ACL injury: How do the physical examination tests compare?

The Lachman test is more accurate diagnostically than the anterior drawer test, although it’s used less often. The newer lever sign test may prove useful in primary care.

CASE ▶ An athletic 25-year-old woman presents to her family physician complaining of a painful and swollen knee. She says that she injured the knee the day before during a judo match. The injury occurred when her upper body suddenly changed direction while her foot remained planted and her knee rotated medially. A cruciate ligament injury immediately comes to mind, but other potential diagnoses include meniscal injury, collateral ligament injury, and patellar instability. The first step in determining an accurate diagnosis is to evaluate the stability of the knee by physical examination—often a difficult task immediately following an injury.

How would you proceed?

Rupture of the anterior cruciate ligament (ACL), partial or complete, is a common injury, especially in athletes who hurt their knee in a pivoting movement.1 The number of patients who present with ACL injury is estimated at 252,000 per year.2 Cruciate ligament injury may lead to complaints of instability with subsequent inability to engage in sports activities. Cruciate ligament injury is also associated with premature development of osteoarthritis later in life.3 Operative treatment seems to be superior to conservative treatment in improving both subjective and objective measures of knee instability and in helping athletes return to their former level of activity.4

Because early detection is key to achieving the best clinical outcome, it is essential that the most accurate physical examination tests are performed during the acute phase. Primary care physicians, emergency room doctors, physical therapists, and athletic trainers are the ones who most often see these patients immediately following the injury, and they often have only the physical examination with which to assess ACL injury. Their task is to identify the patient with potential ACL injury and to refer the patient swiftly.
Three physical examination tests are most commonly used to evaluate cruciate ligament injury. The best known and most frequently used technique is the anterior drawer test. The other 2 tests, the Lachman test and the pivot shift test, are more difficult to perform and are used less often, especially by physicians untrained in their use. In addition, there is a relatively new diagnostic test: the lever sign test. The aim of our article is to provide a short, clinically relevant overview of the literature and to assess the diagnostic value of physical examination for the primary care physician.

**Anterior drawer test**

**How it’s done.** In this test, the patient lies supine on the examination table with hips flexed to 45 degrees and knees flexed to 90 degrees (FIGURE 1). The examiner sits on the table with a leg resting on the patient’s foot, grasps the tibia of the injured leg just below the knee, and draws the tibia forward. If the tibia, compared with the tibia of the uninjured leg, moves farther anteriorly, or if the endpoint feels softened or is absent, the result is positive for an ACL injury.

**The literature.** Nine systematic reviews conclude that the anterior drawer test is inferior to the Lachman test, which we’ll describe in a moment. This is due, in part, to the anterior drawer test’s unacceptably low sensitivity and specificity in the clinical setting—especially during the acute phase. The most recent meta-analysis on the anterior drawer test reports a sensitivity of 38% and a specificity of 81%. In other words, out of 100 ruptured ligaments, only 38 will test positive with the anterior drawer test.

Apart from the matter of a test’s validity, it’s also important to consider the test’s inter- and intra-rater reliability. Compared with the Lachman test, the anterior drawer test is inferior in reliability.

**Lachman test**

**How it’s done.** The Lachman test is performed with the patient supine on the table and the injured knee flexed at 20 to 30 degrees (FIGURE 2). The examiner holds the patient’s thigh with one hand and places the other hand beneath the tibia with the thumb of that hand on the tibial joint line. As the tibia is pulled forward, firm resistance suggests an uninjured ACL. Free movement without a hard endpoint, compared with the uninjured knee, indicates ACL injury.

**The literature.** The Lachman test is the most accurate of the 3 diagnostic physical procedures. The most recent meta-analysis reports a sensitivity of 68% for partial ruptures and 96% for complete ACL ruptures. According to a recently published overview of systematic reviews, the Lachman test has
Two factors are important when assessing results of the Lachman test. The quantity of anterior translation of the tibia relative to the femur is as important as the quality of the endpoint of the anterior translation. Quantity of translation must always be compared with the unaffected knee. Quality of the endpoint in passive anterior translation should be assessed as “firm” or “sudden,” indicating an intact ACL, or as “absent, ill-defined, or softened,” indicating ACL pathology (TABLE).18

A drawback of the Lachman test is that it is challenging to perform correctly.19 The patient’s ability to relax the upper leg musculature is critically important. It is also essential to stabilize the distal femur, which can be problematic if the examiner has small hands relative to the size of the patient’s leg musculature.10 These difficulties might be resolved by conducting the Lachman test with the patient in the prone position, known as the Prone Lachman.19 However, good evidence is not yet available to support this proposed solution. One systematic review, though, reports that the Prone Lachman test has the highest inter-rater reliability of all commonly used physical examination tests.7

The Lachman test is known as the test with highest validity on physical examination. When the outcome of a correctly performed Lachman test is negative, a rupture of the ACL is very unlikely.

### Pivot shift test

**How it’s done.** With the patient lying supine on the table, the examiner uses one hand to hold the patient’s heel or ankle and the other hand to grasp the proximal portion of the lower leg (FIGURE 3).5 Lifting the leg to about 30 degrees from the table with the injured knee in full extension, the examiner rotates the foot or ankle medially, applies a valgus force to the knee, and slowly flexes it. During flexion, a ruptured ACL will cause the tibia to translate posteriorly to the femur. (Note that the starting position of the test has the tibia subluxed anteriorly. The posterior translation is the “pivot shift” back into the neutral position.)

**The literature.** The pivot shift test is technically more challenging to perform than the other 2 tests and is, therefore, less practical in the primary care setting. However, when this test is done correctly, a positive result is highly specific for ACL injury.9,10 Reported sensitivity values are contradictory. The most recent meta-analysis reports...
a sensitivity of 85%. Two other studies cite much lower values: 24% and 28%. These data suggest that the pivot shift test, when carried out correctly, can be of use in confirming a possible ACL rupture. However, the test should not be used alone in ruling out a possible ACL injury.

New diagnostic test:
Lever sign test
How it’s done. The lever sign test (FIGURE 4), introduced in the mid-2010s, is also performed with the patient lying in the supine position. The examiner stands at the side of the affected knee of the patient, places a closed fist just beneath the proximal third of the patient’s tibia, creating a slight flexion of the knee joint. With the other hand, the examiner applies a downward directed force to the distal third of the femur. With an intact ACL, the patient’s foot should rise from the table due to the induced lever mechanism. With a ruptured ACL, the lever effect is absent and the foot will not rise.

The literature. In the prospective clinical study that introduced the lever sign test, the sensitivity rate was reported at 100%—higher than that seen with the other commonly used tests. Another study has reported that the lever sign test was easily adopted in clinical practice and showed higher sensitivity than the Lachman test (94% vs 80% in pre-anesthesia assessment). However, a more recent study has shown a sensitivity of 77% for the lever sign. The lever sign test is relatively easy to perform and requires less examiner strength than does the Lachman test. These factors enhance applicability of the lever sign test in the primary care office and in other settings such as physical therapy centers and emergency departments.

Applying this information in primary care
Given the importance of physical examination in diagnosing ACL injury, how can the current evidence best be applied in primary care practice? Based on its good test properties and feasibility, the Lachman test is preferred in primary care. The anterior drawer test can be used, but its low accuracy must be considered in making an assessment. The pivot shift test, given its difficulty of execution, should not be used by physicians unacquainted with it.

If future research supports early reports of the lever sign test’s accuracy, it could be very helpful in family practice. Going forward, research should aim at developing a constructive strategy for applying these physical examination tests in both primary care and specialty settings.
FIGURE 4

Lever sign test

With the patient lying in the supine position, stand at the side of the affected knee and place a closed fist just beneath the proximal third of the patient's tibia. This creates a slight flexion of the knee joint. With the other hand apply a downward directed force to the distal third of the femur. With an intact anterior cruciate ligament (ACL) (A), the patient's foot should rise from the table due to the induced lever mechanism. With a ruptured ACL (B), the lever effect is absent and the foot will not rise.

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ACKNOWLEDGMENTS
We thank Frits Oosterfeld, PhD, for critically reviewing the manuscript and Ralph de Vries for his assistance in the literature search.

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