An in-depth structural and crystallographic analysis of dental enamel: Reconstructing the life history of a medieval population in Lower Saxony (Germany)

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Dental enamel is the hardest material in the human body. Enamel consists of prisms which are cylindrical bundles of hydroxyapatite crystals [1]. During the incremental secretion of enamel by ameloblasts, different physiological influences leave an impact on the tooth structure. Daily and weekly patterns can be seen on the enamel prisms. Moreover, systematic disturbances like malnutrition, metabolic diseases, or fever lead to an anomalous arrangement of the enamel prisms [2]. The structural analysis of these crystallite structures and defects can be used to reconstruct the life history of individuals.

We selected 30 teeth sets from 10 individuals buried in a burial ground in Gevensleben (Germany). The Gevensleben burial ground was used as an early Christian cemetery in the 8th-10th century. It represents an important source of information of the social and cultural life of the ordinary population of the early Middle Ages in Lower Saxony, Germany.

Each tooth was embedded in epoxy resin for protection and then cut using a low-speed saw. The tooth surface was examined by optical microscopy and scanning electron microscopy (SEM) as well as energy-dispersive X-ray spectroscopy (EDS) to analyse the chemical composition of the dental enamel. X-ray powder diffraction was used to identify the crystallographic phases present.

With this method, the childhood years of individuals can be reconstructed, based on the crystal arrangement in each individual tooth. This was done to extend the results of previous anthropological examinations. During the age of 3 years, children in Gevensleben were exposed to the greatest stress factors, which are also reflected in the increased mortality during this stage of life. To identify these stressful events, accentuated lines (AL) in tooth enamel structure were quantitatively analysed. It is likely that the children in this population were weaned at around 3 years of age and therefore experienced high physiological stress at that time. Furthermore, the crystallographic composition of the excavated teeth was compared to modern teeth. The surface of the teeth showed clear signs of wear caused by mastication of food containing abrasive stone particles, probably from grain milling.

Teeth are often one of the few human remains found in archaeological excavation sites. Due to the high content of mineral, they are usually well conserved, the in-depth structural analysis of tooth morphology can be used to reconstruct the life history of individuals, supplementing archaeological and anthropological investigations about people buried there more than one thousand years ago.