G7 Third Molar Magnetic Resonance Imaging (MRI) in Forensic Age Estimation: Protocol Development and Considerations for Use

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After attending this presentation, attendees will understand which factors influence MRI protocols for age estimation based on the development of third molars and which considerations should be made when third molar development staging techniques are applied to MR images.

This presentation will impact the forensic science community by: (1) providing an MRI protocol to study third molars for age estimation; (2) providing recommendations to apply staging techniques to these images; (3) acknowledging influential factors in the development of an MRI protocol to study third molars for age estimation; and, (4) comparing third molar radiographs with third molar MRIs in order to demonstrate the differences between these two techniques and their advantages and disadvantages.

Established dental age estimation methods in subadults mainly consider development of third molar root apices visible in radiographs; however, in living individuals, minimizing ionizing radiation is essential.[1,2] Studying dental development with MRI complies with this goal, adding the advantage of imaging in three dimensions. Several studies have investigated the use of MRI for dental age estimation; however, none of these studies discussed the differences between staging with radiographs versus staging with MRI.[3-5]

First, this study proposes to demonstrate development of a 3-tesla MRI protocol to visualize all third molar positions for forensic age estimation. Particular attention will be given to the development of the third molar root apices.[6] Second, this study intends to prospectively study root stage assessment of third molars using MRI. In order to provide a comparison of 2D staging to 3D staging, panoramic radiographs will be compared to MRIs.[7]

To develop a clinically feasible MRI protocol visualizing all third molars for age estimation, *ex vivo* scans of porcine jaws and *in vivo* scans of ten living human volunteers aged 17-25 years were performed. Studied parameters were T1 versus T2 weighting, Ultrashort Echo Time (UTE), fat suppression, in-plane resolution, slice thickness, 3D imaging, signal-to-noise ratio, and acquisition time. A bilateral four-channel flexible surface coil was used. Two observers evaluated the suitability of the images.

To compare third molar staging on MRI with staging on panoramic radiographs, all third molars of 16 participants between 14 and 26 years of age were evaluated. Three different staging techniques were used by two observers.[8-10]

T2-weighted images were found to be preferred to T1-weighted images. To clearly distinguish root apices in (almost) fully developed third molars, an in-plane resolution of 0.33 x 0.33mm² was deemed necessary. Taking acquisition time limits into account, only a T2 Fast Spin Echo (FSE) sequence with slice thickness of 2mm generated

images with sufficient resolution and contrast. UTE, thinner slice T2 FSE, and T2 3D FSE sequences could not generate the desired resolution within the 6.5-minute acquisition time limit.

Lower third molars were equally assessable on both imaging techniques (93.8% MRI, 98.4% radiograph). Upper third molars were more difficult to evaluate on radiographs than on MRI (96.9% MRI, 43% radiograph). Inter- and intra-observer agreement for staging was higher for MRI than for radiographs. In both imaging techniques, lower third molar staging revealed higher inter- and intra-observer agreement compared to upper third molar staging. MR images in the sagittal plane proved to be essential for third molar staging. The most significant roots were the palatal in upper third molars and the distal in lower third molars.

The 3-tesla MRI of the third molars is a feasible technique for age estimation, in which a T2 FSE sequence can provide the desired in-plane resolution within a clinically acceptable acquisition time. Several considerations are necessary to transfer known radiographical 2D staging methods to this 3D MRI application.

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