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

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# Table of Contents

Abstract ................................................................................................................................. iv
Declaration ............................................................................................................................. v
Acknowledgements ............................................................................................................... vi

Chapter 1: Introduction .......................................................................................................... 1
  1.1 Scope of thesis ........................................................................................................... 14
  1.2 References .................................................................................................................. 16

Chapter 2: Teeth as a source of DNA for forensic identification of human remains: A review ................................................................................................................................... 21

Chapter 3: Dentine and cementum as sources of nuclear DNA for use in human identification ................................................................................................................................... 31

Chapter 4: Targeted sampling of cementum for recovery of nuclear DNA from human teeth and the impact of common decontamination measures .............................................. 41

Chapter 5: Differential DNA preservation in post-mortem teeth and the implications for forensic and ancient DNA studies ................................................................. 50
  Abstract ............................................................................................................................ 51
  1. Introduction .................................................................................................................. 53
  2. Materials and Methods................................................................................................. 57
    2.1. Sample collection and post-mortem decomposition ............................................. 57
    2.2. Histology ............................................................................................................... 58
    2.3. DNA sampling and analysis ................................................................................. 58
      2.3.1. DNA extraction .................................................................................................. 59
      2.3.2. DNA Quantification ........................................................................................... 60
      2.3.3. STR typing ......................................................................................................... 62
      2.3.4. Statistical analysis .............................................................................................. 62
  3. Results .......................................................................................................................... 64
    3.1. Histology ............................................................................................................... 64
    3.2. DNA yield ............................................................................................................. 68
    3.3. Profiling outcomes ............................................................................................... 73
    3.4. Effects of demineralisation .................................................................................. 74
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

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