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# HEAT-INDUCED SHRINKAGE AND SHAPE PRESERVATION OF TEETH: A RADIOLOGIC EVALUATION

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***Background:*** *Teeth subjected to high temperatures following natural disasters, airplane crashes or house fires can sometimes be the only remains available for forensic identification. The information on macro- and microscopic heat-induced changes of teeth can therefore provide relevant information that can facilitate the identification process. An important macroscopic feature of burned dental remains is the gradual change in colour due to compositional changes (i.e. loss of organic content), which generally allows to deduce a temperature range and can indicate the possible preservation of DNA. In practice, the most reliable and frequently applied method for identification of fire victims is comparative dental radiography, based on the comparison of dentition features. Although forensic odontologists are often confronted with fragmented and isolated dental remains, there is still a lack of precise data for the heat-induced dimensional and morphological changes of human teeth that might influence the identification process.*
*This study therefore investigated the volumetric shrinkage, shape preservation, weight loss and colour alterations of human teeth and looked at the effects of previously reported heating protocols to enable testing the reliability and inter-comparability of results published in literature.*
***Materials & Methods:*** *A total of 104 freshly extracted sound molars and premolars were included in this study. Micro-CT scans (SkyScan 1172; voxel-size 13.5µm) were performed before and after exposure to three different previously reported heating regimes in a range of 400 - 1000°C. Volumetric shrinkage was analysed using Fiji and 3D Slicer software. The weight loss was documented with an high-precision analytical scale. Photographic colour measurements and image analysis were performed on calibrated digital photographs and representative colour palettes were computed for every experimental group using the Fiji software package.*
***Results:*** *A progressive, temperature-dependent shift of colours was observed, with apparent differences depending on the chosen heating regime. Although fragmentation and cracks at elevated temperatures often affected the pulp chamber and root canals, overall tooth morphology was well preserved. The temperature and the chosen heating regime had a statistically significant influence on the dentinal volumetric shrinkage, which ranged from 4.8% (at 400°C) to 32.5% (at 1000°C). A major increase in shrinkage occurred between 700°C and 800°C, whilst no significant statistical difference was found between lower temperature groups. The weight loss measurements overall correlated*

***significantly with the shrinkage, with a mean weight loss between 7.8% (at 400°C) and 32.8% (at 1000°C), again significantly differing between the heating regimes.***
***Conclusions:*** ***In conclusion, the findings of this study showed definite differences of the macro- and microscopic changes related to the experimental heating regime, adding information on the dentinal shrinkage and shape preservation over a large range of temperatures found in possible forensic scenarios. The colour changes are summarised in the newly developed colour palettes and can be used to deduce a temperature range. By vigilantly implementing the knowledge on the specific colour changes, dentinal shrinkage and shape preservation the odontological identification process of fire victims can eventually be facilitated in cases where only fragmented or isolated dental remains are present.***

***KEYWORDS*****:** Forensic Odontology, Identification, Heat.

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