CRD summary
This generally well conducted review concluded that the lift-off test had the highest diagnostic utility, particularly for confirming subacromial impingement syndrome. This broadly reflected the results of the meta-analyses, but data suggested that the drop arm test could also be a useful rule in test. As noted by the authors, results may not be applicable to primary care.

Authors' objectives
To assess the accuracy of clinical tests for diagnosing subacromial impingement syndrome.

Searching
PubMed, EMBASE, The Cochrane Library and Science Direct were searched, without language restrictions, to January 2011 and search terms were reported. Searches included methodological terms for test accuracy studies. The bibliographies of included articles and Google Scholar were searched for additional studies.

Study selection
Prospective or retrospective diagnostic cohort studies, conducted in out-patient or in-patient settings, were eligible for inclusion if they assessed one of the following clinical tests: Neer's sign; Hawkins-Kennedy test; horizontal adduction test; empty can test; full can test; drop arm test; painful arc test; supraspinatus palpation; resisted abduction; resisted external rotation; external rotation lag sign; Patte's test; Hornblower's sign; bear-hug test; belly-press test/Napoleon test; belly-off test; lift-off test; internal rotation lag sign; internal rotation strength test. Participants were adult (16 years or older) patients with painful shoulder. Included studies were required to use findings at arthroscopy or open surgery as the reference standard to confirm diagnosis; positive findings were defined as an enlarged or fibrotic-appearing bursa, or partial or full rotator cuff tears.

The mean age of study participants ranged from 40 to 66 years. Studies assessed 21 different clinical tests, including some which did not appear to have been specified in the inclusion criteria. Most studies assessed more than one test. All of the included studies were conducted in specialist clinic settings in secondary care and most were of stage 1-3 patients. Most studies used arthroscopy as the reference standard.

Two reviewers independently screened studies for inclusion and any disagreements were resolved by consensus.

Assessment of study quality
The methodological quality of included studies was assessed using a modified 13-item version of the QUADAS tool; the item on reporting of uninterpretable/intermediate test results was omitted because it was deemed not relevant to this review.

Two reviewers independently assessed study quality, with disagreements resolved by discussion.

Data extraction
The numbers of true positive, false negative, false positive and true negative results were extracted for each test. Study authors were contacted for additional information as needed.

Two reviewers extracted data and discrepancies were resolved by discussion.

Methods of synthesis
Where the minimum number of data sets (four) was available, a bivariate random-effects model was used to calculate summary estimates of sensitivity and specificity, with 95% confidence intervals (CIs) for each test. Summary receiver operating characteristic (SROC) plots and summary likelihood ratios were also presented for each test.
Heterogeneity was assessed visually using SROC plots and statistically using the variance of logit transformed sensitivity and specificity.

**Results of the review**

Sixteen studies (2,390, range 45 to 552) were included in the review. Overall study quality was rated as moderate-to-good. The main methodological concerns were time delay between clinical test and reference standard and lack of clarity regarding blinded test interpretation.

Ten studies of five clinical tests (1,684) were included in the meta-analyses.

**Hawkins-Kennedy test (six studies, 1,029 patients):** The pooled estimates of sensitivity and specificity were 74% (95% CI 57 to 85) and 57% (95% CI 46 to 67). The pooled positive likelihood ratio was 1.70 (95% CI 1.29 to 2.26) and the pooled negative likelihood ratio was 0.46 (95% CI 0.27 to 0.78).

**Neer's sign (five studies, 1,127 patients):** The pooled estimates of sensitivity and specificity were 78% (95% CI 68 to 87%) and 58% (95% CI 47 to 68). The pooled positive likelihood ratio was 1.86 (95% CI 1.49 to 2.31) and the pooled negative likelihood ratio was 0.37 (95% CI 0.25 to 0.55).

**Empty can test (six studies, 695 patients):** The pooled estimates of sensitivity and specificity were 69% (95% CI 54 to 81%) and 62% (95% CI 38 to 81). The pooled positive likelihood ratio was 1.81 (95% CI 1.16 to 2.83) and the pooled negative likelihood ratio was 0.50 (95% CI 0.40 to 0.63).

**Drop arm test (five studies, 1,213 patients):** The pooled estimates of sensitivity and specificity were 21% (95% CI 14 to 30) and 92% (95% CI 86 to 96). The pooled positive likelihood ratio was 2.62 (95% CI 1.60 to 4.30) and the pooled negative likelihood ratio was 0.86 (95% CI 0.79 to 0.94).

**Lift-off test (four studies, 267 patients):** The pooled estimates of sensitivity and specificity were 42% (95% CI 19 to 69) and 97% (95% CI 79 to 100). The pooled positive likelihood ratio was 16.47 (95% CI 1.43 to 185.61) and the pooled negative likelihood ratio was 0.59 (95% CI 0.37 to 0.97).

No results were reported for the six studies not included in the meta-analyses.

**Authors’ conclusions**

The lift-off test had the highest diagnostic utility of the five clinical tests included in the meta-analyses, particularly for ruling in subacromial impingement syndrome in the presence of a positive test.

**CRD commentary**

The review reported clear inclusion criteria for the assessment of a wide range of clinical tests for subacromial impingement syndrome. A number of sources were searched for relevant studies and, although all included studies were published in English, no language restrictions were reported. The use of methodological search terms for test accuracy studies could have reduced the sensitivity of searches and some relevant studies may have been missed. Measures to minimise error and bias were applied throughout the review process, and the methodological quality of included studies was assessed and reported. Appropriate meta-analytic methods were used. However, no results were reported for those studies which met the inclusion criteria for the review, but were not included in the meta-analyses.

The authors conclusions broadly reflected the results of the meta-analyses, but the data presented would seem to suggest that a positive drop arm test may also be useful for confirming subacromial impingement syndrome. These limitations meant that the reliability of the authors’ conclusions was uncertain. In addition, as noted by the authors, all included studies were conducted in specialist settings, which may limit the applicability of findings to primary care.

**Implications of the review for practice and research**

**Practice:** The authors made no specific recommendations for clinical practice. They stated that the diagnostic accuracy of some clinical tests for subacromial impingement syndrome should be considered in the context of overall patient assessment. They further stated that clinicians should be aware of guidelines on diagnosis and correct management of patients with subacromial impingement syndrome.
Research: The authors stated that future studies should assess the accuracy of clinical tests in primary care settings. In addition, future studies should minimise the time delay between clinical tests and the reference standard and clearly report whether surgeons performing arthroscopy were blinded to the results of clinical tests; the impact of training and experience of examiners on test performance should also be considered. The authors also stated that it could be useful to examine the diagnostic utility of signs and symptoms.

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