Value of radiological diagnosis of skull fracture in the management of mild head injury: meta-analysis

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Authors' objectives
To assess the value of the diagnosis of skull fracture by plain radiograph in the diagnosis of intracranial haemorrhage (ICH) in patients with mild head injury (MHI), and to estimate the prevalence of ICH in these patients.

Searching
MEDLINE, EMBASE and Current Contents were searched from 1966 to 1998; the search terms were reported. The reference lists of original articles were checked.

Study selection
Study designs of evaluations included in the review
The authors did not specify any inclusion criteria in relation to the study design, except that at least 50 patients should be included in the study. The included studies seemed to be retrospective and prospective diagnostic cohort studies.

Specific interventions included in the review
Studies of plain skull radiographs for determining the presence of an ICH were eligible for inclusion. The authors stated that in studies where no plain skull radiography was performed, computed tomography (CT) data were used.

Reference standard test against which the new test was compared
The authors did not explicitly state in their inclusion criteria the reference test against which the skull fracture radiograph should be compared. However, it was implied that the reference test was confirmation of ICH by a CT scan, angiography or neurosurgical findings. If CT was not performed, the authors considered an uneventful recovery as a sign of the absence of ICH.

Participants included in the review
Studies of people with MHI were eligible for inclusion. MHI was defined as trauma to the head with a Glasgow Coma Scale score of 13 to 15 on initial presentation. Studies with only paediatric or geriatric patients were excluded. If the data permitted, patients with multiple traumas and patients referred from other centres were excluded.

Outcomes assessed in the review
Numbers of true-positive, false-positive, true-negative and false-negative observations were derived from the data collected in the included studies. The authors did not specify any inclusion criteria in relation to the outcomes.

How were decisions on the relevance of primary studies made?
Articles were primarily selected on the basis of the title and the abstract, then the full text of about 200 articles was retrieved and the inclusion criteria were applied. The authors did not state how many reviewers performed the selection.

Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
A standard form was used to extract data from the study publications. The true-positive rate (sensitivity, TPR) and false-positive rate (1 minus specificity, FPR) were calculated for each study.

Methods of synthesis
How were the studies combined?
A summary receiver operating characteristic (ROC) curve was generated using the method of Moses et al. (see Other Publications of Related Interest), which incorporated the threshold effect.

How were differences between studies investigated?
To determine the effect of inter-study differences (other than threshold variables), publication year, study design, sample size, age, injury severity, percentage with loss of consciousness, focal neurology and other injuries were incorporated in the summary ROC model. A correlation analysis was performed with the diagnostic odds ratio, using the Spearman correlation test.

Results of the review
Thirteen studies (n=48,619) were included in the diagnostic accuracy part of the review: 4 prospective studies (n=25,890) and 9 retrospective studies (n=22,729).

The sensitivity (TPR) of the finding of skull fracture in predicting ICH ranged from 0.13 (specificity 0.99) to 0.75 (specificity 0.99), while the specificity (1 minus FPR) ranged from 0.73 (sensitivity 0.61) to 0.995.

The Spearman rank correlation analysis showed that the percentage of patients with loss of consciousness or post-traumatic amnesia was significantly correlated with the diagnostic odds ratio. A model that incorporated a factor representing these patients fitted the data better (correlation, R²=0.73). Adding another factor to represent the percentage of patients who underwent CT led to a better fit (R²=0.81). This meant that differences in patient selection and the percentage of patients in whom CT was used to verify the diagnosis were important sources of variation.

Based on studies with at least 50% of patients having a CT scan of the brain, the estimated sensitivity of a radiographic finding of skull fracture for the diagnosis of ICH was 0.38 with a corresponding specificity of 0.95 (mean values from the summary ROC curve).

Authors’ conclusions
The plain skull radiograph was of little value in the initial assessment of patients with MHI.

CRD commentary
The review question addressed in this review was not entirely clear. Although it was clear that the diagnostic value of a radiological diagnosis of skull fracture in the detection of ICH in patients with MHI was being assessed, the study inclusion criteria were not clearly stated. It was unclear which reference tests or which study designs were eligible for inclusion. The literature search was adequate, although it was unclear whether any language restrictions were applied. Unpublished studies did not seem to have been sought, thus it is possible that some relevant studies might have been missed. Details of the review process (e.g. how many reviewers selected the studies) were not reported. There was no systematic assessment of validity, although the authors did discuss verification bias and performed a related sensitivity analysis.

The method of pooling and the investigation of heterogeneity seemed appropriate, although without knowing what the reference tests of the included studies were, it is difficult to comment on whether the pooling of the studies was, in itself, an appropriate strategy. The pooled results were not reported in full. The authors’ conclusion follows from the work presented, but more information would be needed before firm conclusions could be drawn. A test with such low sensitivity is unlikely to be of use in initial screening. The variation in the reference standard was likely to produce heterogeneity but as all reference standards would probably identify ICH, the false-negative result was not likely to be distorted.

Implications of the review for practice and research
Practice: The authors stated that the plain skull radiograph has no place in the assessment of MHI in adult patients. The low sensitivity implies that if a skull fracture is not seen on plain skull radiography, the diagnosis of ICH still cannot be
ruled out. If patient selection increases the likelihood of ICH, CT becomes the first-choice diagnostic tool.

Research: The authors did not state any implications for research.

Bibliographic details

Original Paper URL
http://jnnp.bmjjournals.com/cgi/content/full/68/4/416

Other publications of related interest

This additional published commentary may also be of interest. Skull X-ray for mild head injury. Bandolier 2000;80:7.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.