How old is this fracture? Radiologic dating of fractures in children: a systematic review
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CRD summary
This review concluded that the evidence base for X-ray dating of fractures in children to identify possible abuse is sparse. The review had some limitations but the fact that only three studies were found, despite a thorough search, supports the authors’ conclusions. Their recommendation for further research on dating fractures in children aged under 5 appears appropriate.

Authors’ objectives
To evaluate the evidence for radiological dating of fractures in the context of child protection.

Searching
ASSIA, CareData, MEDLINE, ChildData, CINAHL, EMBASE, PsycINFO, SIGLE, the Social Sciences Citation Index and TRIP were searched from inception to March 2004; the search terms were reported. Textbooks published between 1947 and 2004 were searched by hand. No language restrictions were applied.

Study selection
Study designs of evaluations included in the review
No inclusion criteria for the study designs were specified, although review articles, consensus statements and expert opinions were excluded.

Specific interventions included in the review
Studies of radiological dating of fractures were eligible for inclusion. In the included studies, the mean number of radiographs per child ranged from 1 to 9.

Participants included in the review
Studies of children younger than 17 years were eligible for inclusion. Studies of children with underlying bone disease were excluded. The age of the children in the included studies ranged from birth to 17 years; one study included children aged from birth to 11 days. Children had fractures of the radius and ulna in one study, fractures of the femur in another study, and in a third study newborns had fractures of the clavicle, humerus and femur. All fractures were immobilised.

Outcomes assessed in the review
No inclusion criteria for the outcomes were specified. The included studies reported time from fracture to the appearance of various radiological features of healing, including periosteal reaction, density increase and sclerosis at the fracture margin, calcified callus, bridging, remodelling, three stages of callus formation, and first appearance of calcification at the fracture site.

How were decisions on the relevance of primary studies made?
Two independent reviewers assessed studies for relevance. Any disagreements were resolved by reference to a third reviewer.

Assessment of study quality
The studies were graded for quality based on study design, accurate documentation of the time of injury, and standardised criteria for radiological dating. The authors did not state how the validity assessment was performed.

Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction.

Methods of synthesis
How were the studies combined?
The studies were combined in a narrative.

How were differences between studies investigated?
Differences between the studies were presented in tabular format and discussed in the text.

Results of the review
Three longitudinal studies were included (189 children, 56 of which were younger than 5 years).

Two studies defined staging criteria for dating fractures based on radiology and histology and on callus formation, respectively. One study (141 children) reported that no periosteal reaction was seen less than 2 weeks after injury (based on 22 patients), bridging was seen from week three onwards and remodelling from 4 weeks onwards. One study (25 children) reported periosteal reactions were seen between 1 and 3 weeks, bridging from 1.5 to 3.7 weeks, and remodelling from 5 to 11 weeks. The third study (23 newborn children) reported that the first appearance of calcification at the fracture site was 7 days after birth, peak calcification was seen at 9 to 10 days, and the latest appearance of calcification was 11 days after birth.

Authors' conclusions
The evidence base for radiological dating of fractures in children is sparse.

CRD commentary
This review addressed a clear question, although inclusion criteria for the outcomes and study designs were not specified. The authors searched a wide range of sources without language restrictions, including a search for 'grey' literature, thereby reducing the risk of missing relevant studies. Measures were taken to minimise bias and errors at the study selection stage, but it was unclear whether the same methods were used for the quality assessment and data extraction. The quality of the included studies was assessed, although the results were not explicitly reported or used in the synthesis. This made it difficult to assess the quality of the included studies and, hence, the reliability of any conclusions derived from them.

The use of a narrative synthesis seems appropriate in view of the small number and clinical heterogeneity of the included studies. The participants in the included studies were apparently not victims of suspected abuse and the results may not be generalisable to this population. The authors' cautious conclusions reflect the limitations of the evidence and their recommendations for further research appear appropriate.

Implications of the review for practice and research
Practice: The authors stated that dating of fractures is an inexact science and the limitations of the evidence must be borne in mind when clinicians estimate the timeframe of injuries for investigating agencies or courts.

Research: The authors stated the need for larger scale studies to assess radiological criteria for dating fractures, particularly in children younger than 5 years.

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