# Clinical decision rules for children with minor head injury: A systematic review

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## Background

A large number of decision rules to assist clinicians with the management of patients following head injury have been described over the past two decades with widespread incorporation in to clinical practice, particularly in adult patients. In children much less published work is available and it is unclear how the few rules that exist compare. This study aimed to systematically identify clinical decision rules for children with minor head injury and compare them for diagnostic accuracy in detecting intracranial injury and injury requiring neurosurgery.

## Methods

Potentially relevant studies were identified by an electronic search of key databases. Papers in English were included with a cohort of more than 20 patients and over 50% being adults having suffered a minor head injury (GCS 13-15). Studies described a decision rule derived to identify patients at risk of intracranial injury or neurosurgery and had to include a proportion of the cohort undergoing imaging. Titles, abstracts and full-text articles were independently screened for relevance by two sets of paired authors (one clinician and one reviewer in each pair) with any discrepancies about inclusion being discussed and resolved. A QUality Assessment of Diagnostic Accuracy Studies (QUADAS) checklist was compiled and each article scored appropriately.

## Results

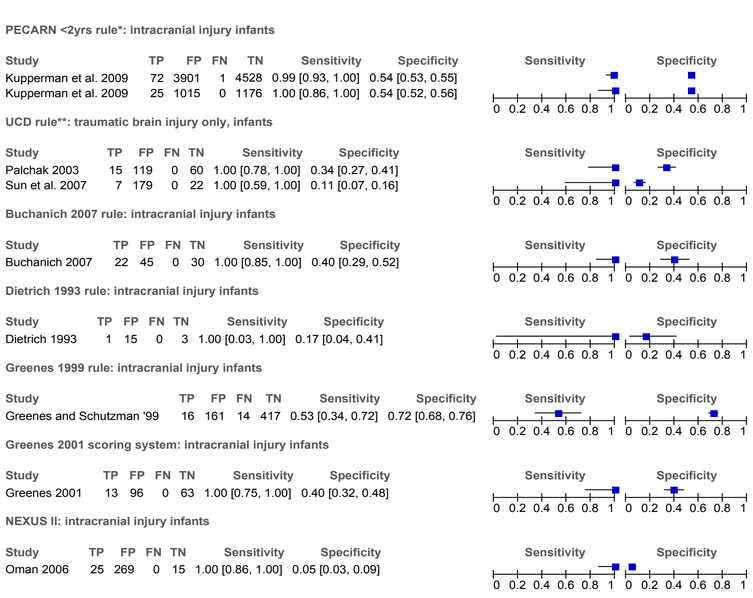
We identified over 8000 titles relevant to minor head injury but only included 222 for full text review. From the 14 studies reporting diagnostic data for decision rules for children with minor head injury a total of 16 decision rules were identified. Overall a total of 79,740 patients were included in these studies.

### Children

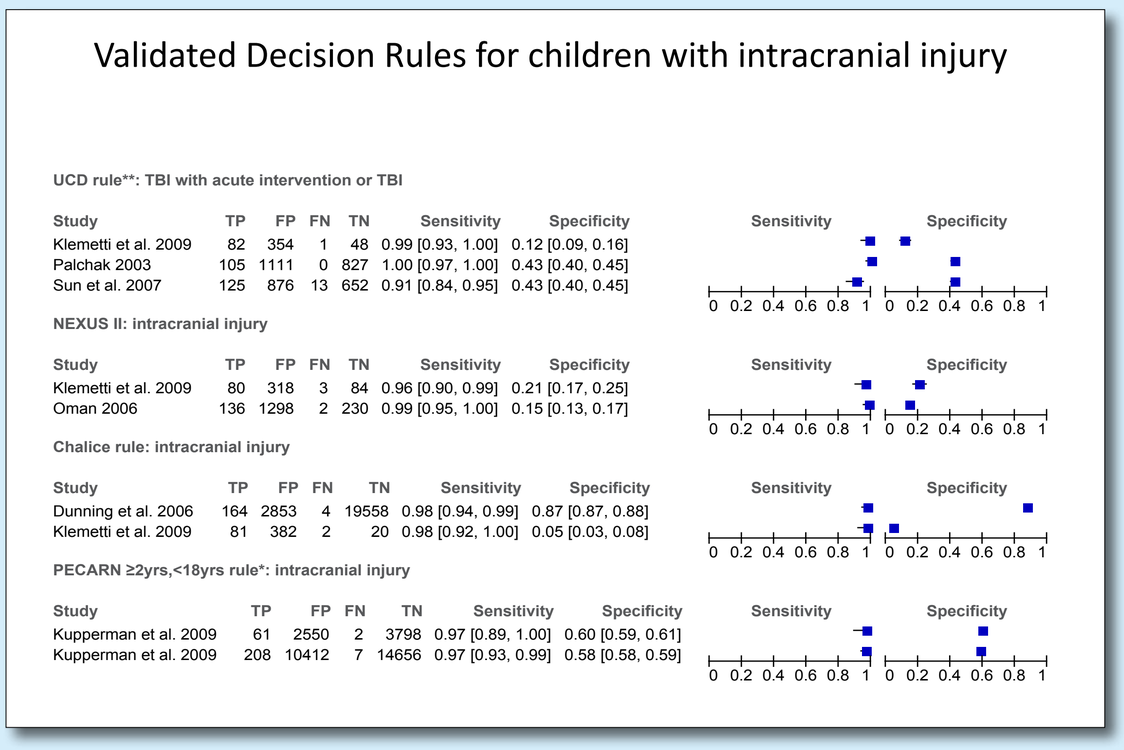
*Intracranial injury*

Of studies reporting prediction of intracranial injury, only four rules were tested in more than one cohort (Figure 10). Of these four rules, the UCD rule for identifying patients with traumatic brain injury or who needed acute intervention (which equates to "any intracranial injury") had the highest sensitivity (99% and 100%) with variable values for specificity (12% and 43%). A modified version of the UCD rule reported in Sun et al., 2007 where 'headache' and 'vomiting' were redefined as 'severe headache' and 'severe vomiting' produced lower sensitivity (91%) but similar specificity (43%).

Decision rules for infants with intracranial injury




Validated Decision Rules for children with intracranial injury




## Results *contiuned*

The CHALICE rule had the next best sensitivity (98% and 98%) but very variable specificity (87% and 5%). The derivation cohort employed a poor reference standard (3% given CT) and the other cohort89 had different patient inclusion criteria (selecting only those admitted) both of which may contribute to the difference in specificity.

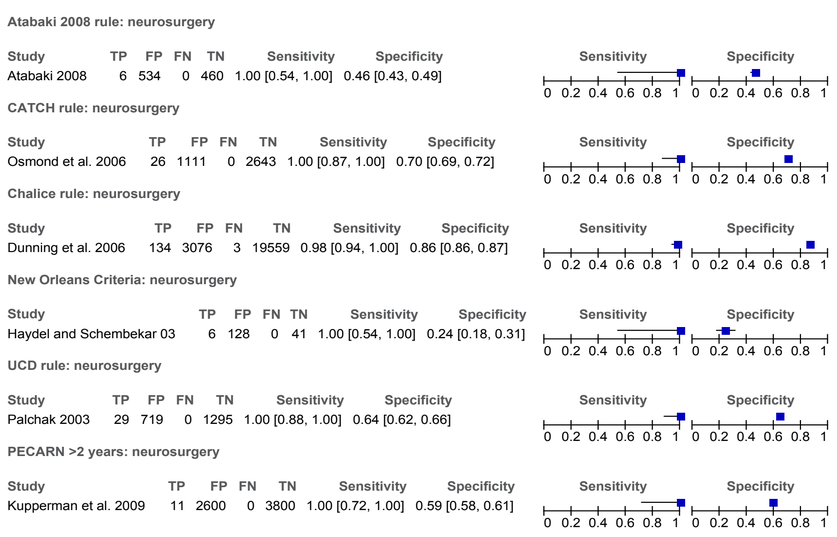
The Paediatric Emergency Care Applied Research Network (PECARN) rule for ≥ 2 years to <18 years was tested in two cohorts; a derivation and a validation cohort, reported in the same paper. Sensitivity (97% and 97%) and specificity (58% and 60%) were very consistent. The rule appears to sacrifice a small degree of sensitivity for a higher specificity when compared to other rules.

The NEXUS II rule was tested in two studies. These reported similar sensitivity (96% and 99%) and specificity (15% and 21%), despite differences in the adequacy of the reference standard in one study, and differences in cohort selection and outcome definitions. Whilst these results seem less promising than the rules discussed earlier, further validation work in a different setting is warranted before conclusions can be drawn.

*Neurosurgery*

Six rules were tested for prediction of the need for neurosurgery, and all in only one cohort. All had very good sensitivity (98 to 100%) but variable specificity (24 to 86%). The CHALICE rule had the highest specificity, but the lowest sensitivity. As observed with the PECARN criteria for children ≥ 2 years, the CHALICE rule appeared to sacrifice a degree of sensitivity for an improved specificity. All these rules need further investigation and validation testing in other settings before firm conclusions can be drawn

Decision rules for children requiring neurosurgical intervention




### Infants

For infants, seven studies were identified for intracranial injury but only two rules have been tested in more than one cohort, with the largest of these (PECARN) giving the best results. All of these rules require further validation by application in other settings before conclusions can be drawn.

### Limitations

The heterogeneity of these rules prevented any meta-analysis of the data and restricted our summary to a narrative synthesis. This highlights the inconsistencies involved in head injury research and the difficulties faced by clinicians in interpreting any published results. There remains a lack of robust validation for these decision rules and the shift from identifying any lesion on CT to focusing on clinically significant lesions has made results more pragmatic for practitioners, but difficult to compare for researchers. This shift also does not appear to take in to account longer-term sequelae, which are beyond the scope of our review.

## Conclusion

Of the currently published decision rules the PECARN rule appears to be the best, validated rule for both children and infants, with the largest study cohort, highest sensitivity and acceptable specificity for intracranial injury. Further validation in new cohorts is required to confirm this finding and compare the PECARN rule directly with other rules.

This project was funded by the NIHR Health Technology Assessment programme and will be published in full in the Health Technology Assessment journal series. Visit the HTA programme website for more details **www.hta.ac.uk/link** to project page. The views and opinions expressed therein are those of the authors and do not necessarily reflect those of the Department of Health