Appendix: ancient DNA, isotope, and osteological analyses

Strand Report by Joe W. Walser III

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Ancient DNA analyses
During 2022, six tooth samples that were found during excavations at Þingeyrar (2016, 2018), directed by Prof. Steinunn Kristjánsdóttir (PI), were selected for ancient DNA analyses. Samples are preferentially selected from molars, particularly where the antimere of the sampled tooth is present. The samples were first described (e.g., calculus, caries, ante-mortem tooth loss, periodontal disease, linear enamel hypoplasia, dental attrition, and other notable characteristics). They were then photographed, and moulds were made, prior to the mechanical cleaning and removal/storage of the dental enamel. The teeth were placed in Eppendorf sample columns for ancient DNA analysis at deCODE genetics.

Four of the samples (2018-28-343, 2016-14-44, 2016-14-46, 2016-14-13) have been analysed and all yielded sufficient endogenous DNA. Of these four samples, there was one male and three females, all of which were Icelandic by ancestry. The female individual also underwent isotope and radiocarbon dating (date to ca. 1600 and showed a mixed marine and terrestrial diet). The two remaining prepared samples, alongside an additional eight samples from 2021 and 2022 will be prepared and the analyses will commence this spring. Of these eight samples, three of the individuals' names (Bjarni Halldórsson, Jón Þorleifsson, and Oddur Stefánsson) have been identified and can be investigated not only scientifically but historically as well.

Isotope analyses
In 2022, six samples were prepared (described, moulded, photographed, cleaned, and sectioned) sent to Durham University for isotope analyses for dietary (CNS) and provenance (Sr, O, and trace elements: Pb, Sb, Zn, As, Hg, Sr, Ba, Cd) estimation. The tooth samples (n=6) were selected from 2021-39-84, 2021-39-22, 2021-39-83, 2021-39-82, 2017-22-17, and 2022-6-Grave 15. Three of these samples were from individuals identifiable by name (see above). These three individuals will also undergo incremental dentine analysis, providing information about changes in their diets and health over the period in which the selected dental samples develop during life. This will be particularly informative in the case of one individual that was in their mid-20s at the time of death. These same three individuals will also undergo ancient DNA analysis this spring, as described above.

The results of the isotope research will form the basis of an article planned for submission and the end of spring 2023, and the data that will be presented at the European Association of Archaeologists conference in Belfast, Northern Ireland, UK taking place between the 30th of August and the 2nd of September 2023.

Osteological analyses

The remains of one complete individual were excavated in 2022 (2022-6-Grave 15) and brought to the National Museum of Iceland for analysis, sampling, and permanent curation. The identity of the individual (Bjarni Halldórsson) is known from the archaeological objects included in/around the burial. Furthermore, several descriptions about Bjarni, his life, occupation, and even appearance are preserved and available.

The osteological analyses showed the skeletal remains were in poor to medium preservation, except for the cranial bones, mandible, and teeth, which were in good preservation. Tooth samples were thus selected for ancient DNA and isotope analyses. Sex estimation results were in line with the known identity, indicating a male individual. Age estimation could only be performed from dental attrition analyses, which is not always reliable on skeletal remains found in Iceland due to the method being developed on populations with very different diets and ecologies. The age estimation nonetheless indicated that the individual was a middle-aged adult at the time of death but did not imply that he was as advanced in age as he is known to have been according to historical documentation.

The good preservation of the teeth allowed for a complete dental analysis. There was a higher rate of dental attrition in the upper and lower left dental arcades than on the right side, implying that the individual may have preferred left-sided mastication. This could be due, for example, to pain or other factors related to the ante-mortem tooth loss visible on the right side (maxillary 3rd molar and maxillary canine) of the maxilla. Linear enamel hypoplasia and other enamel defects could not be analysed due to the extensive and severe supra- and sub-gingival calculus cover extending across all teeth on both the maxilla and mandible. Furthermore, the alveolar resorption was considerable with extensive root exposure, indicating advanced periodontal disease, a condition that increases with age and in response to chronic inflammation, such as that which occurs with large calculus deposits. The individual also presented with pronounced bilateral mandibular torus, a non-metric trait seen in over 50% of the Icelandic skeletal collection (with historical estimates as high as 81%). Comparably high rates of this non-metric trait have otherwise been reported in the Native Greenlandic population, the Norse Greenlanders, Medieval Norwegians, and historical Japanese populations. The trait is still common in Iceland today.

Few of the bones could be assessed for pathological skeletal changes. However, the left tibia exhibited soft tissue ossification on the lateral-distal aspect of the shaft and epiphysis, or articulation with the medial malleolus of the fibula. The soft tissue changes extend superiorly onto the interosseous crest. These new bone formations may have resulted from a traumatic event occurring around the ankle, but numerous other aetiologies could also be at play. It is nonetheless of interest to consider bone changes that occurred around the ankle in context with the historical descriptions of the individual, which suggest that he was overweight and had limited mobility at the time of death.

The individual had pronounced meningeal groves extending from the endocranial base of the left temporal petrous portion, channeling posteriorly, and ending at a circular region of thin parietal bone (approximately around the location of typical parietal foramina). On both the right and left parietals, the circular regions of thin parietal bone are situated 1.5 cm distal to the coronal suture (right 3.5 cm x 2 cm/left 1.5 cm x 1 cm). Additionally, arachnoid granulations (>5) can be observed on the endocranial aspects of the parietals and frontal bone. The combination of these endocranial changes may possibly be explained by increased age.

The presence of completely ossified thyroid cartilage, osteoarthritis in the cervical and thoracic spine, and the endocranial changes, provide secondary indicators of age at death, considering the absence of skeletal elements typically used for anthropological age estimation (e.g., auricular surface, pubic symphysis), beyond dental attrition. For example, thyroid cartilage often begins ossification in the age range of 20-40 and normally completes ossification around or after the age of 65. Historical records show that the individual was 71 years of age at the time of death.