Paper

Recipe for success? Testing a simple multi-proxy screening approach for genetic assay of archaeological skeletal material

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Abstract

Successful and reliable DNA extraction from ancient skeletal material is sometimes problematic due to degradation and contamination. After death, the DNA molecules of an organism are rapidly broken down and sometimes completely lost (Lindahl 1993). How DNA is preserved in the bone is still not clear. Some inferences have been made using bone preservation parameters, which assess the degree of diagenetic alteration. Diagenesis encompasses all the physico-chemical and biological alterations that skeletal material may undergo during burial. This is a complex set of processes which includes uptake and exchange of ions, breakdown and leaching of collagen, alteration of the mineral phase, infilling by mineral deposits and microbial decay (Hedges 2002). Investigating the relationship between various bone preservation parameters and the success rate of DNA extraction and amplification, can elucidate the processes that determine DNA decay and survival. For example, the correlation between bone mineral crystallinity with successful DNA amplification, has led to the suggestion that DNA is preserved by adsorption onto the mineral surface (Götherström et al. 2002). Several studies have shown that if the bone is well preserved, both in terms of the organic and the inorganic phase, the chances of obtaining DNA are higher. So far no single reliable and efficient screening method/preservation parameter has been identified. A multi-proxy approach may therefore be useful. Additionally, any screening method needs to be fast, cheap and minimally destructive. Thus, the aim was to develop a cheap and accessible predictive tool that aids assessment of sample suitability. In the present study, a combination of microscopic analysis (histology) with analysis of bone chemistry (infrared spectroscopy, elemental analysis and collagen extraction) was used to develop a bone sample preservation profile, which was used in the evaluation of DNA results. The results illustrate the usefulness of a simple, multi-proxy approach in creating bone preservation profiles and in the identification of the diagenetic and taphonomic processes that have affected bone. Further data analysis is in progress which may reveal some of the main factors affecting DNA survival in temperate regions. First results indicate that microbial decay is no obstacle to extraction/amplification of well preserved DNA whereas DNA failure seems to be caused by other diagenetic processes such as contamination, acid etching and cracking.

Götherström, A., M. J. Collins, A. Angerbjörn & K. Lidén (2002) Bone preservation and DNA amplification. Archaeometry, 44, 395-404.

Hedges, R. E. M. (2002) Bone diagenesis: an overview of processes. Archaeometry, 44, 319-328.

Lindahl, T. (1993) Instability and decay of the primary structure of DNA. Nature, 362, 709.

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