

Forensic age estimation based on development of third molars: a staging technique for magnetic resonance imaging

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ABSTRACT

Background: The development of third molars can be evaluated with medical imaging to estimate age in subadults. The appearance of third molars on magnetic resonance imaging (MRI) differs greatly from that on radiographs. Therefore a specific staging technique is necessary to classify third molar development on MRI and to apply it for age estimation.

Aim: To develop a specific staging technique to register third molar development on MRI and to evaluate its performance for age estimation in subadults.

Materials and methods: Using 3T MRI in three planes, all third molars were evaluated in 309 healthy Caucasian participants from 14 to 26 years old. According to the appearance of the developing third molars on MRI, descriptive criteria and schematic representations were established to define a specific staging technique. Two observers, with different levels of experience, staged all third molars independently with the developed technique. Intra- and inter-observer agreement were calculated. The data were imported in a Bayesian model for age estimation as described by Fieuws et al. (2015). This approach adequately handles correlation between age indicators and missing age indicators. It was used to calculate a point estimate and a prediction interval of the estimated age. Observed age minus predicted age was calculated, reflecting the error of the estimate.

Results: One-hundred and sixty-six third molars were agenetic. Five percent (51/1096) of upper third molars and 7% (70/1044) of lower third molars were not assessable. Kappa for inter-observer agreement ranged from 0.76 to 0.80. For intra-observer agreement kappa ranged from 0.80 to 0.89. However, two stage differences between observers or between staging sessions occurred in up to 2.2% (20/899) of assessments, probably due to a learning effect. Using the Bayesian model for age estimation, a mean absolute error of 2.0 years in females and 1.7 years in males was obtained. Root mean squared error equalled 2.38 years and 2.06 years respectively. The performance to discern minors from adults was better for males than for females, with specificities of 96% and 73% respectively.

Conclusion: Age estimations based on the proposed staging method for third molars on MRI showed comparable reproducibility and performance as the established methods based on radiographs.