Anthropologists reconstruct mitogenomes from prehistoric dental calculus

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Using advanced sequencing technologies, University of Oklahoma anthropologists demonstrate that human DNA can be significantly enriched from dental calculus (calcified dental plaque) enabling the reconstruction of whole mitochondrial genomes for maternal ancestry analysis—an alternative to skeletal remains in ancient DNA investigations of human ancestry.

Christina Warinner and Cecil M. Lewis, Jr., professors in the

Department of Anthropology, OU College of Arts and Sciences, collaborated with researchers from Arizona State University and Pennsylvania State University on the capture, enrichment and high-throughput sequencing of DNA extracted from six individuals at the 700-year-old Oneota cemetery, Norris Farms #36.

"We can now obtain meaningful human, pathogen and dietary DNA from a single sample, which minimizes the amount of ancient material required for analysis," said Warinner.

In recent years, dental calculus has emerged as an unexpected, but valuable, long-term reservoir of ancient DNA from dietary and microbial sources. This study demonstrates that dental calculus is also an important source of ancient human DNA. Very little dental calculus was required for analysis—fewer than 25 milligrams per individual. This makes it possible to obtain high quality genetic ancestry information from very little starting material, an important consideration for archaeological remains.

The results of this study provided high-resolution, whole mitochondrial genome information for the Oneota, a Native American archaeological culture that rose to prominence ca. AD 1000-1650, but declined sharply following European contact. "The analysis of mitochondrial DNA allows us to better understand the population history of ancient peoples," said Anne Stone, professor in the School of Human Evolution and Social Change, Arizona State University.

Although dental calculus preserves alongside skeletal remains, it is not actually a human tissue. Dental calculus, also known as tartar, is a calcified form of dental plaque that acquires human DNA and proteins passively, primarily through the saliva and other host secretions. Once mineralized within dental calculus, however, human DNA and proteins can preserve for thousands of years. Dental calculus thus serves as an important non-skeletal reservoir of ancient human DNA.

Conventional techniques for recovering ancient human DNA typically require the destruction of bone or tooth tissue during analysis, and this has been a cause of concern for many Native and indigenous communities. Dental calculus represents an important alternative source of ancient DNA that does not damage or disturb the integrity of skeletal remains. In addition, because dental calculus is the richest known source of DNA in the archaeological record, it presents unique opportunities for investigating archaeological sites with preservation challenges.

"Dental calculus may enable researchers to retrieve ancient DNA from samples where bone or other biological tissues are too degraded for analysis. This is particularly exciting to those of us who work in tropical or extremely old contexts, where traditional sources of DNA may be poorly preserved or even non-existent," according to Maria Nieves Colón, Ph.D. candidate, Arizona State University.

The demonstration that whole mitochondrial genomes can be reconstructed from small samples of dental calculus represents an important technological advancement for paleogenomic investigations in prehistoric North America and other regions where destructive analysis of skeletal remains is difficult or controversial.

"We hope that this research on dental calculus from the Norris Farms site acts as the first step toward future paleogenomic investigations of prehistoric North American remains in a respectful and non-destructive way that interests and benefits both descendent communities and anthropologists," said Andrew Ozga, OU doctoral graduate, and currently postdoctoral candidate at Arizona State University.

Provided by University of Oklahoma