



## Physical Anthropology Section – 2008

### H17 Analysis of the Auricular Surface on Multi-Slice Computed Tomography Reconstructions for Assessment of Aging: A Preliminary Study

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The goal of this presentation is to evaluate the possibilities of aging on two (2-D) and three dimensional (3-D) multi-slice computed tomography (MSCT) reconstructions of the auricular surface using criteria previously developed by Lovejoy, Buckberry, and Chamberlain, and original and specific MSCT criteria.

This presentation will impact the forensic community by providing an example of anthropological application of the computed multi-slice computed tomography in forensic sciences.

**Background:** Multi-slice computed tomography (MSCT) is uncommonly used in forensic pathology and anthropology. MSCT allows two (2D) and three-dimensional (3D) reconstructions, which can be helpful for osteoscopic analyses and consequently for age estimation.

**Technique:** 46 coxal dry bones of the anthropological laboratory of Toulouse and Angers (France) were examined with a sixteen-detector row MSCT (Sensation 16, Siemens). For each bone, two acquisitions were performed. The first one concerned the entire coxal bone; two filters were used, one hard and one smooth filter. In this case the thickness of reconstruction was 0.8 millimetre and the collimation 0.4 millimetre. The second one was specifically focused on the auricular surface, with a thickness of reconstruction of 0.6 millimetre and the collimation 0.3 millimetre. Two (with the MPR mode (Multi Planar Reconstructions)) and three-dimensional post-processing (with the VRT mode (Volume Rendering Technique)) were made in all cases. MPR reconstructions were performed in two planes: one parallel to the anterior branch (vertical axis) of the auricular surface and one parallel to the posterior branch (horizontal axis).

For each subject numerous of criteria were studied. On 3D reconstructions and on photos, transverse organisation, pattern, macroporosity, apical and retro apical activities were quantified (absent, moderate, important) and analysed. On 2D reconstructions, macroporosity, auriculo-acetabular line (central line and juxta-linear cells), and bone gradient under and above this line were quantified (absent, moderate, important) and analysed. All these criteria were assessed by two different observers. One observer was an anthropology student and one was a forensic pathologist with anthropological qualifications.

A first statistical analysis was performed to evaluate intra and inter-observers variabilities on MSCT reconstructions and on photos by calculating the coefficient Kappa. A second statistical analysis was performed in order to compare estimations performed on MSCT reconstructions (2D and 3D) and on photos for each observer (inter-method evaluation with a Kruskal-Wallis test). A third statistical analysis was performed for each criteria used to determinate the age of death using box- and whiskers-plots.

**Results:** The sample studied consisted of 46 Caucasoid subjects with 32 males and 14 females.

The intra-observer variabilities for each MSCT criteria were excellent with the coefficient of Kappa ranging from 0.75 to 0.93.

The inter-observers variabilities for each MSCT criteria were excellent with the coefficient of Kappa ranging from 0.77 to 0.93.

The inter-method evaluation between photos and 2D and 3D MSCT reconstructions had a coefficient of Kappa ranged from 0.59 to 0.90.

Concerning the Kruskal-Wallis test performed for each criterion, all the P values were significant.

**Discussion:** Values of the inter-observers and intra-observer variabilities objective the good reproducibility of the quantification and analyse of the selected criteria.

The inter-method error varied according to the criteria. The concordance varied from medium to excellent. For example, concerning the macroporosity criteria, the concordance was medium between photos and 2D reconstructions (coefficient of Kappa= 0.59), and excellent between photos and 3D reconstructions (coefficient of Kappa= 0.90).

For the criteria used for the age of death, the box- and whiskers-plots illustrate the pertinence of the staging performed thanks to some items (present, moderate, absent) and their slight overlapping.

For *transposed dry bones criteria*:

- Moderate or absent transverse organisation or macroporosity isolate younger cases (younger than 40 years old).
- Apical and retro apical activities had been considered by Lovejoy as secondary criteria. However, their absence is a good factor to differentiate people younger than 45 years old.
- The dominant pattern (regular or irregular) separate accurately people older or younger than 40 years old.



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For *specific MSCT criteria*:

- The loss of the continuity and the clear-cut aspect of the auriculo- acetabular line associated to the absence of juxta-linear cells isolate individuals older than 50 years old.
- The difference of bone density under and above the auriculo- acetabular line, namely a bone gradient, is able to differentiate people older than 50 years old.

**Conclusion:** Using MSCT reconstructions of the auricular surface in order to estimate the age of a person using transposed dry bones criteria and specific MSCT criteria is possible and seems to be efficient. This study is a preliminary study and analysis on a larger population is necessary to evaluate real possibilities of age estimation on MSCT images.

**Aging, Forensic Anthropology, Tomography**