A78 Skeletal Age Estimation in the Living: Conventional Radiography (CR) Versus Magnetic Resonance Imaging (MRI) and Staging Technique Versus Atlas Method

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Learning Overview: After attending this presentation, attendees will understand why MRI is of added value to study the clavicles but not the wrist for age estimation in living adolescents and young adults. Additionally, attendees will understand why a wrist staging technique is more useful than an Atlas method for age estimation.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing well-founded argumentation on the preferred approach for age estimation in the living based on developmental changes of the left wrist and both clavicles in terms of a comparison between CR versus MRI and staging technique versus the Atlas method.

Background: At present, forensic age estimation procedures in living adolescents and young adults rely on CR or Computed Tomography (CT) to visualize developing anatomical structures.(1).Hand/wrist and clavicle development both contribute to the age estimate during the considered age range. Nevertheless, in several countries, only CR is considered for skeletal age estimation, while international recommendations advocate CT to visualize the clavicles.[1,2] Moreover, MRI has been proposed as an alternative to CT to avoid exposure to ionizing radiation. Thus, a well-founded argumentation is needed to convince policy makers of the added value of MRI.

Skeletal development is assessed by allocating stages or Atlas standards, based on criteria of particular staging techniques or Atlas methods, respectively. Although Atlas methods seem more comprehensive, it is still unclear whether they should be preferred over staging techniques.

Purpose: To compare CR and MRI of the left wrist and both clavicles for forensic age estimation in living adolescents and young adults. The following hypotheses were made: (1) MRI outperforms CR, and (2) an Atlas method outperforms a staging technique to assess hand/wrist development.

Materials and Methods: CR and 3 Tesla (3T) MRI were prospectively conducted in 108 healthy Caucasian volunteers (52 males, 56 females) with ages ranging from 16 to 21 years. Five observers allocated stages and standards to (part of) the images independently. Staging techniques were applied to the left radius and ulna and to both clavicles.[3,4] Furthermore, Atlas methods were applied to the left hand/wrist.[5,6] For clavicle CR, one posteroanterior and two oblique radiographs were assessed simultaneously. Inter- and intra-observer agreements were quantified, and descriptive statistics were reported.

Results: Inter- and intra-observer agreements for wrist CR and MRI were similar. By contrast, the CR Atlas method was less reproducible than the staging technique. Inter- and intra-observer agreements for clavicle CR were lower than those for MRI.

Regarding the wrist, within-stage age distributions were similar on CR and MRI, as were those for the staging techniques and Atlas methods. Regarding the clavicles, the possibility to apply (profound) substages to MRI rendered a more gradual increase in the age distributions with increasing stages than on CR.

Conclusion: For multi-factorial age estimation based on the left wrist and both clavicles, CR suffices for the wrist, while MRI is necessary for the clavicles. Furthermore, a wrist staging technique is more useful than an Atlas method.

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Age Estimation, Conventional Radiography, Magnetic Resonance Imaging

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