirmed with arthroscopy. Many tests are used for diagnosis of ACL with different sensitivity and specificity.

Objectives: To evaluate lever sign test as a diagnostic tool for ACL injury compared the other 3 tests (anterior drawer, Lachman, and pivot shift test) when performed before anesthesia and under anesthesia.

Patients and Methods: The study included 100 patients in the age of 18 to 45 years complaining of knee instability and confirmed as ACL injury by MRI. The 4 special tests for ACL (the Lachman, the anterior drawer, the pivot shift test and the lever sign test) were performed on the injured knee and the contralateral non-injured knee as a control both preanesthesia and under anesthesia. The results were compared to the arthroscopic findings.

Results: Lever sign test sensitivity is 72% on examination before anesthesia and 80% on examination under anesthesia with specificity 92%. The most sensitive test Preanesthesia was the Lachman test 88% and postanesthesia was the pivot shift test 89%. The most specefic test was highest for the pivot-shift test 100%.

Conclusion: Lever sign test is a simple test which can be routinely used in evaluation of ACL function in both acute and chronic knee injury. The test is weak diagnostic tool in partial ACL injury as it uses pure translational displacement as its assessment method and does not assess the rotational component.

Key words: Anterior cruciate ligament; ACL; Lelli; Lever sign test.

INTRODUCTION

The anterior cruciate ligament (ACL) is one of the most commonly injured knee ligaments and is one cause of anterior knee instability (Jarbo et al., 2017). ACL ruptures occures in young and physically active population and could result in instability followed by, meniscal tears, and articular cartilage damage if not well treated (Makhmalbaf et al., 2013). In the clinical evaluation, the first and most important step of the patient history is the physical examination. Three basic tests are used in the physical examination from which different results may be obtained according to the sensitivity and specificity of each test. These are the Lachman, the

anterior drawer and the pivot shift test (DeFranco and Back, 2009). Patients may be guarding due to pain and fear of subluxation. Concomitant injuries may obstruct the physical exam. In addition, partial ruptures may be harder to diagnose than complete ruptures due to the stability provided by the remaining fibers (Van Eck et al., 2013).

Lever Sign test a new clinical test for the diagnosis of ACL described by Alessandro Lelli in 2014 (Lelli et al., 2014). It has been claimed that this test is more valuable than the other 3 tests in both partial and complete lesions. In particular, it has been suggested that it could be applied effectively, regardless of the interval from trauma to examination. One potential advantage of this physical examination method is that rapid motions of the injured knee can be avoided, likely reducing the incidence for additional patient pain and resultant guarding (Deveci et al., 2015).

While arthroscopic visualization is the gold standard for diagnosing rupture of the ACL, magnetic resonance imaging (MRI) is a valid and noninvasive diagnostic method, with a specificity and sensitivity of 94–98 %. MRI could show not only ACL tear but also shows any other soft tissue or bone injuries (Makhmalbaf et al., 2013).

PATIENTS AND METHODS

This study included 100 patients presented to the outpatient clinic of El-Hussien Hospital complaining of knee instability after trauma to the knee. The ACL injury is confirmed by X-ray and MRI with no other ligamentous injury (Figure 1). The 4 special tests for ACL (the Lachman, the anterior drawer, the pivot shift test and the lever sign test) were performed on the injured knee and the contralateral non-injured knee as a control both before anesthesia and under anesthesia.

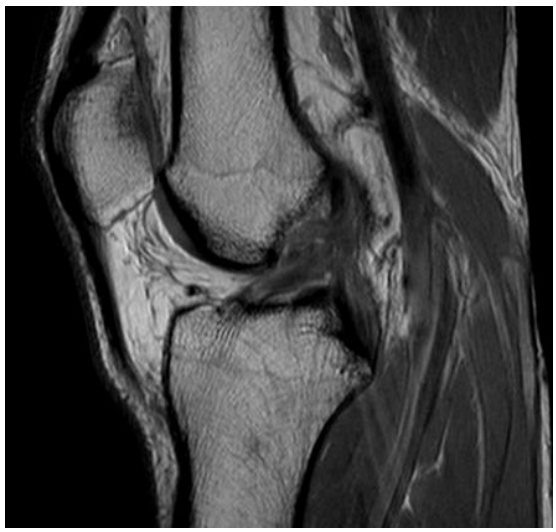

Figure (1): Sagittal T2- weighted magnetic resonance knee image shows abnormal signal of ACL suggest ACL tear.

The lever sign test was performed as described by Lelli; the patient is placed supine with the knees fully extended on a hard surface such as the examining table. The examiner stands at the side of the patient and places a closed fist under the proximal third of the calf. This causes the knee to flex slightly. With his other hand, he applies moderate downward force to the distal third of the quadriceps (Lelli et al., 2014).

In an intact knee, the creation of a complete lever by the ACL allows the downward force on the quadriceps to more than offset the force of gravity, the knee joint rotates into full extension, and the heel rises up off of the examination table (Lelli et al., 2014).

In ACL deficient knee, tibial plateau slides anteriorly with respect to the femoral condyles. In this case, the gravity pulls the heel down to the examination table and the heel does not rise up off of the table (Prodromos et al., 2007). The results were compared to the arthroscopic finding as the gold standard for diagnosis of ACL injury (Figure 3 & 4).

According to arthroscopic findings, 82 of patients had complete ACL tear (82%) and 18 patients had partial tear (18%).

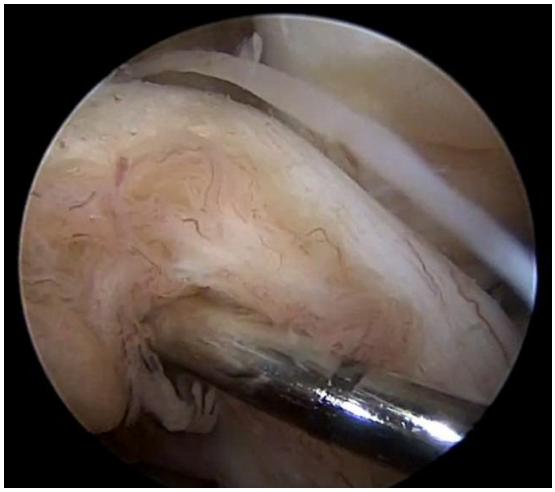

Figure (2): Arthroscopic view of knee joint showing remnant of torn ACL.

Figure (3): Lever Sign test. Positive test in the Rt. Injured leg and negative in the Lt. normal leg.

RESULTS

Preanesthesia and postanesthesia sensitivities were 88% and 96%, respectively, for the Lachman test; 78% and 88%, respectively, for the anterior drawer test; 54% and 98%, respectively, for the pivot shift test; and 72% and 80%, respectively, for the lever sign test. The specificity was highest for the pivot-shift test 100%, followed by the Lachman test 96%, anterior drawer test 92%, and lever sign test 92% (Table 1).

Comparing the results of the lever sign test with the arthroscopic results , 78 patients had positive test of 82 patients with complete ACL tear 95% and 2 patients had positive test of 18 patients with partial ACL tear 11%.

Table (1): The sensitivity values of all 4 tests at preanesthesia and postanesthesia.

	Preanesthesia assessment (%)	Postanesthesia assessment (%)
Lachman test	88.0	96.0
Anterior drawer test	78.0	88.0
Pivot-shift test	54.0	98.0
Lever sign test	72.0	80.0

DISCUSSION

Early recognition of pathological processes of the ACL is crucial to selecting the correct course of care to optimize outcomes (Jarbo et al., 2017). Diagnosis of ACL tear is made by a combined evaluation of the patient history, physical examination and MRI. Accurate diagnosis is made by interpretation of these 3 steps together. The diagnostic standard for ACL injuries is direct arthroscopic visualization, but the accepted reference standard is magnetic resonance imaging (MRI), with sensitivity and specificity ranging from 94%to 98% (Ng et al., 2011).

In the clinical evaluation and after taking patient history, three basic tests are used in the physical examination from which different results may be obtained according to the sensitivity and specificity of each test. These are the Lachman, the anterior drawer and the pivot shift test. The physical examination methods are indispensable as practical, cheap, non-invasive methods (DeFranco et al., 2009).

The accuracy of these examinations may be affected by patient factors such as swelling, pain, protective muscle action, and examiner experience. The maneuvers themselves can produce falsely normal results, particularly in patients with partial tears (Jarbo et al., 2017).

There are some difficulties on applying these tests. For Lachman test examiners with small hands and patients with a large thigh may affect test results. (Kuroda et al., 2016).

The anterior drawer test the hemarthrosis and reactive synovitis may preclude knee flexion to 90°, hindering the proper performance of the test, protective muscle action of the hamstrings secondary to joint pain provides a vector force opposite to the anterior translation of the tibia and the posterior horn of the medial meniscus becomes buttressed against the posterior most margin of the medial femoral condyle and may preclude anterior translation of the tibia. The pivot shift test patient with a chronic ACL-deficient knee is familiar with unpleasant phenomenon of pivoting and will show

protective muscle action. The accuracy of a complex test maneuver such as the pivot shift test may increase with experience thus the pivot shift test has very high specificity and low sensitivity (Thapa et al., 2015).

A clinical test for the diagnosis of ACL rupture is described: the so-called “Lever Sign”. It has been claimed that this test is more valuable than the other 3 tests in both partial and complete lesions. In particular, it has been suggested that it could be applied effectively, regardless of the interval from trauma to examination. The lever sign test did not rely on the strength of the examiner or the size of the patient; a provider with small hands can easily and effectively perform this test on a patient with a large leg, an advantage that no other test can offer. One potential advantage of this physical examination method is that rapid motions of the injured knee can be avoided, likely reducing the incidence for additional patient pain and resultant guarding (Lelli et al., 2014).

Our study included 100 patients with knee concerns after an injury. The four special tests for ACL were performed on the injured knee and the contralateral non-injured knee as a control both preanesthesia and under anesthesia. The results were compared to the MRI and the arthroscopic findings.

In 2014, Lelli and Colleagues were the first to describe and assess the lever sign. the lever sign test was performed with the other three tests on the injured leg and the contralateral non-injured leg of all 400 patients.

In 2015, Thapa and Colleagues included 80 patients with knee concerns after an injury. The four physical examination maneuvers were performed on all patients and compared with arthroscopic surgery, the diagnostic standard.

In 2015, Deveci and Colleagues included 117 patients with an arthroscopic diagnosis of a chronic ACL tear (further specified as complete or partial). All patients underwent the 4 clinical examination maneuvers both preoperatively and under anesthesia.

In 2017, Jarbo and Colleagues included 102 patients, 54 were surgical and 48 were nonsurgical. In the nonsurgical group, the four tests were performed during the initial clinic visit, and in the surgical group, the four tests were performed in the operating room with the patient under anesthesia.

In our study, preanesthesia and postanesthesia sensitivities were 88% and 96%, respectively, for the Lachman test; 78% and 88%, respectively, for the anterior drawer test; 54% and 98%, respectively, for the pivot shift test; and 72% and 80%, respectively, for the lever sign test. The specificity was highest for the pivot-shift test 100%, followed by the Lachman test 96%, anterior drawer test 92%, and lever sign test 92%.

Results of Lelli et al. (2014) were 100% sensitivity and 100% specificity for the lever sign test. Results of Thapa et al. (2015) were 86% sensitivity and 91% specificity. Results of Deveci et al. (2015) were 94% sensitivity preanesthesia and 98% sensitivity postanesthesia. Jarbo et al. (2017) stated that were 68% sensitivity preanesthesia , 86% sensitivity postanesthesia and 90% specificity.

After comparing data of the patients and results of all four tests, there was no statistically significant relation between patient's age, sex, or associated meniscal injury and the sensitivity of lever sign test.

CONCLUSION

Lever sign test being simple , with comparable sensitivity and specificity to those routinely applied clinical test for ACL tear can be routinely used in evaluation of ACL function in both acute and chronic knee injury.

The lever sign test, similar to the anterior drawer and Lachman tests, uses pure translational displacement as its assessment method and does not assess the rotational component, which may lead to a missed diagnosis in a partial tear. Additionally, the test is not affected by anesthesia, which cannot be stated for other ACL examinations as pivot shift test.

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صلاحية إختبار الرافعة في تشخيص إصابة الرباط الصليبي الأمامي

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خلفية البحث : إصابة الرباط الصليبي الأمامي من أكثر الإصابات في مفصل الركبة. و يعتمد التشخيص على التاريخ والفحص البدني ونتائج التصوير بالرنين المغناطيسي، ويتم تأكيد التشخيص النهائي بواسطة المنظار. و يتم استخدام العديد من الإختبارات لتشخيص إصابة الرباط الصليبي الأمامي مع إختلاف دقة وخصوصية كل إختبار.

الهدف من البحث: تقييم إختبار الرافعه كأداة لتشخيص إصابة الرباط الصليبي الأمامي مقارنة بثلاثه اختبارات أخرى (إختبار الدرج الأمامي ، و إختبار لاخمن ، وإختبار التحول المحوري) عندما يتم التنفيذ قبل التخدير وتحت التخدير.

المرضى وطرق البحث: شملت الدراسة ١٠٠ مريض في عمر ١٨ إلى ٤٥ عامًا يشكون من عدم إستقرار الركبة، و تم تأكيد إصابة الرباط الصليبي الأمامي بواسطة التصوير بالرنين المغناطيسي. و قد تم إجراء ٤ إختبارات (إختبار الدرج الأمامي ، و إختبار لاخمن وإختبار التحول المحوري وإختبار الرافعة) قبل التخدير وتحت التخدير على الركبة المصابة والركبة المقابلة غير المصابة كمرجع. وتمت مقارنة النتائج إلى نتائج المنظار.

النتائج: بلغت دقة إختبار الرافعة ٧٢٪ على الفحص قبل التخدير و ٨٠٪ عند الفحص تحت التخدير مع خصوصية ٩٢٪ ،و كان الإختبار الأكثر دقة قبل التخدير هو إختبار لاخمن ٨٨٪ و بعد التخدير هو إختبار التحول المحوري ٨٩ ٪ ،و كان الإختبار الأكثر خصوصية هو إختبار التحول المحوري بنسبة ١٠٠٪.

الاستنتاج: إختبار الرافعة هو اختبار بسيط يمكن إستخدامه بشكل روتيني في تقييم وظيفة الرباط الصليبي الأمامي في إصابة الركبة الحادة والمزمنة و الإختبار هو أداة تشخيص ضعيفة في الإصابة الجزئية للرباط الصليبي حيث أنه يستخدم الانتقال الأمامي للقصبة كطريقة تقييمه، ولا يقوم بتقييم مكون الدوران.