



Research article

A standard procedure for accommodating forensic anthropological and genetic analysis of decomposing human remains from tropical climates

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ABSTRACT

At the Medical Legal Center in Ribeirão Preto, Brazil (CEMEL/FMRP-USP), unidentified decomposing bodies routinely undergo soft tissue removal (by immersion in water at 80–90 °C for 24 h) prior to an anthropological analysis intended to yield a biological profile of age, sex, ancestry, height, pathology and so on. In the event that this analysis is unsuccessful, samples may be submitted for DNA profiling. The tropical climate and the defleshing process may confound preservation, recovery and analysis of DNA, however. In order to establish an optimal standardized protocol for identification of decomposing human remains from a tropical climatic region, the outcome of anthropological and genetic analyses was compared, along with the utility of bone (mainly femur and sternum) and teeth (mainly molar) specimens for DNA analysis. In a sample ($n = 39$) of partially skeletonized remains, anthropological analysis was sufficient for identification in eight cases. In further six cases, DNA profiling was successfully attempted. As a consequence of our study, we recommend collection of 1–2 well preserved teeth prior to defleshing and anthropological analysis in these circumstances.

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1. Introduction

Forensic anthropology is a branch of the forensic sciences concerned with the application of anthropological knowledge to the process of law. In practice, its utility is mainly related to identification of human remains in the context of a medico-legal investigation [1] and may be applied to remains which have been dismembered, lacerated, carbonized, macerated, putrefied, and partly or wholly skeletonized [2].

The advent of molecular biology has led to new methods for human identification and DNA profiling has become a 'gold standard'. It is not without some limitations, however. It may still have a higher relative cost per case and sampling the skeleton for DNA analysis may interfere with the anthropological examination. Furthermore, DNA analysis is of limited value without a candidate – such as an alleged victim – with which a profile may ultimately be compared.

2. Methods

Thirty-nine cases of decomposing human remains were investigated, received by CEMEL-FMRP-USP with the aim of identification. All of the cases were submitted for anthropological analysis. A sub-sample of six cases was submitted for DNA profiling [3], using specimens from the sternum ($n = 1$), femur ($n = 1$) and teeth ($n = 4$).

3. Results

In two cases, osteological analysis established that the remains were zoological. Eight cases (21.60%) were identified following the anthropological examination alone and six cases (16.20%) were identified following a subsequent DNA analysis. Thus, identification was possible in fourteen cases (37.8%).

4. Discussion

Dense cortical bone (mainly femur and sternum) and teeth (mainly molars) are typically chosen for DNA analysis because of anticipated higher levels of DNA preservation. Sampling from the

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femur, however, may damage external features of value to age and sex estimation, as well as cortical bone used in radiological estimation of age. In this study, DNA profiling was effective when both tooth and bone specimens were tested. The sample is small, however, and a larger study indicates that teeth appear to provide better sources for DNA analysis [3] and allow damage to the skeleton to be avoided. The high variability of dental characteristics and high degree of physical and chemical resistance of the dental structures [4] mean that teeth are also invaluable to anthropological investigation, however. We therefore recommend the following protocol for anthropological analysis of decomposing skeletal remains in tropical climates:

- (1) Record and recover one or two intact molar teeth for DNA analysis prior to defleshing, using extraction and storage techniques likely to minimize the potential for contamination with intrusive DNA, and after careful odontological analysis.
- (2) Remove the soft tissue for osteological analysis, being careful to avoid damage to any part of the skeleton.
- (3) If no suitable dental material is available, recovering of a specimen of dense cortical femoral shaft, again after careful recording and using extraction and storage techniques likely to minimize the potential for contamination with intrusive DNA.
- (4) Complete the anthropological examination and report.
- (5) Compare the anthropological and odontological profile with the ante mortem profiles of alleged victims.

- (6) If a firm positive identification can be made, conclude the process. If not, submit the tooth specimens for DNA analysis.

5. Conclusion

Anthropological analysis remains an important investigative tool in human identification that may support DNA profiling, necessitating the development of protocols which accommodate both procedures. A protocol based on the collection of 1–2 well preserved teeth for DNA analysis prior to soft tissue removal appears optimal for decomposing bodies encountered in tropical climatic regions.

Conflict of interest

None.

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