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Accuracy of 3 Diagnostic Tests for Anterior Cruciate Ligament Tears

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Reference: Scholten RJPM, Opstelten W, van der Plas CG, Bijl D, Deville WLJM, Bouter LM. Accuracy of physical diagnostic tests for assessing ruptures of the anterior cruciate ligament: a meta-analysis. *J Fam Pract.* 2003;52:689–694.

Clinical Question: In patients presenting with possible rupture of the anterior cruciate ligament (ACL), which diagnostic test can provide an accurate diagnosis during the physical examination?

Data Sources: Two reviewers searched MEDLINE (1966 to February 14, 2003) and EMBASE (1980 to February 14, 2003). Articles written in English, French, German, or Dutch were included. The key search terms were *knee injuries, knee joint,* and *knee.* These terms were combined with the headings *joint instability* and *anterior cruciate ligament,* as well as the text words *laxity, instability, cruciate,* and *effusion.* The results of these searches were combined with the subject headings *sensitivity* and *specificity, physical examination,* and *not (animal not [human and animal]).* Additional text words searched were *sensitivit*, specificit*, false positive, false negative, accuracy, screening, physical examination,* and *clinical examination.* The reference lists of included articles were examined.

Study Selection: Inclusion criteria consisted of (1) investigation of at least one physical diagnostic test for assessment of ACL ruptures in the knee and (2) the use of a reference standard of arthrotomy, arthroscopy, or magnetic resonance imaging.

Data Extraction: Two independent reviewers extracted data from each included study. The methodologic quality of each test was assessed and recorded on a checklist for the screening of diagnostic tests (rwww.cochrane.de/cochrane/sadtdoc1.htm). The 3 diagnostic tests validated in this review were the pivot shift test, the anterior drawer test, and the Lachman test. A summary receiver operating characteristic curve was performed for each test, and the sensitivity, specificity, and predictive values were reported.

Main Results: The search strategy produced 1090 potentially eligible studies, of which 17 studies were selected. One study was included via reference list examination and 2 reports referred to the same study. Thus, 17 studies met the inclusion criteria and were used for this review. For the included studies, the sample size ranged from 32 to 300 patients. As for the age of the subjects, the authors of 4 studies failed to report it. Thus, the average age of patients across 13 of the 17 studies was 28.6 years. Authors of all studies failed to measure the clinical test and reference standard separately and with blinding. In addition, all but two studies had a significant degree of verification bias. Arthrotomy was the lone reference standard in 4 studies whereas arthrotomy/arthroscopy was the reference standard in 5 studies. Arthroscopy alone was the reference standard in 6 studies where only 2 studies used MRI as the reference standard. Authors of 8 studies examined the anterior drawer test and reported sensitivity values ranging from 0.18–0.92 and specificity values ranging from 0.78–0.98. When pooled together using the bivariate random effects model (BREM), the sensitivity value of the 8 studies was 0.2 and the specificity value was 0.88. Authors of 9 studies examined the Lachman test and reported sensitivity values ranging from 0.63–0.93 and specificity values ranging from 0.55–0.99. Pooled together using the BREM, the sensitivity value was 0.86 and the specificity value was 0.91. Lastly, authors of 6 studies examined the pivot shift test and reported sensitivity values ranging from 0.18–0.48 and specificity values ranging from 0.97–0.99. Data for the pivot shift test could not be pooled using the BREM because of the low number of available studies. Predictive values were reported graphically, with the pivot shift test having the highest positive predictive value and the Lachman test having the best negative predictive value.

Conclusions: Based on predictive value statistics, it can be concluded that during the physical examination, a positive result for the pivot shift test is the best for ruling in an ACL rupture, whereas a negative result to the Lachman test is the best for ruling out an ACL rupture. It can also be concluded that, solely using sensitivity and specificity values, the Lachman test is a better overall test at both ruling in and ruling out ACL ruptures. The anterior drawer test appears to be inconclusive for drawing strong conclusions either way.

Key Words: sensitivity, specificity, physical examination, knee, validity, joint instability

COMMENTARY

This review by Scholten et al suggests that during the physical examination of the knee, a negative Lachman test would indicate no anterior cruciate ligament (ACL) tear, whereas a positive pivot shift test would indicate an ACL tear. However, the authors base this assumption on predictive values, which can be highly influenced by the incidence of the condition in the study population.[1] Whether a Lachman test would be as effective in ruling out an ACL rupture in a setting involving a wide range of knee injuries or one that specializes primarily in upper extremity injuries is unknown. Similarly,

the pivot shift test may be effective in ruling in an ACL rupture because most patients on whom it was performed had the condition.

Therefore, sensitivity and specificity values may be more useful than predictive values.[1] The *sensitivity* of a test represents the number of the total group of patients with the condition who had a positive test result.[1] This measure of true-positive results indicates the degree to which a positive clinical test truly represents the presence of the condition. Expressed as a percentage, the higher the sensitivity, the better the chance that a positive test confirms the presence of the condition. Fritz and Wainner[1] said that a negative test finding for a test with high sensitivity provides a strong indication that the condition is indeed absent, whereas a positive test finding for a test with high specificity rules in the condition. *Specificity* represents the number of patients without the condition who had a negative test result.[1] This measure of true-negative results indicates the degree to which a negative clinical test truly represents the absence of the condition. Again expressed as a percentage, the higher the specificity, the better the chance that a negative test result reflects the absence of the condition. Applying this criterion to the pooled results gathered from the Scholten et al review suggests that the Lachman test is a better overall test for assessing the ACL. In addition, the Lachman test is easier to perform than the pivot shift test.

Finally, it has been suggested that likelihood ratios can help provide a better understanding of the effect of a test result on clinical decision making.[2,3] Positive and negative likelihood ratios reflect the shift in probabilities once the results of the clinical tests are obtained. A positive likelihood ratio provides an estimate of the odds favoring a condition being present given a positive test result. With a positive test result, a larger positive likelihood ratio indicates a stronger correlation between a positive test and the condition being present. A negative likelihood ratio can help to rule out a condition. A negative ratio provides an estimate of the odds favoring a condition being absent given a negative test result.[1] A smaller negative likelihood ratio reflects a strong shift in the probability of the absence of a condition given a negative test result and leaves little room for error. Although only a few groups in the Scholten et al review reported likelihood ratios, they can easily be calculated. For the anterior drawer test pooled data, the positive likelihood ratio is 5.17 and the negative likelihood ratio is 0.43. For the Lachman test pooled data, the positive likelihood ratio is 9.56 and the negative likelihood ratio is 0.15. For the pivot shift test, using the median values of the reported range, the positive likelihood ratio is 16.5 and the negative likelihood ratio is 0.68. Using an interpretation scale,[1] it would appear that the Lachman test provides the best overall positive and negative likelihood ratios, whereas the pivot shift test solely has a high positive likelihood ratio and the anterior drawer test is mediocre in both categories.

Clinically, this review provides certified athletic trainers with statistical evidence that the Lachman test is a valid test for diagnosing ACL rupture, whereas the anterior drawer may be a needless additional test. Athletic trainers should consider whether a clinical test is helpful in establishing a diagnosis and may even confuse the diagnosis. Authors of future review studies should look at combining several clinical tests and even a thorough history to help improve the validity of the physical examination. Such studies may reveal that the results of the anterior drawer and Lachman tests, combined with subjective history items, are as effective in diagnosing ACL ruptures as is magnetic resonance imaging. This premise is certainly attainable, based on reported sensitivity and specificity values for magnetic resonance imaging in ACL-deficient knees of 95.5% and 100%, respectively.[4] Such a finding should reduce the need for this expensive and time-consuming test.

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