Clinical diagnosis of an anterior cruciate ligament rupture: a meta-analysis
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CRD summary
This review assessed the diagnostic performance of physical tests for anterior cruciate ligament rupture. The lack of details of the included studies and the variation between them mean that the results should be treated with caution. The authors' recommendation of the Lachman test appears reasonable, but no data were presented to support its use in combination with the pivot test.

Authors' objectives
To determine the diagnostic accuracy of clinical tests for assessing anterior cruciate ligament (ACL) ruptures.

Searching
MEDLINE, EMBASE and CINAHL were searched from inception to April 2005; the search strategy was reported. Additional references were sought through personal contacts and by screening the bibliographies of relevant review articles. Only articles written in English, German or Dutch were included.

Study selection

- Study designs of evaluations included in the review
  No inclusion criteria for the study design were specified.

- Specific interventions included in the review
  Studies assessing the diagnostic accuracy of one or more physical tests for ACL rupture were eligible for inclusion. The tests assessed by the included studies were the anterior drawer test, the Lachman test and the pivot shift test.

- Reference standard test against which the new test was compared
  The included studies were required to use arthroscopy, arthrotomy or magnetic resonance imaging (MRI) as the reference standard test. Half (14 out of 28) of the studies used arthroscopy as the reference standard, five used arthrotomy, seven used a combination of arthroscopy and arthrotomy, and the remaining two used MRI.

- Participants included in the review
  Studies of patients with suspected ACL rupture were eligible for inclusion.

- Outcomes assessed in the review
  Studies reporting sufficient data to construct 2x2 contingency tables of diagnostic performance were eligible for inclusion. Calculated values for the sensitivity and (where sufficient data were available) specificity, positive and negative likelihood ratios (LR+ and LR-, respectively), and diagnostic odds ratio (DOR) were reported for each included study.

How were decisions on the relevance of primary studies made?
One author reviewed the titles and abstracts of identified articles for potential relevance. Three authors reviewed the full papers of those citations considered potentially relevant.

Assessment of study quality
Two authors applied a standardised assessment of methodological quality to each included study; any disagreements were resolved through consensus with the assessment of a third reviewer. Quality assessment criteria addressed: methods of data collection; patient selection; blinding; verification bias; study design; description of the index test and reference standard.
Data extraction
One author extracted 2x2 data and a second author checked them. The data were abstracted on a per knee, rather than per patient, basis.

Methods of synthesis
How were the studies combined?
Pooled estimates of the sensitivity, specificity, LR+, LR- and DOR were presented with 95% confidence intervals (CIs). Pooled estimates of sensitivity and specificity were generated using a fixed-effect model, while pooled estimates of the LR-, LR+ and DOR were generated using a random-effects model; the studies were weighted by sample size.

How were differences between studies investigated?
The studies were grouped for analysis by clinical test (with and without anaesthesia) and subgroup analyses for acute and chronic lesions were presented. The chi-squared test was used to assess statistical homogeneity.

Results of the review
Twenty-eight studies were included in the review. The total number of participants was not clear.

Only 3 studies described an independent blind comparison of the index test with a reference standard of diagnosis; one of these and another 2 studies interpreted the index test independently of other clinical information. Three further studies were free from verification bias. The spectrum of disease varied across the included studies and only 11 studies reported the index test in sufficient detail to permit its replication.

Anterior drawer test without anaesthesia.
The pooled estimates for sensitivity (20 studies) and specificity (12 studies) were 55% (95% CI: 52, 58) and 92% (95% CI: 90, 94), respectively. The pooled estimates for the LR+ and LR- (12 studies) were 7.3 (95% CI: 3.5, 15.2) and 0.5 (95% CI: 0.4, 0.6), respectively. Diagnostic performance was similar when the data were subgrouped for chronic and acute disease.

Anterior drawer test with anaesthesia.
The pooled estimates of sensitivity (15 studies) and specificity (7 studies) were 77% (95% CI: 75, 80) and 87% (95% CI: 82, 91), respectively. The pooled estimates of the LR+ and LR- (7 studies) were 5.9 (95% CI: 0.9, 38.2) and 0.4 (95% CI: 0.2, 0.8), respectively. Diagnostic performance was similar when the data were sub-grouped for chronic and acute disease; sensitivity appeared slightly higher in chronic disease.

Lachman test without anaesthesia.
The pooled estimates of sensitivity (21 studies) and specificity (12 studies) were 85% (95% CI: 83, 87) and 94% (95% CI: 92, 95), respectively. The pooled estimates of the LR+ and LR- (12 studies) were 10.2 (95% CI: 4.6, 22.7) and 0.2 (95% CI: 0.1, 0.3), respectively. Diagnostic performance was similar when the data were sub-grouped for chronic and acute disease.

Lachman test with anaesthesia.
The pooled estimates of sensitivity (15 studies) and specificity (5 studies) were 97% (95% CI: 96, 98) and 93% (95% CI: 89, 96), respectively. The pooled estimates of the LR+ and LR- (5 studies) were 12.9 (95% CI: 1.5, 108.5) and 0.1 (95% CI: 0.0, 0.3), respectively. Diagnostic performance was similar when the data were sub-grouped for chronic and acute disease.

Pivot shift test without anaesthesia.
The pooled estimates of sensitivity (15 studies) and specificity (8 studies) were 24% (95% CI: 21, 27) and 98% (95% CI: 96, 99), respectively. The pooled estimates of the LR+ and LR- (8 studies) were 8.5 (95% CI: 4.7, 15.5) and 0.9
(95% CI: 0.8, 1.0), respectively. Diagnostic performance was similar when the data were sub-grouped for chronic and acute disease; sensitivity appeared slightly higher in chronic disease.

Pivot shift test with anaesthesia.

The pooled estimates of sensitivity (13 studies) and specificity (6 studies) were 74% (95% CI: 71, 77) and 99% (95% CI: 96, 100), respectively. The pooled estimates of the LR+ and LR- (6 studies) were 20.9 (95% CI: 2.8, 156.2) and 0.3 (95% CI: 0.1, 0.7), respectively. Specificity was similar when the data were subgrouped for chronic and acute disease; sensitivity was slightly higher for both subgroups.

Authors' conclusions
The authors recommended the Lachman test in combination with the pivot shift test, because the latter was very specific in both acute and chronic injury in cases of suspected ACL rupture.

CRD commentary
The review addressed a clearly stated question, defined by appropriate inclusion criteria. The search strategy was adequate, although the restriction to English, German and Dutch publications might have resulted in the loss of some relevant data. No attempt to identify unpublished data was reported. The review methodology was clearly reported and included some measures to minimise the potential for error and bias. However, the initial selection of potentially relevant citations by only one author leaves open the possibility of selection bias. The methodological quality of the included studies was assessed using criteria appropriate for diagnostic accuracy studies and the results were reported in full; some limited investigation of the impact of methodological quality upon estimates of accuracy was reported in the discussion.

Even though the results were reported in full for each of the included studies, no further details of the individual studies were given. This, together with the lack of reporting of the results of statistical tests of homogeneity, makes it impossible to judge the appropriateness of pooling. The CIs around the summary estimates and the range of estimates reported for the individual studies indicate that significant between-study heterogeneity is likely, as the authors acknowledged in their discussion; the results of the review should therefore be viewed with caution. The authors' recommendation of the Lachman test appears reasonable given the data presented, but no data were presented to support the suggestion of additional value when the Lachman test and pivot test are used in combination.

Implications of the review for practice and research
Practice: The authors recommended the use of the Lachman test in combination with the pivot test in cases of suspected ACL injury. Research: The authors stated that further high-quality studies are needed in this area. They placed particular emphasis on the need for independent, blinded interpretation of index tests with respect to the reference standard, and vice versa.

Bibliographic details

PubMedID
16715828

DOI
10.2519/jospt.2006.2011

Indexing Status
Subject indexing assigned by NLM
MeSH
Anesthesia; Anterior Cruciate Ligament /injuries; Diagnostic Tests, Routine /standards; Humans; Knee Joint; Rupture /diagnosis; Sensitivity and Specificity

**AccessionNumber**
12006002033

**Date bibliographic record published**
31/10/2007

**Date abstract record published**
31/10/2007

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