Multi-factorial age estimation: a Bayesian approach combining dental and skeletal magnetic resonance imaging.

Jannick De Tobel, Steffen Fieuws, Elke Hillewig, Inès Phlypo, Mayonne van Wijk, Michiel Bart de Haas; Constantinus Politis; Koenraad Luc Verstraete; Patrick Werner Thevissen.

Purpose: To study age estimation performance of combining MRI data of all four third molars, the left wrist and both clavicles, and added anthropomorphic and sexual maturation data in both females and males, with specific attention to prediction intervals.

Materials and methods: Three tesla MRI of the three anatomical sites was prospectively conducted from March 2012 to May 2017 in healthy volunteers from 14 to 26 years old (160 females, 138 males). Development was assessed by allocating stages. Furthermore, anthropomorphic measurements were done and sexual maturation data was self-reported. The data were incorporated in a continuation-ratio model to estimate age, applying Bayes' rule to calculate point and interval predictions. Two performance aspects were studied: (1) accuracy and uncertainty of the point prediction, and (2) diagnostic ability to discern minors (<18 years old) from adults (≥ 18 years old).

Results: Combining information from different anatomical sites decreased the mean absolute error (MAE) compared to incorporating only one site (P < .0001). By contrast, adding anthropomorphic and sexual maturation data to the model did not further improve MAE (P = .11). In females, combining all three anatomical sites rendered a MAE equal to 1.41 years, a mean width of the 95% prediction intervals of 5.91 years, 93% correctly classified adults and 91% correctly classified minors. In males, the corresponding results were 1.36 years, 5.49 years, 94%, and 90%, respectively.

Conclusion: All aspects of age estimation improve when multi-factorial MRI data of the three anatomical sites are incorporated. Anthropomorphic and sexual maturation data do not seem to add relevant information.