Accuracy of Ottawa Ankle Rules to exclude fractures of the ankle and midfoot in children: a meta-analysis

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CRD summary
This review concluded that Ottawa Ankle Rules were reliable for excluding fractures in children greater than five years of age without worry of missing a significant fracture. This was a well-conducted review and the conclusions are likely to be reliable.

Authors' objectives
To determine the accuracy of the Ottawa Ankle Rule for the exclusion of ankle and midfoot fractures in children.

Searching
MEDLINE, Cochrane Central Register of Controlled Trials (CENTRAL), EMBASE and CINAHL were searched from 1992 to May 2007. Search terms were reported in a web appendix and included a diagnostic filter. Current Controlled Trials and ClinicalTrials.gov were searched for unpublished studies. Relevant websites were searched for conference abstracts. Reference lists were screened, primary authors were contacted and key articles were tracked forward using the cited reference search in Web of Science. No language restrictions were applied.

Study selection
Prospective and retrospective diagnostic cohort studies that assessed the accuracy of Ottawa Ankle Rule for diagnosis of fractures of the ankle or midfoot in children (18 years or less) who presented to the emergency department with an acute blunt ankle and/or midfoot injury were eligible for inclusion. Studies had to include X-ray of the ankle and/or foot or a proxy measure as the reference standard and report sufficient data to construct a 2x2 table of test performance. Children had to be able to walk to be included. Studies that included both adults and children were eligible if data were reported separately for children.

Included studies were prospective or retrospective and assessed the ankle, foot or both. Mean/median age ranged from 11 to 13 years, where reported (overall range one to 18 years). Studies were conducted in Canada, USA, UK, France and Mexico.

Two reviewers independently assessed studies for inclusion. Disagreements were resolved through discussion or referral to a third reviewer.

Assessment of study quality
Two reviewers independently assessed study quality using QUADAS (Quality Assessment of Diagnostic Accuracy Studies) criteria. Disagreements were resolved through discussion.

Data extraction
One reviewer extracted data as 2x2 tables of test performance. Sensitivity, specificity and X-ray reduction rates were calculated. A second reviewer checked data extraction. Where necessary, authors were contacted for missing data.

Methods of synthesis
Variation in diagnostic threshold was assessed using the Spearman correlation and Littenberg Moses method. Summary sensitivity, specificity and X-ray reduction rates, together with 95% confidence intervals (CIs), were estimated using an approximation of the inverse variance method. Summary likelihood ratios were estimated using the DerSimonian and Laird model. Heterogeneity was assessed using the \( I^2 \) statistic. Where substantial heterogeneity was found (\( I^2 > 50\% \)), data were not pooled. Subgroup analyses were conducted to assess effects of age (<6 versus >6 years), study design, type of fracture, type of assessment (ankle, foot or both) and methodological quality. Publication bias was assessed visually using funnel plots and statistically using the regression test for asymmetry.
Results of the review
Twelve studies were included (n=3,130): four prospective and eight retrospective studies. Ten studies included an appropriate patient spectrum; this was unclear in two studies. All studies used X-rays taken at the initial emergency department visit at the discretion of the physician as the reference standard; those who were not X-rayed were either followed-up or asked to return for reassessment. Ottawa Ankle Rule was interpreted blind to the reference standard and vice versa in seven studies; the other five studies did not report blinding. There was a possibility of verification bias in one study. All studies accounted for all children enrolled.

Summary sensitivity was 98.5% (95% CI 97% to 99%). Sensitivity was above 97% in 10 studies. The summary negative likelihood ratio was 0.11 (95% CI 0.05 to 0.26, $I^2=51\%$). Specificity ranged from 8% to 50%; data were not pooled due to substantial heterogeneity. There was substantial heterogeneity in positive likelihood ratio ($I^2=94\%$) and so data were not pooled. X-ray reduction rates ranged from 5% to 44% with a summary estimate of 25% (95% CI 23% to 26%). Based on mean prevalence of fractures of 21%, a negative Ottawa Ankle Rule assessment reduced the post-test probability of fracture to around 2.9%.

There was no evidence of publication bias.

Authors' conclusions
The Ottawa Ankle Rule appeared to be a reliable tool to exclude fractures in children greater than five years of age who presented with ankle and midfoot injuries without worry of missing a significant fracture. Application of the Ottawa Ankle Rule in children would result in a 25% reduction in X-ray usage.

CRD commentary
The review addressed a focused question supported by clearly defined inclusion criteria. The literature search covered a broad range of databases and included attempts to locate unpublished data. However, use of a diagnostic filter meant that there was a possibility that relevant studies were missed. Appropriate steps were taken to minimise bias and errors at all stages of the review process. Study quality was assessed using appropriate criteria and the results of the assessment were discussed. Relevant study details were summarised in tables. The analysis was adequate, but it appeared that for unstated reasons the subgroup analyses proposed in the methods were not conducted. Methods used to assess publication bias were not appropriate for diagnostic studies. Overall the authors conclusions are likely to be reliable.

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

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