H109 Virtual Anthropology: A Comparative Study of Real Bone vs. Virtual Bone Surface

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After attending this presentation, attendees will understand the advantages and limits in applying anthropological methods on virtual bones.

This presentation will impact the forensic science community by demonstrating the future role of cross-sectional techniques for anthropological studies

In recent years, modern cross-sectional imaging techniques such as multi-detector computed tomography (MDCT) have pioneered applications in various postmortem investigations. Since 2008, MDCT is used in the routine investigation of all bodies examined by the University Center of Legal Medicine in Lausanne. This data pool is opening new opportunities in several research fields. Concerning forensic anthropology, problems, such as insufficient sample composition and lack of individual data, could be solved, if those data can be made available. For this reason, we started to create the anthropological data base of virtual skeletons of Lausanne. Consequently, basic research should focus on data comparability in order to understand limitations of applying conventional anthropological methods on virtual bones.

Preliminary studies in the field of virtual anthropology have shown that anthropological investigations can only be performed if the radiological data are of highest quality. Accordingly, special scanning protocols are important to gain sufficiently high resolution to investigate details. The purpose of this study was to evaluate the application of anthropological-morphological methods of age estimation to 3D reconstructions of virtual bones and to develop appropriate scanning parameters.

Therefore, the reliability of the applied methods and their validity for MDCT data were tested. Eleven skulls and 21 hip bones, which originate from archaeological, anatomical and medicolegal collections, were examined by two experienced and four inexperienced observers. First, each bone was classified by conventional anthropological methods. In a second run, which was performed within an appropriate time lag, the virtual bones have been investigated using the same scoring system. The method applied on the hip bone is based on four traits of the sacro-iliac joint and the aspect of the iliac tuberosity. The method used for the skull is based on the 16 sections and five scoring stages of the ecto- and endo-cranial sutures. The bones were scanned on an eight-row MDCT using a high resolution (slice thickness of 0.625 mm). The 3D reconstructions were made on the CT-workstation.

Our study shows that, in general, estimating age of virtual bones shows a higher risk of false classification. While correlations between real and virtual bone-age estimations are quite sufficient in case of ecto-cranial sutures, the endo-cranial sutures and the sacro-iliac area are showing very low correlations. Two problems that interfere with the age estimation of virtual bones could be observed: The first is caused by areas of low bone density, which are not recognized by the software program of the workstation and which are therefore not calculated for the 3D image of the bone. This leads to a loss of substance during the 3D reconstruction that renders impossible its interpretation. Secondly, an automatic smoothing of the surface occurred during the reconstruction process. Thus, the examination of fine structures became infeasible and it affected the scoring of higher stages.

Besides, significant differences could be observed between the raters for estimations performed on virtual as well as on real bones. The reliability of estimates is increased by experience.

These results indicate firstly, that MDCT does not permit a sufficiently precise 3D reconstruction of the surface of dry bones in order to apply conventional anthropological methods. Consequently, the development of a special scanning protocol will be inevitable. Secondly, modifications of classical anthropological-morphological methods will be necessary for using the reconstructed surface of virtual bones.

Virtual Anthropology, Bone Imaging, MDCT

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