# Non-destructive sampling techniques for DNA extraction from human skulls

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## Introduction

The analysis of aDNA (ancient DNA) from human skeletal remains can help answering many different scientific questions, such as the biogeographical origin of an individual, its biological sex or phenotypic appearance as well as the kinship between individuals [1].

Particularly the possibility of finding indications on the biogeographical origin can be of great use for provenance research. Since in different religious or cultural contexts the skeletal remains must not be damaged [2], we are investigating the possibility of obtaining DNA from human skulls without having to damage them.

Besides provenance research, archaeological applications may also benefit from such techniques.

## Sampling techniques

Our investigations aim to acquire sufficient amounts of DNA without destructing parts of the skeletal remains. We therefore target to obtain DNA from tissue residues still attached to the bone from natural cavities of the human skull which are not likely to be contaminated. To do this, we are pursuing three approaches:

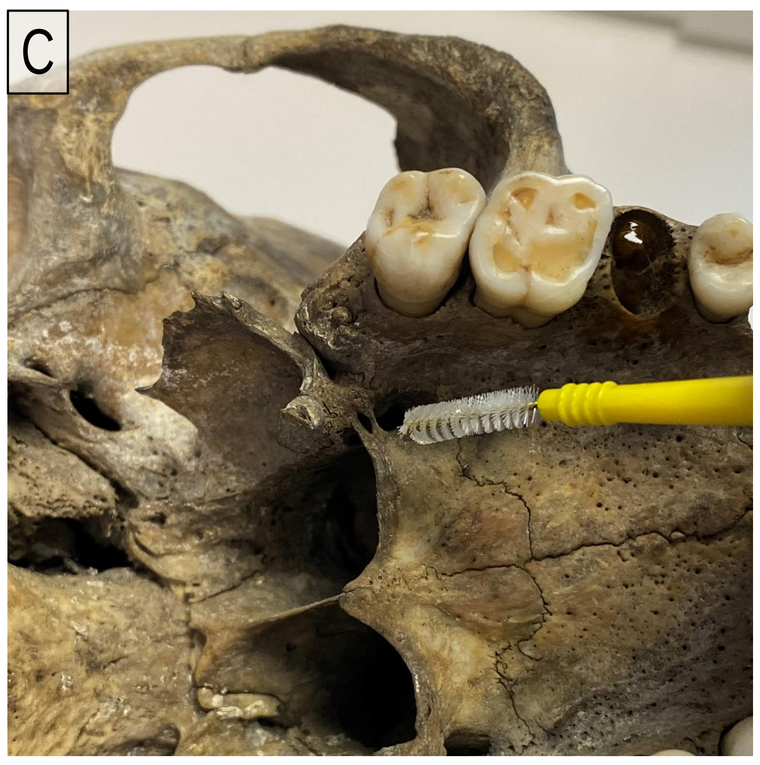
(A) Ultrasonic-assisted flushing out of certain cavities in the human skull, e.g. the porus acusticus, the alveoli or the carotid canal

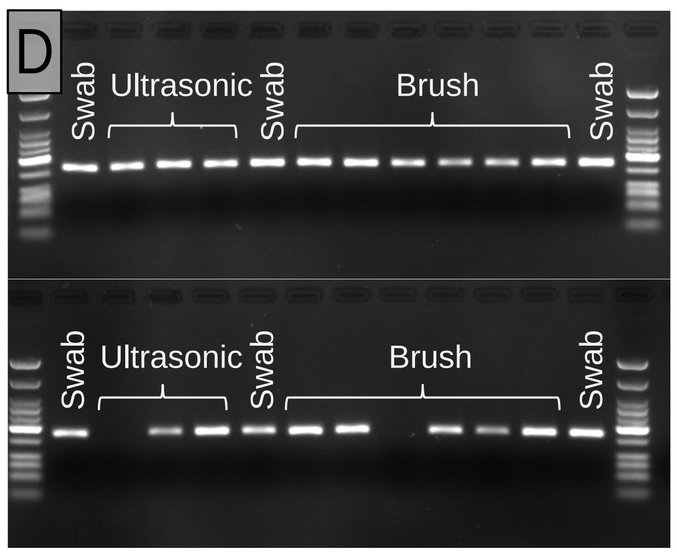
(B) Swabs from areas inside the skull that are difficult to access, e.g. the pars basilaris, the skullcap or in the nasal cavity

(C) Sampling of various small foramina with the help of small brushes, e.g. the greater palatine foramen, the incisive foramen or the nasolacrimal duct

After sampling, the cell material obtained is lysed and the DNA is then purified. The purified DNA can afterwards be used for further analysis.

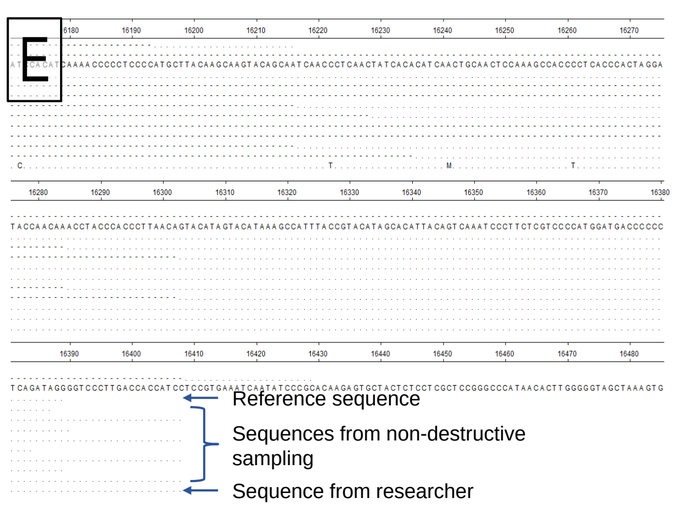





## Preliminary results

First experiments indicate that with the help of the methods presented, sufficient genetic material for DNA analysis can be obtained. The image to the left (D) shows an agarose gel with amplification products of human mitochondrial DNA amplified from non-destructively collected samples. A specific product could be amplified for 22 of 24 different samples. A subset of amplification products was sequenced to assess the quality and authenticity of the samples. The sequences (E+F) obtained were of good quality. It could be shown that the sequences from the sampling of the porus acusticus and the swabs of the pars basilaris in the interior of the skull matched the sequence from a conventionally prepared DNA extract from a tooth root of the individual.




## Outlook

The preliminary results indicate that our approach to non-destructive DNA extraction is promising. The experiments will be repeated with other skulls in order to check the reproducibility of the methods. Furthermore, we hope to increase the yield of DNA by using more sensitive purification methods in order to be able to obtain chromosomal DNA in the future.

## Acknowledgement

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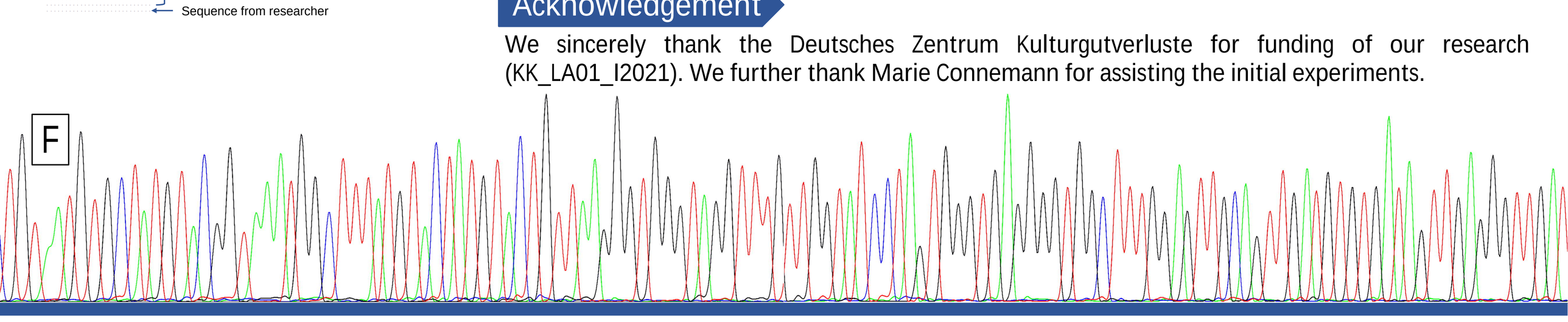


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[2] Walker, P. L. (2000). Bioarchaeological ethics: a historical perspective on the value of human remains. *Biological anthropology of the human skeleton*, 3, 40.

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