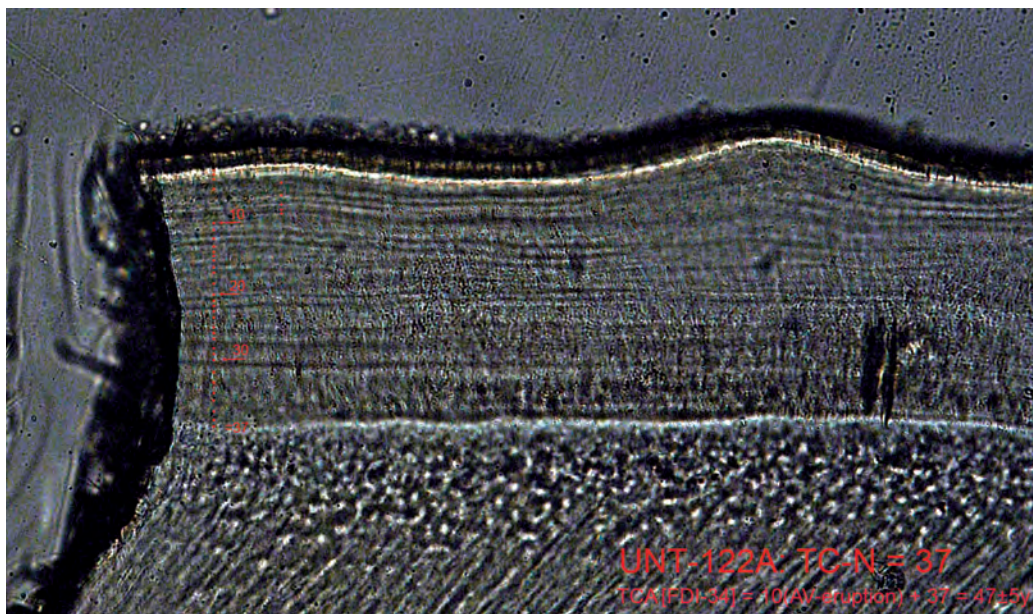




New Approaches to Burnt Human Bones and Teeth: the bioarchaeology of cremations and tooth cementum annulation

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New Approaches to Burnt Human Bones and Teeth: the bioarchaeology of cremations and tooth cementum annulation

The potential of studying cremated remains for insights into the past has traditionally been seen as rather limited. The process of burning the dead destroys many of the features usually studied in skeletons; Bronze and Iron Age research has therefore centred on the transformative and ritual aspects of the funerary practice. New bioarchaeological approaches, however, have recently opened up exciting opportunities for extracting information from the cremated individual: C14-dating, isotope and DNA analyses, tooth cementum annulation and metric approaches to sexing have expanded the methodological toolkit. This workshop aims to reflect on these new scientific approaches to cremated human bones and the way new data will inform archaeological narratives of the past.

Tooth cementum annulation is one of the methods with potential for cremated bones, but it is also useful for skeletonised bodies from inhumation graves. That the analysis of thin sections through the dental roots provides insights into age at death of the buried individual is well established. Current research focuses at using tooth cementum analysis to investigate the season of death as well as periods of stress and extraordinary life events. The second part of this workshop will explore this methodological avenue in greater depth.

This workshop is jointly organised by the ERC project “The Value of Mothers to Society” and Urn-field Culture Networks, a discussion forum for research on the Late Bronze Age (13th to 8th centuries BC) in Europe. In addition to the traditional format of lectures, a hands-on element will enable participants to examine thin sections of teeth under the microscope. The format combines one day of lectures on new approaches to analysing cremated bones (Thursday) and one day of lectures on tooth cementum analysis and a practical/excursion to the Medical University of Vienna and the Natural History Museum in Vienna (Friday).

PROGRAMME

Wednesday, 15 November

KEYNOTE LECTURE

- 17.30 Estella Weiss-Krejci**
Fuel for Thought: Thermal Modification of the Corpse in Cross-Cultural Perspective

Thursday, 16 November

- 9.30 Katharina Rebay-Salisbury**
Welcome Introduction
- 9.45 Christophe Snoeck**
Do's and don'ts: Isotopic analyses and radiocarbon dating of cremated bone

COFFEE BREAK

- 11.00 Claudio Cavazzuti**
Sex, gender and mobility in the Urnfield period. New osteometric methods for sex assessment and isotopic data on human cremated remains
- 11.30 Jo Appleby**
Using strontium isotope analysis from cremations to understand Bronze Age mobility: the cemetery at Over, Cambridgeshire

LUNCH BREAK

- 13.30 Stefanos Gimatzidis**
Death and burial between the Aegean and the Balkans
- 14.00 Sidney Sebald, Manuel Zeiler, Gisela Grupe**
Anthropology and provenance analysis of cremated bones from Iron Age North-Rhine-Westphalia
- 14.30 Larissa Otto, M. Greiner, C. Braun, M. Graw, Gisela Grupe**
Age-related microstructure of burned bones has a hand in identifying cremations

COFFEE BREAK

- 15:30 Justyna Baron, Agata Hałuszko, Kamil Nowak, Tomasz Stolarczyk**
Old data, new results: research on the 'Lusatian' urnfields in Poland
- 16.00 Lukas Waltenberger, Vienna**
Stabbed and Burnt – Reliability of cut marks

Closing remarks, discussion and get-together

PROGRAMME

Friday, 17 November

9.00 Fabian Kanz & Katharina Rebay-Salisbury
An introduction to tooth cementum annulation: Austrian case studies

9.30 Timothy P. Gocha
Examining the utility of tooth cementum annulations for age estimation in thermally altered human remains

COFFEE BREAK

10.30 Vicki L. Wedel
Expanding cementum annulation theory and method

11.00 Gabriela Mani-Caplazi, Ursula Wittwer-Backofen, Werner Vach, Gerhard Hotz
The tooth cementum analysis: A critical verification of the method to identify pregnancies and diseases

LUNCH BREAK

13.00 Petra Urban
Deciduous teeth and the neonatal line

13.30 Marlon Bas
Microwear texture analysis of human deciduous teeth

COFFEE BREAK

from 15.00 Excursion to the Department of Forensic Medicine, Medical University of Vienna

ATTENDANCE IS FREE

REGISTRATION UNTIL 1.11.2017
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ABSTRACTS

KEYNOTE LECTURE

Fuel for Thought: Thermal Modification of the Corpse in Cross-Cultural Perspective

Estella Weiss-Krejci

(Institute for Oriental and European Archaeology, Austrian Academy of Sciences)

One interesting aspect of our past history is the change in our treatment of the dead. The reasons for multiple transitions from inhumation to cremation (and vice versa) as well as the parallel existence of both practices within societies are still poorly understood. Were the transitions from inhumation to cremation caused by changes in religious beliefs? Were they caused by societies themselves or by the arrival of new groups of people – and why did people invent cremation in the first place? These are just some of the questions that have troubled archaeologists in the past. The advances in anthropological and chemical studies of burnt bones that will be discussed at the international conference ‘New Approaches to Burnt Human Bones and Teeth’ will probably one day provide us with the tools to answer some of these questions. Since the conference will focus primarily on technical and methodological aspects of the investigation of burnt bones and teeth, this keynote lecture will provide a more holistic approach to the subject and will look into the question of funerary thermal modification of the corpse from the perspective of ethnography and ethnohistory. Archaeologists often understand inhumation and cremation as two opposing funerary treatments of dead bodies, thereby forgetting that there is a wide array of primary and secondary funerary rites that make use of fire and leave behind burnt bones in varying quantities and degrees. The lecture provides a brief cross-cultural overview of these traditions. The importance of ideology, concepts of purity, cosmogony and properness for funerary treatments will also be discussed as well as aspects of age and social identity and the meaning of teeth.

Do's and don'ts: Isotopic analyses and radiocarbon dating of cremated bone

Christophe Snoeck (Vrije Universiteit Brussel, Université Libre de Bruxelles), Nadine Mattielli (Université Libre de Bruxelles), Philippe Claeys (Vrije Universiteit Brussel)

Due to the very high temperatures reached during cremation (up to 1000°C and more) all organic matter present in bone (i.e. collagen) is destroyed and the inorganic fraction of bone (called bone apatite or bioapatite) is heavily altered. Traditional radiocarbon dating and isotope analyses of collagen are therefore not possible. The inorganic fraction of bone has, so far, been considered as unreliable for both radiocarbon dating and isotope analyses. Indeed, unburned bone incorporates exogenous carbonates, strontium and other elements from its burial environment skewing the radiocarbon and isotope results. However, once calcined, the crystallinity of bone increases drastically preventing such post-burial contaminations opening a wide range of possibilities that were not possible with unburned bone. However, before obtaining reliable measurements from calcined bone, it is crucial to assess the modifications that happen during burning.

This paper presents the results of on-going research on the variations in elemental and isotopic composition of bone during burning and discusses their impact on radiocarbon dating and isotope analyses studies focussing on archaeological cremated bone.

Sex, gender and mobility in the Urnfield period. New osteometric methods for sex assessment and isotopic data on human cremated remains

Claudio Cavazzuti (Durham University)

Sex determination of human remains is one of the most important research steps for physical anthropologists and archaeologists dealing with funerary contexts and trying to reconstruct the demographic structure of ancient societies. However, it is well known that in the case of cremations sex assessment might be complicated by the destructive/transformative effect of the fire on the bones.

As argued in several recent studies, osteometric standards built on unburned human remains and contemporary cremated series are often inadequate for the analysis of ancient cremations, and frequently result in a misclassification of a variable and sometimes consistent part of the male component. This

work is an attempt to overcome the scarcity of methodological tools and to develop new osteometric procedures that could be applied to prehistoric contexts. A set of 39 anatomical traits were measured on 142 Bronze Age and Iron Age cremated individuals with clearly engendered grave goods. Considering gender largely correlated to sex, male and female distributions of each single measured trait were compared to evaluate sexual dimorphism through inferential statistics and Chaktaborty and Majumder's method.

This paper will also focus on the first strontium isotope data obtained on Northern Italy urnfields of the 14th-11th century BC. The analyses have been carried out on cremated petrous bones from a selected sample of urn cremations, taking into consideration sex, age, topography of the cemeteries and grave goods. As sex is an important variable for disentangling the dynamics of mobility, the two advances will be presented through an integrated approach.

Using strontium isotope analysis from cremations to understand Bronze Age mobility: the cemetery at Over, Cambridgeshire

Jo Appleby (University of Cambridge)

Strontium isotope analysis of cremated remains is still in its early stages, but has the ability to transform our understanding of mobility in the British Early and Middle Bronze Age, when cremation became the most common archaeologically visible burial rite. In this paper, I report on the analysis of strontium isotopic signatures from the otic capsule of 27 Early Bronze Age cremations from the barrow cemetery at Over, Cambridgeshire, in the United Kingdom. Because bone turnover in the otic capsule essentially ceases by age two, the analysis gives us information about the location of the mother during pregnancy and the child during early life. Initial results suggest a mixture of locals and people who were mobile over a relatively short distance. There is no clear pattern on the basis of sex, chronology or burial rite. Whilst these results give us the first indication of mobility patterns in cremated Bronze Age individuals from the British mainland, I argue that in order to better understand patterns of movement, we will need to take multiple data points from each cremation burial (otic capsule, femur and rib) to give a picture of mobility across the life course, rather than just at its beginning.

Death and burial between the Aegean and the Balkans

Stefanos Gimatzidis (OREA/ÖAW, Vienna)

Several profound transformations that occurred in the Greek archaeological culture in the 12th and 11th century BC are traditionally perceived as evidence for an invasion of people from the north. These transformations are particularly perceptible in the burial rites of South Greece, e.g. the change from multiple burials in chamber tombs to single inhumations in cist tombs and shortly afterwards the widespread practice of cremation. Many scholars used to perceive in these changes the legendary Dorian invasion that is known by some historiographers of the classical period. Thus, a legendary event became historical fact and formed the departure point for many reconstructions of the past in Greece and the Balkans.

The aim of this new project is to present the first solid evidence from the territory that is usually regarded as the place of origin of these changes, comprising Serbia, Kosovo, FYR of Macedonia and northern Greece. On the one hand, new archaeological finds from modern excavations will be analytically presented. New finds and a modern study of old excavations will offer comparative evidence from the Balkan hinterland. In addition, modern scientific methods that include DNA and strontium isotope analysis will help define gender, family and kin relations of the individuals buried in several necropolises that will be presented as case studies. Strontium analysis can offer further evidence on human mobility and highlight possible out-marriages, migrations etc. Radiocarbon analyses, statistical and further historical evaluation of the burial rites, finds and contexts can contribute to the reconstruction of the social organization of the local communities and its development. Lead isotope analysis of the bronze artifacts that used to be deposited as precious burial gifts will elucidate the exchange networks and economic relations.

New archaeological and bioarchaeological data from the Balkans and northern Greece will thus help construct a new narrative on the social relations in the region by means of the regional mortuary record.

Anthropology and provenance analysis of cremated bones from Iron Age North-Rhine-Westphalia

Sidney Sebald (University of Munich), Manuel Zeiler (Landschaftsverband Westfalen-Lippe), Gisela Grupe (University of Munich)

The objective of this study was the anthropological investigation of two Iron Age burial sites in the Siegerland (North-Rhine Westphalia): Nethpen-Deuz and Neunkirchen-Zeppenfeld. 60 individuals from the burial mound in Nethpen-Deuz, which was in use between 300 BC to 50 BC, were available. From the second burial site in Neunkirchen-Zeppenfeld only urn no. 2 from only two excavated urns, dated from 50 BC to 16 AD, was inspected.

During the Iron Age, an early mining industry developed in the Siegerland in the context of ore exploitation. The archaeological context as well as grave goods indicated parallels to today's Wetterau (Hesse), which led to the hypothesis of migration into the Siegerland.

Since the cremated bones were poorly preserved and highly fragmented, age-at-death diagnosis was supported by histological analysis. The application of regressions for femur and humerus showed that all individuals could be classified into anthropological age categories, avoiding gross macroscopical age categories such like "maximal senile".

The $^{87}\text{Sr}/^{86}\text{Sr}$ isotopic ratio in 29 dentine and 15 bone samples was measured. At least 19 individuals exhibited a non-local signal which was indicative of a most probable provenance from the Wetterau region. The high number of non-local individuals exceeding normal human mobility suggests a high attractiveness of the early montane region in the Siegerland.

Age-related microstructure of burned bones has a hand in identifying cremations

Larissa Otto, M. Greiner, C. Braun, M. Graw, Gisela Grupe (University of Munich)

The relevance of histological age-at-death determination of cremations – both quantitative and qualitative – increased during the last decades, because the traditional macromorphological methods for age determination suitable for unburned human skeletons often provided insufficient results for cremated remains. The objective of this study is to elaborate a catalogue of histomorphometrical criteria in order to facilitate the microanatomical analysis of cremated human remains.

For this purpose, both known-age archaeological and forensic bone material, preferably compact femoral bone, is used. The samples are cut into pieces of about 1.5–2.0 cm to provide two corresponding pieces of each fragment. After that one of the corresponding fragments is heated to different burning temperatures ranging from 100°C to 1000°C. The corresponding fragment is used as a reference for the temperature-related changes of the bone's microstructural organization and the changes of the micro-morphological parameters. Because mineral density is not uniform throughout a compact bone cross section, the cremated bone pieces are subject to corresponding mineralogical analyses to control for temperature-related changes of the crystallographic unit cell and crystallinity and the possible impacts on histomorphometric analyses.

By a histomorphometric inspection age-at-death diagnosis will be considerably refined and frequently encountered gross age categories such as "minimum adult" can be further differentiated for the establishment of a paleodemographic profile. Since cremation was the predominant burial custom in Central Europe between the Bronze age and Imperial Roman Times, this method is especially important in the archaeological context. Beyond this histological age determination can also provide assistance in a forensic context.

Old data, new results: research on the 'Lusatian' urnfields in Poland

Justyna Baron, Agata Hałaszkó, Kamil Nowak, Tomasz Stolarczyk (University of Wrocław)

The Lusatian urnfields are considered to be the most characteristic site type of the Middle and Late Bronze Age (c. 1300–400 BC) in Poland. Based on the data collected in the early 1960s by T. Malinowski, there are 3 000 (!) archaeological sites with cremation graves available for study. This number includes both single graves and large, extensive sites containing thousands of graves. Despite recent new and

spectacular discoveries, urnfields are considered to be just static collections of similar objects bringing little or no new data to improve our knowledge about the past. The abundance of evidence about urnfields has become a curse and a striking example of the fact that quantity of data does not necessarily result in a corresponding increase in knowledge.

The urnfields also seem to be resistant to many analytical approaches, as the cremated bones are often poorly preserved. What can therefore be done with the mass material excavated decades ago, sometimes with missing items or poor quality field documentation? We want to present several examples from recent projects based on old data, mostly obtained in 1970s. The interesting results proved that urnfields can be an excellent field to apply a variety of methods including pottery studies (micro-morphology, DTA analyses and GCMS), use-wear observations (of grave goods made of metal, bones, lithics etc.). The anthropological analysis included bone recognition, colouration and structural changes, weight, minimum number of individuals (MNI), age-at-death, sex and pathological interpretations. Moreover, we studied the bone distribution at the level of individual graves. On the basis of anthropological data we reconstructed the biological dynamics of the urnfield population.

Stabbed and Burnt – Reliability of cut marks

Lukas Waltenberger, Holger Schutkowski (Bournemouth University, UK)

Cut marks on bones provide crucial information about the tools used and procedures in mankind as well as in criminal cases. Although lots of research has been done on cut mark analysis and the influence of fire on bones (shrinkage, fracture pattern, recrystallisation), there is still a lack of knowledge on cut mark analysis on burnt remains.

This presentation addresses two topics: First, three different 3D-techniques, which are suitable for cut mark analyses (micro-ct, digital microscopy & confocal laser scanning microscope (CLSM)) will be alluded and advantages and problems discussed. Micro-ct and digital microscopy are both suited methods to analyse cut marks and provide similar results. In contrast, CLSM is a time-intensive method, which needs lots of experience for a profound interpretation. In the second part, the reliability of burnt cut marks and its benefits in archaeological and forensic science will be presented. This study elutes how cut marks are altered during heat treatment and which features are consistent and allow a direct interpretation of tools used. For this experimental approach, cut marks on pig ribs, which were produced in a controlled way, were examined using 3D-techniques as described in the first part. Statistical analysis demonstrates that floor angles, and maximum slope height undergo a shift, whereas width, depth, floor radius, slope and opening angle remain stable.

An introduction to tooth cementum annulation: Austrian case studies

Fabian Kanz (Medical University, Vienna) & Katharina Rebay-Salisbury (OREA/ÖAW, Vienna)

Tooth cementum annulation (TCA) or cementochronology investigates acellular extrinsic fiber cementum that grows continuously and regularly at 2-3 µm per year in every tooth. One year includes a two-phase annual growth corresponding to a pair of alternating clear and dark lines, ending when the tooth is extracted or death occurs.

This growth pattern can be studied in histological thin sections of the teeth's roots under the microscope to answer a number of questions to re-construct the life history of a buried person from archaeological contexts. Counting lines and adding the tooth eruption age gives the approximate age at death; life events such as pregnancies, skeletal traumata and renal disease may be noted and further estimated at what age they occurred; the season of death may be identified, if the outer surface of the tooth is sufficiently preserved; and in deciduous teeth, the neonatal line may be used to differentiate stillborn babies from those who survived a few days to weeks.

In a pilot study focussing on early Bronze Age contexts, we sampled teeth from 22 individuals from Franzhausen, Unterhautzenhal and Zwingendorf. We will present our results in this workshop and use the opportunity to discuss the thin sections amongst peers.

Examining the utility of tooth cementum annulations for age estimation in thermally altered human remains

Timothy P. Gocha (Department of Anthropology, University of Nevada, Las Vegas)

Since the turn of the twentieth century, the use of tooth cementum annulations has been gaining scientific momentum for its ability to more accurately estimate age at death in human skeletal remains than the macroscopic or skeletal histological methods typically utilized by anthropologists. However, prior to this research, the use of cementum annulations in thermally altered or cremated remains was only investigated in samples of unknown demographics, and therefore no quantitative assessment of accuracy was possible. This research sought to address this research gap by assessing cementum annulations in a sample of 30 modern, known-age teeth after experimental burning at temperatures of 600°C, 800°C, and 1000°C for a period of 30 minutes.

Cementum annulations were found to survive in these thermally altered teeth; however, their visibility was directly dependent on the maximum exposure temperature, with annulations more clearly visible and readily countable in teeth burned at lower temperatures, and more difficult to visualize and count in teeth burned at the highest temperatures. A direct linear relationship exists between cremation temperature and age estimation inaccuracy, potentially due to thermally induced structural alteration. Physico-chemical changes induced by cremation resulted in TCA only being applicable to 63.3% of the original sample. For samples burned at 600°C the correlation coefficient between estimated and known was $r = 0.868$ ($p < 0.05$), for samples burned at 800°C the correlation coefficient between estimated and known was $r = 0.249$ ($p > 0.05$), and for samples burned at 1000°C the correlation coefficient between estimated and known was $r = -0.185$ ($p > 0.05$). Overall, the correlation coefficient between estimated and known age was $r = 0.522$ ($p < 0.05$) and an average age underestimation of 22.5 years was found. Macroscopic measurements of dental roots confirm that when heated to 600°C dental roots shrank between 2–5% in size, when heated to 800°C roots shrank 6–8% in size, and when heated to 1000°C roots experienced shrinkage between 15–17% in size. Scanning electron microscopy confirmed that as the maximum exposure temperature increased, so did the degree to which hydroxyapatite crystals in cementum fused together, explaining the macroscopic shrinkage. These physical and chemical changes, resulting in shrinkage, increased opacity, and cracking of specimens are believed to be responsible for the difficulty in visualizing cementum annulations in thermally altered material. The results of this study indicate that in teeth exposed to temperatures of 600°C or higher, cementum annulation is of limited utility in either paleodemographic or forensic investigations.

Expanding cementum annulation theory and method

Vicki L. Wedel (Western University of Health Sciences, Pomona, CA 91766)

Cementum annulations have been demonstrated to accurately reflect the length of individual human lifespans, and several studies have achieved success exploring seasonality and death. Yet, several key questions remain unanswered. Among them are the following: Why does cementum form alternating bands in humans and other mammals? Do cementum annulations accumulate consistently throughout the human lifespan, between deciduous and permanent teeth? Lastly, what role does geography play in cementum annulation biology? This paper seeks to advance these three discussions using cementum annulation data taken from teeth collected from several diverse populations: ancient Peruvian mummies, historical American Blacks, historical Guatemalans, modern coastal Californians, modern Mid-western US adults and children, and modern American forensic cases. Analyzing patterns of cementum annulations from the Western hemisphere distant from versus near to the equator, from individuals early versus late in life, and from populations historical versus modern can advance our understanding of this taphonomy-resistant source of information. Fields of potential application include human evolution, social bioarchaeology, demography, and forensic science. Within these fields, cementum analysis can illuminate the interplay among physiology, social context, and preservation.

The tooth cementum analysis: A critical verification of the method to identify pregnancies and diseases

Gabriela Mani-Caplazi (Univ. Basel), Ursula Wittwer-Backofen (Univ. Freiburg), Werner Vach (Univ. Hospital Basel), Gerhard Hotz (Univ. Basel)

The tooth cementum annulation (TCA) is an established method to assess the age-at-death. Irregular incremental lines (stress markers) in the tooth cementum have been observed in several human studies and could be linked with pregnancies and diseases affecting the calcium metabolism. This study aims to assess if pregnancy and secondary disease related stress markers can be accurately identified by applying objective criteria. As part of a pilot study non-invasive μ CT imaging techniques, nanotom and synchrotron, will be explored to display the incremental lines and to identify stress markers.

Histological sections of tooth root of 40 archaeological teeth from the identified skeletons of the St. Johann hospital cemetery in Basel (timeframe: 1845-1868) (women with and without birth, six men) and 30 recent teeth with known birth history will be assessed in a blinded fashion. The TCA method will be adapted to capture pregnancies and diseases related irregularities in the tooth cementum based on the incremental lines width and appearance. 12 archaeological teeth will be scanned by the μ CTs nanotom and synchrotron.

This research should contribute to the understanding of the TCA and the potential mechanism, which is responsible for this continuous apposition and which can lead to irregular incremental lines.

Deciduous teeth and the neonatal line

Petra Urban (University of Freiburg)

The applicability of the Tooth Cementum Annulation (TCA)-method for deciduous teeth was evaluated in a small sample. Therefore deciduous teeth of historical children's skeletons were used to determine chronological age as well as incremental stress markers. Those incremental stress markers were to be linked to potential morphological stress markers.

Histological age determination rendered satisfactory results, the applicability of the TCA method was therefore to be regarded as successful. Incremental stress lines were detected in five individuals. Correlating of the detected incremental stress lines to morphological stress markers, however, was not possible.

When analyzing human deciduous teeth with light microscopy, a distinct line in the enamel can be detected and is called neonatal line (NNL) (Kurek et al., 2015, 2016). It has been assessed that the width of NNL correlates with the level of stress experienced by the children's organism: The more stressful pre- and perinatal conditions have been, the thicker the NNL will be (Kurek et al., 2016). In our study we analyzed the incisors of two pairs of siblings (modern context) for differences or commonalities of the NNL concerning interspecific characteristic (birth order and sex) and intra-specific characteristics (differences in enamel or NNL between the different incisors).

References

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Microwear texture analysis of human deciduous teeth

Marlon Bas (OREA/ÖAW, Vienna)

Microwear texture analysis using a confocal microscope and scale-sensitive fractal analysis has made major contributions to dietary reconstruction in the last 15 years. However, the method has seldom been applied to deciduous human teeth. Furthermore, the interpretation of microwear signatures remains difficult as many aspects of microwear formation are still poorly understood and the impact of differences in deciduous enamel composition and masticatory biomechanics is still unknown.

In order to discuss methodological considerations, and improve interpretations of microwear texture analysis from deciduous archaeological samples, an exploratory study was conducted into the microwear signatures in the Tooth Fairy collection, a reference sample of deciduous teeth with documented records for individuals. All tests were conducted on phase II facets of deciduous molars. Six microwear texture variables were calculated using Toothfrax and Sfrax. Intra-facet and inter-facet variabilities were measured for 15 individuals to discuss acquisition methodology. Variability between facets of Udm1, Udm2 was measured in 15 teeth to discuss the potential impact of the position of the molar in the dental row. And comparisons were made between teeth from the left and right maxillary row.

Preliminary results showed unexpected high variability in microwear signatures between different measurements across the same facet. Control tests revealed it was difficult to visually detect the edges of the wear facet and any topographical anomalies impacted the signature significantly. Better selection of samples improved the PCA's ability to distinguish between individuals. Anisotropy (epLsar) and complexity (Asfc) variables were found to better group individuals from the same family than the other texture variables: large-scale heterogeneity (Hasfc9), fine-scale heterogeneity (Hasfc81), coarse texture fill volume (CTfv) and fine texture fill volume (FTfv). The textures of Udm1 and Udm2 were found to differ almost significantly but larger samples are required. The same was found for and teeth from the left and right maxillary row.

The investigation into the application of DMTA to deciduous teeth shall be continued as part of a PhD project within VAMOS with the aim to gather information about childhood diet during the Bronze Age.