

JOURNAL of FORENSIC ODONTO-STOMATOLOGY

VOLUME 31 Supplement 1 October 2013
Abstract book IOFOS Conference 2013 Firenze

HUMAN DENTAL AGE ESTIMATION BY CONE BEAM COMPUTED TOMOGRAPHY - AN IN VITRO STUDY

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The authors declare that they have no conflict of interest.

Background: The formation of secondary dentine leads to an age-related decrease of the dental pulp cavity volume. Hence, the volume of the pulp cavity relative to the volume of its tooth could be useful for dental age estimation. This study aimed to evaluate a method for dental age estimation based on three-dimensional cone-beam computed tomography (CBCT) x-ray images of extracted teeth by using the diagnosis and therapy planning software VoXim (IVS Technology GmbH, Chemnitz, Germany). **Methods:** A sample of 69 single-rooted teeth from 26 patients aged 19-89 years was collected for this pilot study. The teeth had no caries or signs of restorative dental treatment and showed unimpaird root apices. All teeth were scanned by a cone-beam CT (Accuitomo, J. Morita, Kyoto, Japan) using an clearly defined experimental set up ensuring a uniform exposure setting that had been determined by pretrials. Using threshold segmentation, three different methods for segmentation and volume measurement of enamel, dentine and pulp cavity were tested: Besides a reproducible method using the aid of software default settings, two manual techniques were developed. As one of the manual techniques used strictly defined procedures, it also allowed reproducibility. In order to evaluate the accuracy of a non-reconstructable, manual method, its intraobserver error was determined by repeated measurements. Tooth and pulp volumes and volume ratios were calculated for the whole tooth (pulp cavity to the whole tooth, W ; pulp cavity to the whole tooth excluding enamel, WE), for the root region (pulp cavity to the root region, R) and at four levels (crown area, coronal third, midroot, apical third) using segmentation by the default settings. The relationship between the volume ratios and age was determined by Pearson's correlation coefficient (r), the accuracy of age estimation by the determination coefficient R^2 . The Wilcoxon sign rank test was employed to measure the intraobserver error of manual segmentation. **Results:** From the three segmentation methods, the manual non-reconstructable method showed the highest correlation and coefficient of determination ($R^2 = 0,663$). There were no statistically significant intra-observer differences between the volume ratios calculated from repeated measurements. From the specific volume ratios, the pulp/tooth ratio for the whole tooth when enamel was excluded (WE) showed the highest accuracy for age estimation ($R^2 = 0,585$). From the volume ratios of tooth segments, the highest correlation was observed for the coronal third of the root ($R^2 = 0,621$). **Conclusion:** The results confirm those of other authors obtained by micro-CT. To our knowledge this is the first study on the accuracy of CBCT three-dimensional x-rays for dental age estimation obtained in a clearly defined in-vitro experimental



design using special planning software. The results provide support for the use of tooth-pulp volume measurements from clinically acquired CBCT images for age estimation.

KEYWORDS: Forensic Odontology, Age estimation, CBCT

JFOS. October 2013, Vol.31, Sup.No.1 Pag 149-150
ISSN :2219-6749