The use of magnetic resonance imaging in forensic age estimation of living children and subadults systematically reviewed.

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Purpose: To systematically review the use of MRI in forensic age estimation of living children and subadults. To provide a comprehensive overview that can guide age estimation practice and future research.

Search methods: The following databases were searched: MEDLINE, Embase and Web of Science. Additionally, reference lists of included articles, citing articles and study registers were searched. No restrictions were made based on the country of publication, language or publication date.

Selection criteria: Two review authors independently selected articles based on titles and abstracts. Study populations including living subjects up to 30 years were considered. MRI of any field strength studying the development of anatomical structures related to age were included. Studies with unclear or doubtful outcome were excluded. Cross-sectional observational studies, pilot studies, cohort studies and case reports were included. Review articles and pilot studies of other references were excluded. After achieving a consensus regarding the selection of articles, the full text papers were independently evaluated for eligibility by two reviewers.

Data extraction and analysis: The authors independently developed study characteristics tables and data extraction tables for the included articles. A risk of bias assessment tool was developed, based on the EPOC overview and QUADAS-2. Authors were contacted for further details and data if these were unclear, missing or in a format unsuitable for analysis.

Results: After deduplication, 391 records were screened based on title and abstract, rendering 84 eligible articles. Citation tracking rendered 16 additional articles. After full-text screening, 55 studies were included in qualitative analysis and 33 in quantitative analysis. Most studies included European (Caucasian) populations. Only regarding hand/wrist were African, Asian and Latin American populations studied too. However, studies were highly biased by their study populations and MR-sequences varied widely, as did staging techniques. Therefore, pooling of the age distribution data was not appropriate. Still, the studies suggested that combining third molars, the left hand/wrist and the knee would have the strongest potential to estimate age accurately in females. In males, combining third molars, the proximal humerus and the knee might be ideal. Age estimation performance was in line with the gold standard, which uses radiographs, with mean absolute errors ranging from 0.85 to 2.0 years. The proportion of correctly classified minors ranged from 65% to 91%.

Conclusion: The use of MRI in age estimation has been explored extensively in reference studies focusing on single anatomical sites. Although age estimation based on MRI does not outperform the gold standard, it is a valuable alternative to study multiple sites.