

A study of post-mortem degradation of teeth to
advance forensic DNA analysis as a tool for
human identification

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A thesis submitted for the degree of Doctor of

Philosophy at the University of Adelaide

2013

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Abstract

The post-mortem decomposition of human teeth is an area of forensic taphonomy that has received little attention. As they are a skeletal element, the diagenesis of teeth is often considered to occur in the same manner as bone. However, there are a number of morphological and chemical differences between these two mineralized tissues, making extrapolation of findings from bones to teeth difficult. With the advent of increasingly sensitive DNA recovery and analysis techniques, successful forensic identification using low levels of DNA present in highly degraded skeletal remains is now possible. As teeth are often the most reliable source of DNA in skeletal remains, an in depth understanding of their decomposition in the post-mortem environment should facilitate more successful identification outcomes.

This research examined the individual tissues of human teeth to address two questions. Firstly, what are the ante-mortem factors that impact on intra- and inter-individual variation in the DNA content of teeth; and secondly, how does post-mortem degradation affect the availability and distribution of DNA in the various tissues of teeth. The overall aim was to provide information to inform sample selection and targeted sampling of teeth for genetic identification of human remains. The low levels of DNA preserved in skeletal remains are associated with compounds that, if co-extracted, complicate the DNA extraction process and can potentially inhibit down-stream analysis. The most problematic of these compounds, which occur naturally in teeth, are calcium and collagen. Targeted sub-sampling of teeth avoids the unnecessary addition of excess amounts of inhibitory compounds and enables extraction of the low levels of endogenous DNA, increasing the likelihood of successful identification of human remains.

This research has confirmed that the roots of the teeth are a better source of DNA than the crown and has shown for the first time that the cementum, which is located on the external surfaces of the roots, is more valuable for nuclear DNA analysis than dentine. In both fresh and decomposed teeth cementum provides a rich source of nuclear DNA, which is easy to access and sample without the need for specialised equipment. Histologically the structure of cementum is maintained during decomposition, whereas pulp is degraded rapidly and dentine loses structural integrity starting at the pre-dentine layer.

Declaration

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Acknowledgements

Undertaking a PhD from the initial conception of the research idea, through grant writing and campaigning for funding to completing the laboratory work and analysing the results to culminate in a series of manuscripts has been a mammoth task, which at times seemed impossible but against all odds I have completed. However I would not have been able to reach this point without the help of those that believed in me, so to those individuals and organisations I wish to extend my sincere thanks. Firstly, I would like to thank my supervisors and co-authors Jeremy Austin, John Kaidonis, Grant Townsend, Toby Hughes, Adam Rohlach and Helen James for their efforts and ongoing support. Secondly, I would like to thank Forensic Science South Australia (FSSA), the Forensic Odontology Unit at the University of Adelaide, the Australian Federal Police (AFP), the American Society of Forensic Odontology (ASFO), the Australian Dental Research Foundation (ADRF) and the Australian Dental Industry Association (ADIA) for financing my ideas and also a big thank you to FSSA for their technical support. I would also like to sincerely acknowledge the help and friendship I received from everyone in ACAD but in particular my fellow PhD inmates Janette Edson and Jennifer Young without whom my journey would have been far more arduous. Finally, although not least significantly, I would like to thank my husband Evan for his love and support (and culinary expertise) and my gorgeous daughters Rachel and Courtney for always being available to listen and lend moral support.