Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: systematic review
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CRD summary
This review evaluated the accuracy of the Ottawa ankle rules for excluding ankle and mid-foot fractures. The authors concluded that they were an accurate instrument for excluding fractures of the ankle and mid-foot. However, since there was little information on the reference standard, the conclusion should be treated with caution.

Authors' objectives
To evaluate the accuracy of the Ottawa ankle rules for excluding fracture of the ankle and mid-foot.

Searching
MEDLINE (1990 to 2003), EMBASE (1990 to 2002), CINAHL (1990 to 2002), the Cochrane Library (Issue 2, 2002) and the Science Citation Index were searched with no language restrictions. The reference lists of the included studies were also checked. Clinical experts and authors of relevant research were contacted.

Study selection
Study designs of evaluations included in the review
Specific inclusion criteria relating to the study design were not reported. All studies included in the review were prospective in design. No further details were provided.

Specific interventions included in the review
Studies evaluating the Ottawa ankle rules were eligible for inclusion.

Reference standard test against which the new test was compared
The authors neither reported inclusion criteria specific to the reference standard, nor stated the reference standard used in the included studies. Only 13 of the 27 studies pooled in the analysis reported using radiography in all participants.

Participants included in the review
Specific inclusion criteria relating to the participants were not reported. Thirteen of the studies excluded participants under 18 years of age. The mean age of the participants varied from 11 to 37.1 years. Twelve of the studies reported consecutive enrolment of the participants.

Outcomes assessed in the review
Sufficient data for the construction of a 2x2 table were required for studies to be included in the review.

How were decisions on the relevance of primary studies made?
Two reviewers independently selected the studies.

Assessment of study quality
The criteria used to assess validity were methods of data collection, patient selection, blinding, prevention of verification bias, and the description of the index test and reference standard. Two reviewers independently assessed the quality of the studies. Any disagreements were resolved by consensus.

Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction.
The authors calculated pooled estimates of sensitivity, specificity, likelihood ratios (LRs) and their standard errors.

**Methods of synthesis**

How were the studies combined?
Pooled sensitivities and 95% confidence intervals (CIs) were calculated using bootstrapping, a method that creates hypothetical samples by randomly selecting values from the original sample. The median and interquartile range (IQR) were calculated for specificity. Pooled negative LRs and 95% CIs were calculated using a random-effects model.

How were differences between studies investigated?
The authors assessed the impact of study quality by calculating a series of pooled negative LRs, successively increasing the number of methodological criteria required for each calculation.

**Results of the review**

Thirty-two studies assessed the Ottawa ankle rules, of which 16 assessed the ankle, 11 the mid-foot and 10 a combination of the two. Twenty-seven studies (n=15,581) were available for pooling, of which 12 assessed the ankle, 8 the mid-foot, 10 a combination of the two, and 6 assessed the ankle or mid-foot in children.

Overall, the pooled sensitivity of the Ottawa rules was 97.6% (95% CI: 96.4, 98.9) and the median specificity was 31.5% (IQR: 23.8, 44.4). The pooled sensitivity was 98% (95% CI: 96.3, 99.3) for the ankle, 99% (95% CI: 97.3, 100) for the foot and 96.4% (95% CI: 93.8, 98.6) for the two combined. The median specificity was 39.8% (IQR: 27.9, 47.7) for the ankle, 37.8% (IQR: 24.7, 70.1) for the foot and 26.3% (IQR: 19.4, 34.3) for the two combined.

Overall, the probability of having a fracture after a negative result was 1.73% (95% CI: 1.05, 2.75). The probability of having a fracture after a negative result was 1.39% (95% CI: 0.53, 3.08) for the ankle, 1.39% (95% CI: 0.53, 3.41) for the foot and 2.91% (95% CI: 1.73, 5.03) for the two combined. The results for further subgroups were also reported.

The negative LRs increased for subgroups of increasing methodological quality.

**Authors' conclusions**
The Ottawa ankle rules were an accurate instrument for excluding fractures of the ankle and mid-foot.

**CRD commentary**
This was a well-conducted review addressing a clearly stated and clinically relevant research question. An appropriate literature search was undertaken, and measures were taken to minimise the potential for error and bias in the review process. The validity of the included studies was assessed using criteria specific to the methodology of diagnostic accuracy studies. Appropriate measures of accuracy were calculated, though the description of the statistical analyses was limited. Although details of the included studies were not reported in the paper, further information was available online: 59% of the studies included in the analysis used radiography as the reference standard in all participants. There was no clear indication of what constituted the reference standard for the remaining studies, or of completeness of follow-up where this was used as the reference standard. The authors’ conclusions follow from the data presented, but should be interpreted with consideration of the possible impact of unknown variation in the reference standards applied in the included studies.

**Implications of the review for practice and research**
The authors did not state any implications for practice or further research.

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Other publications of related interest

This additional published commentary may also be of interest. Fletcher RH. The Ottawa ankle rules have a high sensitivity for excluding fractures of the ankle and midfoot in acute ankle sprain. Evid Based Med 2003;8:185.

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